United States Department of the Interior
Bureau of Land Management
Winnemucca Field Office

April 2003

Draft
Supplemental Environmental Impact Statement
Glamis Marigold Mining Company's
Millennium Expansion Project

Cooperating Agency:
Nevada Department of Conservation and Natural Resources, Division of Wildlife

BLM MISSION STATEMENT

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times.

Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific and cultural values.

BLM/NV/PL-03/006+1610

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Winnemucca Field Office
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Winnemucca, Nevada 89445
(775) 623-1500
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In Reply Refer To:
3809/1792
NV020.06

APR 0 4 2003

Dear Reader:

Enclosed for your review and comment is the Draft Supplemental Environmental Impact Statement for Glamis Marigold Mining Company's Millennium Expansion Project, prepared by the Bureau of Land Management (BLM), Winnemucca Field Office.

The Draft Supplemental Environmental Impact Statement is based on the Plan of Operations submitted to the BLM under 43 Code of Federal Regulations 3809. This Draft Supplemental Environmental Impact Statement analyzes the direct, indirect, and cumulative impacts associated with consolidation and deepening of the Top Zone Pit and Red Rock Pit into the Terry Zone Pit, mining of five new pits (Mackay, Target No. 1 Pit, Target No. 2 Pit, Antler Pit, and Basalt Pit), construction of two new heap leach facilities and expansion of the existing heap leach facility, expansion of existing waste rock storage areas and creation of new waste rock storage areas, development of new support facilities (truck shop, warehouse, offices, fuel and oil storage and dispensing areas, etc.), expansion of ancillary facilities (power lines, water supply system, haul and access roads, storm water control structures, fencing, materials storage areas, etc.), and modification of the closure and reclamation measures for the existing and proposed heap leach pads.

The BLM is interested in your review and comment on the proposed action and alternatives for the Millennium Expansion Project. Public comments will be accepted during the 60-day comment period. Written comments on the Draft Supplemental Environmental Impact Statement must be postmarked by June 5, 2003, and should be sent to: Mr. Jeff Johnson, SEIS Project Manager, Bureau of Land Management, Winnemucca Field Office, 5100 E. Winnemucca Boulevard, Winnemucca, Nevada 89445.

In addition, public meetings to accept verbal comments are scheduled for the following dates, times, and locations. <u>All meetings will start at 7:00 P.M.</u>

May 13, 2003	Winnemucca Field Office, 5100 E. Winnemucca Blvd., Winnemucca, Nevada
May 14, 2003	Battle Mountain Field Office, 50 Bastian Road, Battle Mountain, Nevada

A Final Supplemental Environmental Impact Statement (FSEIS) will be prepared that will consider the comments received during the public review and comment period. This FSEIS will be in the non-abbreviated format and will incorporate changes made to the Draft SEIS as a result of public comments. For additional information, please contact Jeff Johnson at the above address or at (775) 623-1500.

Sincerely,

for Terry A. Reed
Field Manager

DRAFT
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
MILLENNIUM EXPANSION PROJECT

Lead Agency:	U.S. Department of the Interior Bureau of Land Management Winnemucca Field Office
Project Location:	Humboldt County, Nevada
Comments on this SEIS Should be Directed to:	***Jeff Johnson*** SEIS Project Manager Bureau of Land Management Winnemucca Field Office 5100 East Winnemucca Blvd. Winnemucca, NV 89445 (775) 623-1500
Date Draft SEIS Filed with EPA:	March 31, 2003
Date by Which Comments Must Be Received by the BLM:	June 05, 2003

ABSTRACT

Glamis Gold, Inc., doing business as Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations at the Marigold Mine in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca.

The proposed Millennium Expansion Project would disturb approximately 667 acres of private land and 807 acres of BLM-administered public land, for a total of 1,474 acres. The proposed project would include: consolidation and deepening of two pits and development of five new pits; expansion of one waste rock storage area and development of three new waste rock storage areas; development of two new heap leach facilities and expansion of the existing heap leach facility; haul roads, solution ponds, growth media stockpiles, exploration drill pads and access roads, and storm water diversion channels; new support facilities; water supply system; and miscellaneous ancillary facilities. The Proposed Action would extend the mine operations an additional six years through 2013.

This Draft Supplemental Environmental Impact Statement analyzes the environmental effects of the Millennium Expansion Project, the Trout Creek Diversion Realignment Alternative, the Expanded Red Rock Pit Stabilization Alternative, and the No Action Alternative.

Responsible Official for SEIS:

Ken Jola

for Terry A. Reed

Field Office Manager
Winnemucca Field Office

EXECUTIVE SUMMARY

PROPOSED ACTION

Glamis Marigold Mining Company (GMMC) proposes to construct new facilities and expand existing gold mining operations at the Glamis Marigold Mine in Humboldt County, Nevada. The mine is located on public and private lands near Interstate Highway 80 (I-80) approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca, Nevada. The mine has been in continuous operation since 1988, and as Glamis Marigold Mine since 1999. Historical mining in the proposed project vicinity dates back to 1927. To date, approximately 1,831 acres have been disturbed or authorized for disturbance.

A Plan of Operations Amendment and Reclamation Plan for the proposed Millennium Expansion Project was submitted to the Bureau of Land Management (BLM) in April 2002. Current mine facilities consist of a series of pits, waste rock storage areas, a heap leach pad and associated processing plant, a tailings impoundment, access and haul roads, and ancillary facilities.

The BLM completed an environmental impact statement (*Final Environmental Impact Statement Marigold Mine Expansion Project*, BLM/WN/PL-01/009+1610 [FEIS]) at the Glamis Marigold Mine in 2001. The modification to the Plan of Operations, known as the Millennium Expansion Project, proposes facilities similar in nature to those analyzed in the previous FEIS. Therefore, BLM has determined that a Supplemental Environmental Impact Statement (SEIS) is required for the proposed Millennium Expansion Project.

The proposed Millennium Expansion Project includes the following new and expanded facilities:

- Consolidation and deepening of two existing pits;
- Expansion of an existing waste rock storage area
- Expansion of internal project access and haul roads, power line and substation facilities, communications systems, and water distribution system;
- Development of five new mining areas;
- Development of three new waste rock storage areas;
- Backfilling two of the new pits;
- Development of two new heap leach pads and associated processing facilities;
- Expansion of the existing heap leach facility, including a new heap leach pad cell, a solution conveyance channel, and expansion of the existing processing facilities;
- Modification of Heap Leach Closure and Stabilization;
- Development of new support facilities;
- Storm water diversion ditches;
- Water storage components; and
- Miscellaneous ancillary facilities.

The proposed Millennium Expansion Project would disturb approximately 667 acres of private land and 807 acres of BLM-administered public land, for a total additional surface disturbance of 1,474 acres. The Proposed Action would extend the mine operations a maximum of six years through 2013.

ALTERNATIVES

This SEIS analyzes the direct, indirect, cumulative, and residual environmental impacts of the Proposed Action, two Alternative Actions, and the No Action Alternative. The alternatives are described in the following sections.

Alternative 1 - Trout Creek Diversion Realignment

Trout Creek was originally diverted to permit mining of the 8-South Pit and construction of the 8-South Waste Rock Storage Area. The stabilization of the diversion has been previously analyzed in the Resort EA (BLM EA # N26-88-005P) and March 2001 FEIS with respect to the Red Rock Pit. The analysis identified concerns with the long-term stability and potential failure of the west highwall in the Red Rock Pit, which could result in flow from Trout Creek entering the Red Rock Pit.

The proposed consolidation of the Red Rock and Top Zone pits into the Terry Zone Pit by combining and deepening portions of the two pits has created concern over the long-term stabilization of the Trout Creek Diversion/Red Rock Pit high wall.

All components of the Proposed Action are part of this Alternative. Under this Alternative a new diversion channel would be constructed that would parallel the existing Trout Creek channel and eventually flow into the north end of the existing Trout Creek Diversion. The new diversion channel would be 100 to 200 feet west of the existing channel. To achieve the required channel elevation and stream gradient, the new diversion would need to be excavated into the side of a small hill. The new channel would be approximately 2,300 feet in length. The new diversion would be designed to accommodate the 100-year, 24-hour event within the constructed channel. Approximately 12 acres of disturbance would be associated with the new channel diversion.

Alternative 2 - Expanded Red Rock Pit Stabilization

All components of the Proposed Action are part of this Alternative. Under this Alternative the buttress previously authorized for the Red Rock Pit would be expanded and constructed with waste rock material to provide additional long-term stability. The expanded buttress would consist of backfilling the west side of the Red Rock Pit to an elevation ten feet above the west pit crest and ten feet beyond the pit footprint along the entire length of the west highwall. Waste rock material would be backfilled into the pit to form the buttress. The buttress would be designed to divert or withstand the flow from the 100-year, 24-hour event. The backfill would be graded to approximately 3H:1V within the pit and 2H:1V on the Trout Creek side of the buttress (i.e., the portion that would be resloped and extend beyond the pit footprint). The buttress would have a crest width of 30 feet after re-sloping to 3H:1V, growth media would be placed and reseeded.

Alternative 3 - No Action Alternative

Under the No Action Alternative, currently permitted operations at the Marigold Mine would cease after 2007, with final reclamation extending ten years beyond closure. Additional minerals in the project area would remain undeveloped, and no construction or expansion of mine pits, waste rock storage areas, heap leach pads, or other ancillary facilities would occur.

IMPORTANT ISSUES AND IMPACT CONCLUSIONS

A small number of issues were raised during scoping for this SEIS. Public scoping meetings were held in Winnemucca and Battle Mountain, Nevada, on August 14 and 15, 2002, respectively. Additional issues were identified by resource specialists during the preparation of the SEIS. These issues along with their impact conclusions are presented below. Impact conclusions include the implementation of mitigation measures that have been identified. These measures are presented in detail in Chapter 3.0 of this SEIS for each affected resource.

Water Resources and Geochemistry

Issue: Formation of a pit lake as a result of mine development and impacts to wildlife from degraded water quality.

Conclusion: The construction and development of the proposed new pits would not create pit lakes. All new pit floors would be above the established groundwater table. The consolidation and deepening of the existing Top Zone Pit and Red Rock Pit into the Terry Zone Pit has potential to intercept the groundwater table. The pit would be partially backfilled to a level above the established pre-Lone Tree Mine dewatering water table; no pit lake would be created.

Issue: Impacts to surface water and groundwater levels resulting from pit dewatering and groundwater use for mine operations.

Conclusion: Based on the evaluation of historic and current groundwater level data within the project vicinity, hydrologic impacts to springs or intermittent creeks located in or near the project are not anticipated. Springs and intermittent creeks located in or near the project area would not be affected since the water source for the springs and intermittent creeks is not hydrologically connected with the bedrock aquifer. No pit dewatering is anticipated during mining. Water used for the proposed mine operations would be obtained from the Lone Tree Mine and supplemented with the water from water supply wells in the project vicinity. The source of water for the water supply wells is mainly the bedrock aquifer, whereas the source of water for the springs and intermittent creeks is shallow alluvium and surface flows resulting from runoff.

Issue: Long-term stability of Trout Creek Diversion Channel.

Conclusion: Potential exists for impacts from failure of the Red Rock Pit highwall/Trout Creek Diversion. Two alternative actions have been developed to address this issue.

Issue: Degradation of groundwater quality.

Conclusion: Waste rock storage areas, heap leach facilities, and pit backfill areas would be covered with an evapotranspiration store and release cover (ET cover) system to limit meteoric water infiltration. Overall geochemical testing indicates that waste rock from the mine has low potential to generate acidic seepage. However, some constituents of the waste rock could be mobilized, but would not be expected to reach groundwater due to predicted low infiltration rate (1.5×10^{-7} gallons per minute per square foot) through the heap leach pads. Heap leach drain down would remain in containment and would be managed by passive water management facilities.

Air Quality

Issue: Cumulative impacts to air quality.

Conclusion: The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below national or state ambient air quality standards.

Vegetation Resources

Issue: Loss of wetland or riparian areas resulting from the mine expansion or dewatering.

Conclusion: Wetlands or riparian areas would be avoided by the operator. No dewatering is proposed for this project. Impacts to wetlands or riparian areas are not anticipated.

Wildlife and Fisheries Resources

Issue: Wildlife habitat disturbed or lost.

Conclusion: No riparian habitat would be affected. Loss of upland habitat would not exceed 1,474 acres. The value of habitat lost would be low to moderate, due to the proximity of the project to past and present disturbances and activities and the availability of native habitats in the surrounding region. Approximately 1,204 acres of disturbed habitat would be reclaimed.

Issue: Loss of mule deer winter range.

Conclusion: A total of 1,263 acres of mule deer winter range would be removed for the life of the project.

Issue: Impacts to resident and migratory birds.

Conclusion: Potential effects to breeding birds (e.g., passerines, raptors) could occur from incremental habitat loss, disturbance to nesting habitat, and increased noise and human presence. These impacts would be minimized by the applicant committed protection measures. Effects to upland game birds would be minor, based on relative habitat value, bird species occurrence, and committed protection measures.

Issue: Measures to prevent wildlife exposure to cyanide solutions on heaps, in solution channels, and ponds should be developed.

Conclusion: Potential impacts from cyanide ingestion would be low, since bird netting would be installed over the solution ponds and GMMC would monitor heap leach pads to avoid the puddling of cyanide solution.

Special Status Species

Issue: Potential impacts to special status species.

Conclusion: Removal of nesting habitat for burrowing owl and winter habitat for sage grouse would occur under the Proposed Action and alternatives. The loss would be temporary until facilities are successfully reclaimed.

Range Resources

Issue: Loss of available grazing land and interference in ranch management activities resulting from the construction of the range perimeter fence.

Conclusion: Construction of the range perimeter fence would remove 1,586 acres of rangeland available for grazing resulting in the temporary loss of 79 animal unit months. A permanent loss of 14 animal unit months would result after mine reclamation. The perimeter fence and mine facilities would interfere with livestock trailing routes.

Land Use and Access

Issue: Access to private land, mineral claims, and grazing leases.

Conclusion: Private land within the mine permit boundary that is not under GMMC's control would remain accessible, as would the livestock forage on these lands. Existing mining claims would also remain accessible.

Aesthetics (Visual and Noise Resources)

Issue: Visual contrasts with elements of the characteristic landscape in exceedence of BLM Visual Resource Management (VRM) objectives.

Conclusion: The Proposed Action and the Alternative Actions would result in moderate contrasts with existing forms, lines, and textures of the characteristic environment as a result of the construction of the new heap leach facility and expansion of the waste rock storage areas. These contrasts would not exceed VRM objectives during the life of mining. If proposed reclamation efforts were successful, visual contrasts would be reduced to near pre-mining levels within ten years of the reclamation period.

Cultural Resources

Issue: Direct physical disturbance of cultural resources that are listed on or are eligible to the National Register of Historic Places or are protected under state or other Federal statutes.

Conclusion: GMMC has proposed new environmental protection measures for known eligible sites near the proposed facilities. These measures are designed to avoid inadvertent impacts to these sites. In addition, environmental protection measures involving cooperation between GMMC, the BLM, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation would be implemented if cultural resources are discovered or affected during construction or operation activities. Based on the protection measures, proper steps would be taken to evaluate the quality of the resource, to determine whether the loss is acceptable, and to mitigate losses that are not acceptable. Known sites in the project area would be avoided by mining and exploration activities.

Issue: Utilize native species in reclamation seed mixes.

Conclusion: The interim seed mix would include crested wheatgrass, which is a non-native species. This species would be used since it readily establishes on disturbed sites and reduces soil erosion. The permanent reclamation seed mix to be used during reclamation would consist of native species.

Ethnography

Issue: Direct physical disturbance of traditional use sites that are listed on or are eligible to the National Register of Historic Places or are protected under state or other federal statutes.

Conclusion: No traditional use sites that are listed on or are eligible to the National Register of Historic Places have been identified in the Millennium Expansion Project Area. The general area and the springs near the Proposed Action have been identified as traditional use areas for hunting, food gathering, and trails to other areas.

Paleontology

Issue: Impacts to significant paleontological resources.

Conclusion: Significant fossil-bearing formations have not been identified in the project area to date. However, if previously unidentified paleontological resources are located during the Millennium Expansion Project, environmental protection measures designed to mitigate impacts would be implemented, as per BLM policy.

AGENCY-PREFERRED ALTERNATIVE

In accordance with the National Environmental Policy Act, Federal agencies are required by the Council on Environmental Quality (40 Code of Federal Regulations 1502.14) to identify their preferred alternative for a project in the Draft SEIS, if a preference has been identified, and in the Final SEIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the Draft SEIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this Draft SEIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The agency-preferred alternative is Alternative 2 as described in the SEIS, with all appropriate mitigation.

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1.0 INTRODUCTION

Glamis Gold Ltd, doing business as Glamis Marigold Mining Company (GMMC), operates the Glamis Marigold Mine, located approximately three miles south of Valmy in the southeastern portion of Humboldt County, Nevada. GMMC has submitted a *Plan of Operations/Reclamation Permit Modification* (PoO Modification) for the Millennium Expansion Project to the Winnemucca Field Office of the U.S. Bureau of Land Management (BLM) and to the Nevada Division of Environmental Protection (NDEP), Bureau of Mining Regulation and Reclamation (BMRR) to describe proposed changes to *Plan of Operations (N26-88-005P/N-65034)* and Nevada State Reclamation Permit No. 0108 for the Glamis Marigold Mine.

GMMC proposes to expand the mining, heap leaching and ancillary facilities at the Glamis Marigold Mine beyond the expansion authorized in the September 2001 Record of Decision for the *Final Environmental Impact Statement Marigold Mine Expansion Project*, BLM/WN/PL-01/009+1610 (FEIS) and July 2001 modification to the Reclamation Permit. GMMC also proposes the development of new facilities and modifications to the closure and reclamation plan for the existing Glamis Marigold Mine heap leach facilities.

The existing mining operation consists of multiple open pits and precious metal processing facilities, which are located approximately three miles south of Valmy, Nevada (Figures 1-1 and 1-2). The mine is located on public and private lands approximately 13 miles northwest of Battle Mountain and approximately 40 miles southeast of Winnemucca. GMMC has been operating the Glamis Marigold Mine since 1999.

The proposed Millennium Expansion Project consists of expansion of some of the existing Glamis Marigold Mine facilities, the development of new facilities, and modification to the closure and reclamation plan for the existing and currently authorized heap leach pads. The Millennium Expansion Project was described as a “reasonably foreseeable action” in the FEIS (BLM 2001; Section 2.6.2). The mining activities proposed for public lands are subject to review and approval by the BLM pursuant to the Federal Land Policy and Management Act (FLPMA) and subsequent surface management regulations (43 Code of Federal Regulations [CFR], Subpart 3809). The activities, and their approval by the BLM pursuant to FLPMA, constitute a federal action and are thus subject to the National Environmental Policy Act (NEPA). The BLM has determined that the proposed Millennium Expansion Project constitutes a major federal action. However, the proposed new and expanded mining and heap leaching activities, and associated support facilities are similar to the types and magnitude of activities described and analyzed in the EIS. No new environmental concerns, interests, resource values, or circumstances in the vicinity of the Glamis Marigold Mine have been identified since the publication of the EIS. Therefore, BLM has further determined that a Supplemental EIS (SEIS) must be prepared to fulfill NEPA requirements.

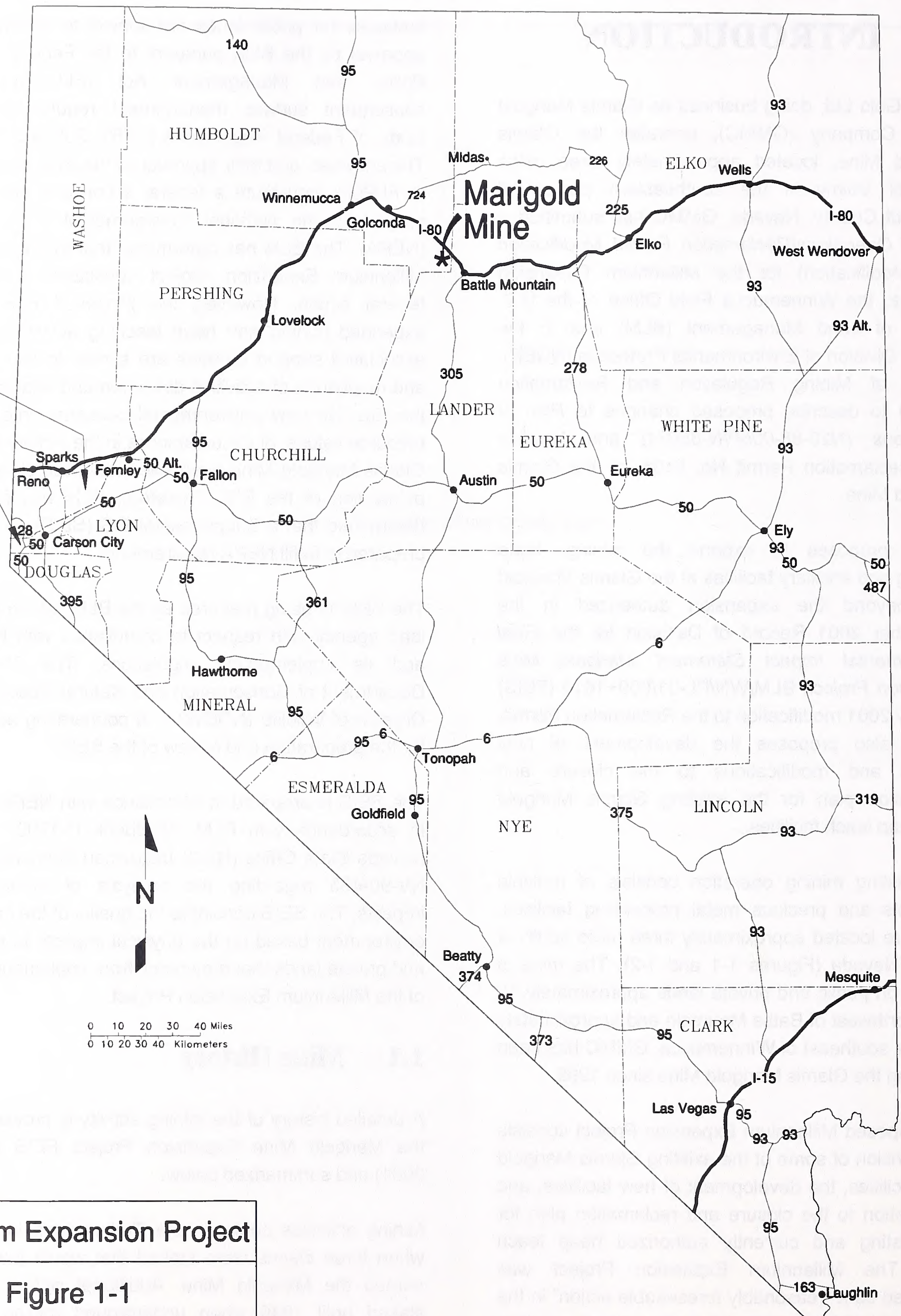
The SEIS is being prepared by the BLM, which is the lead agency with respect to compliance with NEPA and its implementing regulations. The Nevada Department of Conservation and Natural Resources, Division of Wildlife (NDOW) is a cooperating agency for the preparation and review of the SEIS.

The SEIS is prepared in compliance with NEPA, and in accordance with BLM Handbook H-1790-1 and Nevada State Office (NSO) Instruction Memorandum NV-90-435 regarding the analysis of cumulative impacts. The SEIS considers the quality of the natural environment based on the physical impacts to public and private lands that may result from implementation of the Millennium Expansion Project.

1.1 Mine History

A detailed history of the mining activity is provided in the Marigold Mine Expansion Project FEIS (BLM 2001) and summarized below.

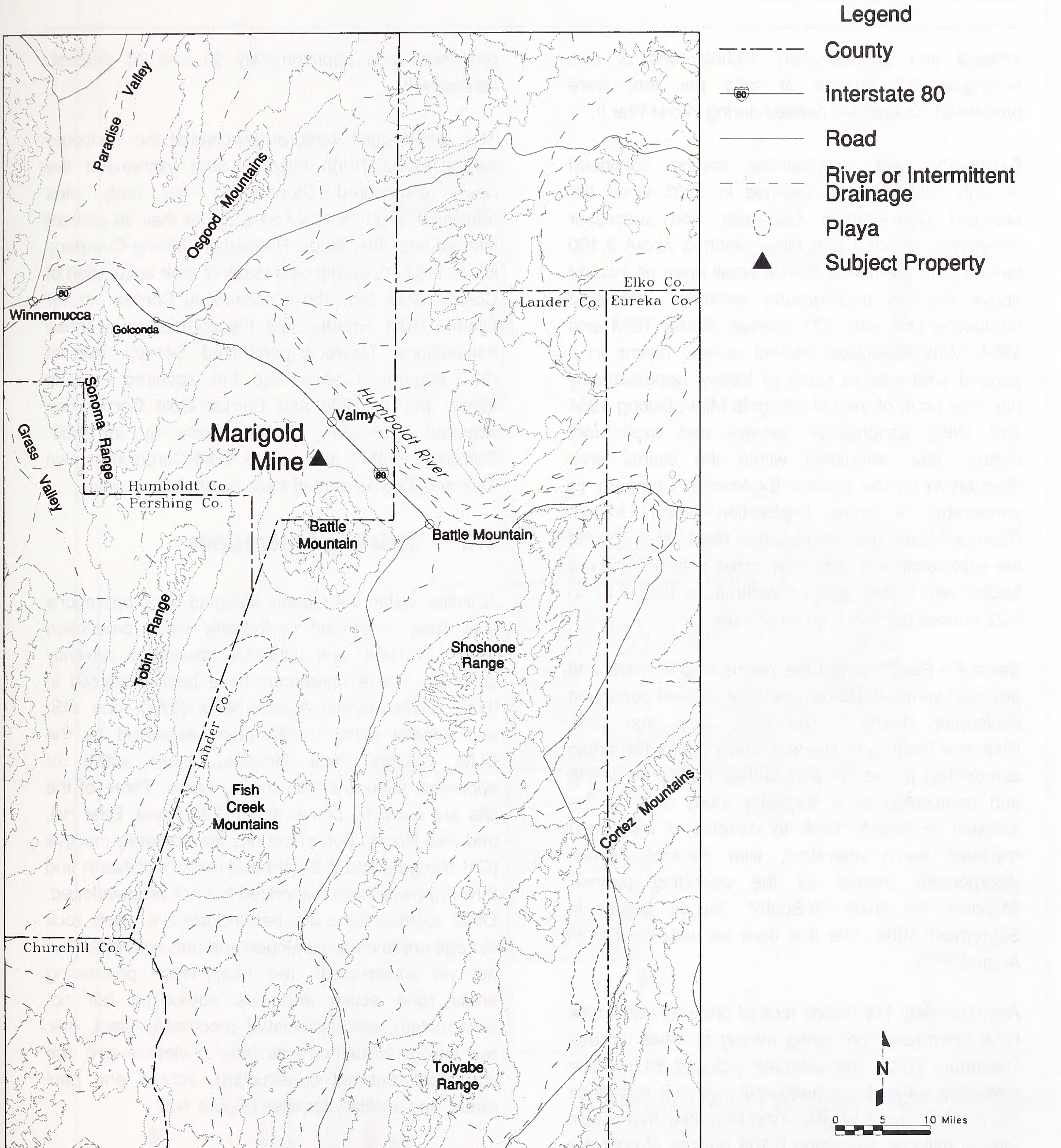
Mining activities began in the Project Area in 1927 when three claims were staked that would later be named the Marigold Mine. Additional claims were staked until 1940 when underground mining was



Millennium Expansion Project

Figure 1-1

Project Location



Millennium Expansion Project

Figure 1-2

Local Vicinity Map

initiated and approximately 10,000 tons of ore, averaging 0.2 ounces of gold per ton, were processed. Operations ceased during World War II.

Exploration and geochemical testing continued through 1980. Mining resumed in 1983 when the Marigold Development Company and successor companies crushed and heap leached about 3,100 tons of gold ore mined from a small open pit located above the old underground workings. The gold production rate was 271 ounces during 1983 and 1984. VEK Associates staked several claims in a general area located south of Valmy, approximately one mile north of the old Marigold Mine. During 1984 and 1985, geophysical surveys and exploratory drilling were completed within the claims area (Section 8) by the Cordex Exploration Company (a partnership of Dome Exploration (U.S.) Limited, Rayrock Mines, Inc., and Lacana Gold, Inc.). Two of the exploration drill sites intersected gold-bearing ore bodies with higher gold concentrations (i.e., 0.07 to 0.22 ounces per ton) than other sites.

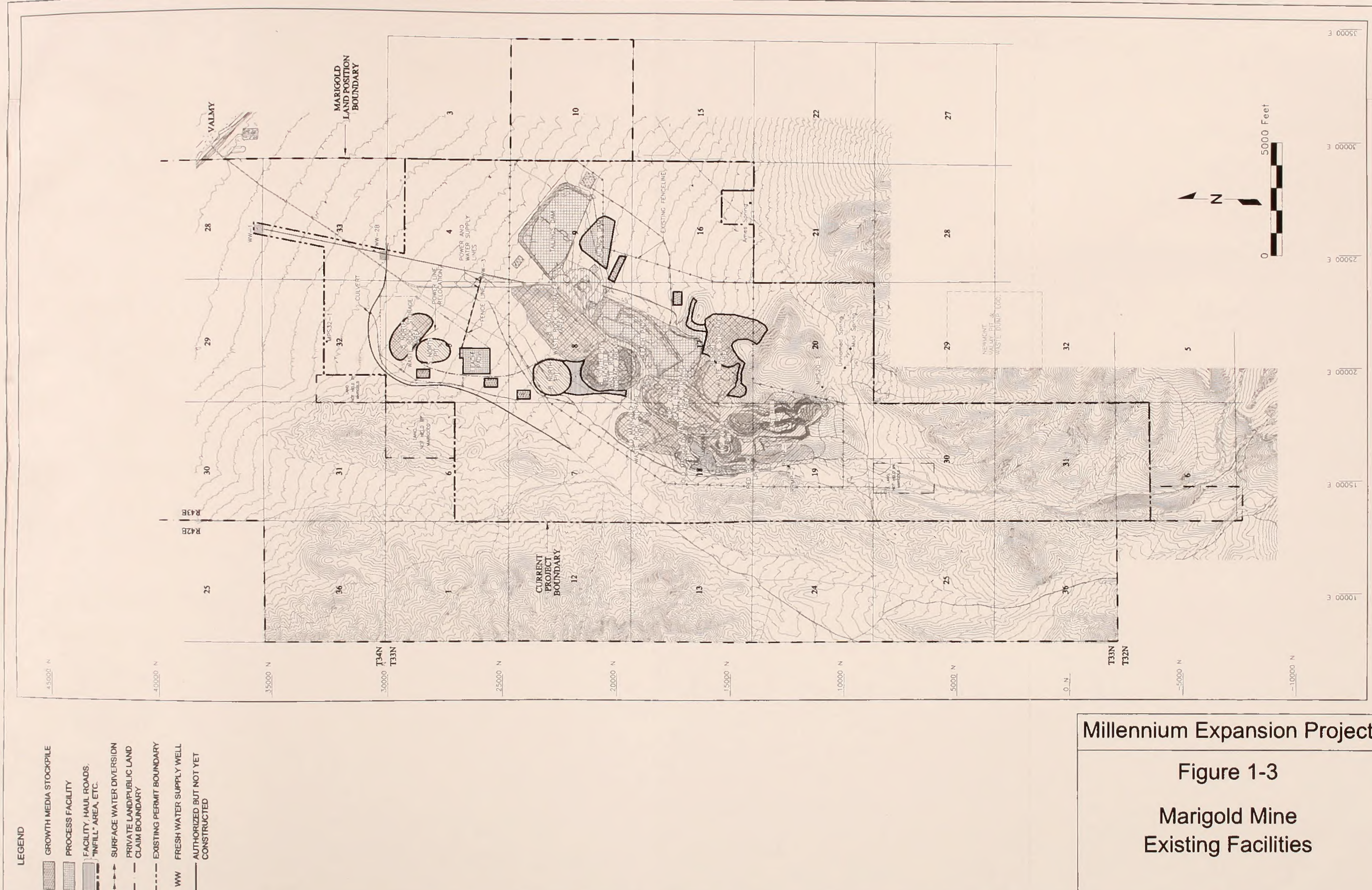
Santa Fe Pacific joined the partnership in 1986 and provided some additional land that allowed continued exploration drilling in the area. Later that year, Welcome North and Nevada North (small Canadian companies) joined the partnership. Additional drilling and completion of a feasibility study lead to the decision in March 1988 to develop a mine and mill/heap leach operation, with Rayrock Mines, Incorporated named as the operating partner. Stripping the main "8-South" deposit began in September 1988. The first doré bar was poured in August 1989.

Approximately 178 million tons of ore and waste rock have been removed during mining activities through December 2002. This estimate included 38.0 million tons of combined leach-plus-mill ore that contained 1.3 million ounces of gold. Approximately five million tons of mill ore, averaging 0.108 ounces of gold per ton, were processed in a conventional cyanide-in-leach mill. Gold was extracted from the remaining 33 million tons of ore, containing 0.023 ounces of gold per ton, via run-of-mine heap leaching processes. The gold recovery rate from milling and leaching processes was approximately 90 and 70 percent, respectively.

The various joint ventures purchased the Welcome North/Nevada North interests and exchanged the newly discovered Stonehouse ore body plus additional land to Santa Fe Pacific for their 30 percent interest and other lands. Homestake Mining Company joined the partnership as a result of their acquisition of Corona Gold, Inc., the successor to Cordex partner Lacana Gold. Shortly after the completion of these transactions, Rayrock purchased Dome's interest (33.3 percent). Glamis Gold, Ltd. acquired Rayrock Mines, Inc. in 1999 and Barrick Gold Corporation acquired Homestake Mining Company in 2002. Currently, GMMC and Barrick Gold Corporation own 66.7 and 33.3 percent of the project, respectively.

1.2 Existing Operations

Activities within the Glamis Marigold Mine operations area have expanded periodically since production began in 1988, and full-scale operations currently continue. These operations have been analyzed in three Environmental Assessments (EAs), one EIS, and several minor modifications approved by the BLM. Current mine facilities, either active or approved, include seven mining areas. Three of the pits are currently being mined (Top Zone, East Hill, and Red Rock). Two of the pits are presently inactive (Old Marigold and 8-South) and two pits (5-North and 8-North) have been authorized but not yet developed. Other existing mine facilities include five waste rock storage areas (four developed and one authorized but not yet constructed), two heap leach processing areas (one active and one authorized but not constructed), and associated processing plant, mill, two tailings impoundments (one in closure and one authorized but not constructed), access and haul roads, and ancillary facilities (Figure 1-3).



Millennium Expansion Project

Figure 1-3

Marigold Mine Existing Facilities

Mining currently involves excavating a total of 2.5 million tons of waste rock and ore per month, and is conducted on 20- to 40-foot benches in the existing and authorized pits. Ongoing mine operations are described in the PoO and BLM plan #N26-88-005P, as amended July 3, 1997, May 27, 1998, and August 6, 1998. BLM also prepared an EIS for the Marigold Mine Expansion Project based on amendments to BLM PoO #N26-88-005P and Nevada State Reclamation Permit No. 0108. The Record of Decision for the FEIS was issued in September 19, 2001 and amendment to the Reclamation Permit was issued on July 6, 2001.

In February 2002, GMMC submitted a Minor Modification to the PoO and Reclamation Permit. This modification involved changes in the configuration of the heap leach facilities and several operational changes (i.e., increased mining rate and the addition of new mining equipment), but did not increase the acres of surface disturbance or substantively change site operations. BLM authorized the minor modification through a Determination of NEPA Adequacy in March 2002, and NDEP-BMRR approved the minor modification in April 2002 The approved amendments comply with the BLM regulations for surface mining of public land under the General Mining Law (43 CFR 3809), and the State of Nevada regulations for reclamation of land subject to mining operations under Nevada Revised Statutes (NRS 445 and 519A).

Under existing permits, mining and heap leach activities at the Glamis Marigold Mine would continue through 2007. See Table 1-1 for a summary of existing and approved operations at the mine that have been authorized under previous environmental evaluations in 1988, 1997, 1998, and 2001.

1.3 Proposed Action

The proposed Millennium Expansion Project includes the following new and expanded facilities:

- Consolidation and deepening of the Top Zone and Red Rock pits into the Terry Zone Pit;
- Partial backfill of the Terry Zone Pit and other pit areas, as feasible;
- Expansion of the Old Marigold Waste Rock Storage Area;
- Expansion of internal project access roads and haul roads;
- Expansion of power line and substation facilities to extend electrical power to the Millennium Expansion Project components that require power;
- An expanded utility corridor for electrical power, communications systems, and water distribution along the access road;
- Development of five new mining areas: the Mackay Pit, the Target No. 1 Pit, the Target No. 2 Pit, the Antler Pit, and the Basalt Pit;
- Development of three new waste rock storage areas: the 119 million-ton capacity North Waste Rock Storage Area, the five million-ton capacity South Waste Rock Storage Area, and the 31 million-ton capacity West Waste Rock Storage Area;
- Complete backfilling the Target No. 1 and Target No. 2 pits with approximately 84 million tons of material;
- Development of two new heap leach processing facilities: the Section 30 Heap Leach Facility comprised of a 51 million-ton capacity pad, ponds, and adsorption-desorption recovery (ADR) processing facility, and the Section 16 Heap Leach Facility comprised of a 23 million-ton capacity pad, ponds, columns and reagent storage tanks;
- The Millennium Expansion Project ADR Facility, located at the Section 30 Heap Leach Facility, and comprised of the following components: process columns, acid wash

plant, carbon regeneration kiln, retort, electrowinning, refinery, assay lab, reagent storage facilities, office, and enclosures;

- Expansion of the existing heap leach facility by the addition of the Section 17 Heap Leach Pad (Cell 12), a solution conveyance channel, and expansion of the existing processing facilities;

- Modification of the heap closure method for the existing heap leach pads and for the proposed heap leach pads, consisting of an evapotranspiration (ET) storage and release cover, development of passive water treatment for effluent, and/or attenuation/evapotranspiration basins; a leach field would constructed as a water management contingency;

Table 1-1: Glamis Marigold Mine Existing and Authorized Facilities

Mine Component	Activity
Heap Leach Pads	• Marigold Heap Leach Facilities (Cells No. 1, 2, 3, the 2/3 infill area, 4, 5a, 5b, 6, 7, 8, 9, 10, and 11 [Cell No. 11 is also known as the "Southwest Heap Leach Pad Extension]); and • 5-North Heap Leach Pad (not currently developed).
Tailings Impoundment	• Existing Tailings Facility (currently in closure); and • Authorized New Tailings Facility (not yet developed).
Mill and ADR Facilities (Ore Processing)	• Includes leaching tanks, thickening tank, crushing facility, rod and ball mills, carbon columns, screen separator, electrowinning units, stripping units, retorts, refining furnaces, carbon regeneration kiln; no autoclave or roaster is utilized at the mine.
Waste Rock Dumps	• 8-South Waste Rock Storage Area; • Old Marigold Waste Rock Storage Area; • Resort Waste Rock Storage Area; • Top Zone-East Hill Waste Rock Storage Area; and • 5-North Waste Rock Storage Area (not yet developed).
Mining Areas (Open Pits)	• 8-South Pit; • Old Marigold Pit; • Top Zone Pit; • Red Rock Pit; • East Hill Pit; • 5-North Pit (not yet developed); and • 8-North Pit (not yet developed).
Ancillary Facilities	• Growth media stockpiles; • Haul roads; • Water supply system - three water supply wells and the Lone Tree Water Line; • Exploration - continued exploration and ore body delineation; • Support facilities – administrative offices, truck shop, lab, fuel station, warehouse, mobile office structures, substation, laydown yards, ore stockpiles, chemical tanks, parking areas, and fencing; • Surface water diversions – Trout Creek Diversion (around Red Rock, 8-South Waste Rock Storage Area and 8-South Pit – constructed; around 8-North Pit – authorized), Cottonwood Creek Diversion (around 5-North Heap Leach Pad, Pit and Waste Rock Storage Area – authorized), and unnamed diversion (around the new tailings facility – authorized); and • Miscellaneous facilities and infill areas.

- Development of new support facilities in Section 31 between the Basalt Pit and the Target No. 2 Pit, consisting of a truck shop, truck wash bay, fuel and oil storage and dispensing areas, a warehouse, and a septic system;

- Storm water diversion ditches;

- Water storage components including tanks, a pumping booster station, and a fresh water pond at the Section 30 Heap Leach Facility;

- Infill disturbance zones to accommodate miscellaneous land use and surface disturbance around the margins and in between the above described facilities; and

- Miscellaneous ancillary facilities including expanded fencing, a new lime silo southwest of the Section 30 Heap Leach Pad, and explosive storage facilities adjacent to the pits.

The Proposed Action would extend the mine operations an additional six years, through 2013.

1.4 Purpose of and Need for the Proposed Action

GMMC proposes to expand mining operations at the Glamis Marigold Mine for the purpose of extracting economically recoverable gold reserves in existing pits and to develop additional gold reserves known to exist south of the existing pit areas in an environmentally compatible manner. GMMC has identified the following economically driven project objectives:

- Expand processing facilities within the Project Area to accommodate an increase in the rate of production from 2.5 million tons per month or 30 million tons per year to 45 million tons per year and an increase in the rate of solution processing from the existing 3,000 gallons per minute (gpm) to 6,000 gpm at the Section 30 Heap Leach Facility;

- Extract economically recoverable gold that exists in the Project Area;

- Operate and reclaim the Project Area in an efficient, environmentally conscientious, and safe manner; and

- Meet or exceed federal, state, and local regulations for the protection of human health and safety, and the environment.

The project need is reflected by the demand for gold identified in national and global markets.

1.5 Relationship to BLM and Non-BLM Policies, Plans, and Programs

The BLM has the authority and responsibility to manage the surface and subsurface resources on public lands within its charge. The following provides a summary of the BLM and non-BLM policies, plans, and programs that direct mineral development and apply to the Proposed Action.

1.5.1 Surface Management Regulations

BLM's surface management regulations under the General Mining Law (43 CFR 3809) recognize the statutory right of mineral claim holders, such as GMMC, to explore for and develop federal mineral resources, and encourage such development. These same regulations require BLM to review proposed operations to ensure that:

- Adequate provisions are included to prevent unnecessary or undue degradation of public lands and to protect the non-mineral resources of the public lands;

- Measures are included to provide for reclamation of disturbed areas;

- Compliance with applicable state and federal laws is achieved; and

- Reclamation bonding is in place.

The 43 CFR 3809 were revised in 2001, and BLM has reviewed the PoO Modification to ensure it is in conformance with the revised surface management regulations, including the definition of unnecessary or undue degradation and the new performance standards.

1.5.2 Resource Management Plan

The BLM's Sonoma-Gerlach Management Framework Plan (MFP) contains no constraints that conflict with the Proposed Action. Management activities for the Proposed Action area are identified as livestock grazing, wildlife habitat, and recreation. Mineral resource development conforms to the Sonoma-Gerlach MFP, which states: "Make public lands and federally owned minerals available for the exploration and development of mineral and material commodities."

1.5.3 Mining and Mineral Policy Act

The Mining and Mineral Policy Act of 1970 (MMPA) mandates that federal agencies ensure environmentally responsible mine closure and reclamation by promoting the:

> "… development of methods for the disposal, control, and reclamation of mineral waste products, and the reclamation of mined lands, so as to lessen any adverse impact of mineral extraction and processing upon the physical environment that may result from mining or mineral activities."

The BLM policy and standards for reclamation are set forth in the *Solid Minerals Reclamation Handbook* (BLM Manual Handbook H-3042-1, BLM 1992a), the BLM Surface Management of Operations Handbook (Nevada State Office #H-3809-1), and through other BLM policy or guidance. The BLM has reviewed the PoO Modification for the proposed Millennium Expansion Project to ensure that the reclamation would meet the BLM reclamation standards and goals.

1.5.4 Cyanide Management Plan Requirements

The NSO of BLM has prepared and administers the *Nevada Cyanide Management Plan* (BLM 1992b) as required by BLM's national cyanide management policy. The *Nevada Cyanide Management Plan* would be applicable to the proposed heap leach facilities, and the precious metal recovery processes.

State standards, where established for mining operations, must also be considered. Nevada has established standards through the NDEP-BMRR. BLM would review the Millennium Expansion Project PoO Modification to ensure that it is in conformance with the *Nevada Cyanide Management Plan* and Nevada BLM's Guidance for Hardrock Mining Reclamation/Closure Activities – Management of Heap Leach Effluents (IM #NV-2000-066, August, 2000).

1.5.5 Local Land Use Planning and Policy

The Proposed Action is consistent with the Humboldt County zoning ordinances. The Project Area is zoned M-3 (Open Land Use District), and this land classification recognizes mineral extraction industries as an accepted land use. Article 10 of the Humboldt County Zoning Ordinance requires a Special Use Permit for mining operations located on private lands.

1.6 Environmental Review Process

Public involvement is an important and necessary component of the NEPA process. Documentation of this involvement has been compiled into a Project Scoping Document that includes a summary of the issues and concerns identified during the scoping process. The Project Scoping Document has been used by BLM to identify the key issues that would be analyzed in the SEIS and to identify concerns that are not considered critical in terms of anticipated effects of the Proposed Action. The Project Scoping Document is on file and available for review during normal business hours at the BLM Winnemucca Field Office.

A Notice of Intent (NOI) to prepare the SEIS was published in the Federal Register on July 12, 2002. The NOI invited public scoping comments to be sent to the BLM through August 19, 2002. A letter announcing the proposed Millennium Expansion Project and public informational meeting dates and times was sent to all individuals, groups, and agencies that were on the Marigold Expansion EIS mailing list. The Millennium Expansion Project was also announced in the local newspapers and on the local radio station on various dates between July 19, 2002 and August 19, 2002. The newspaper articles briefly described the project, presented public informational meeting dates and times, and indicated that BLM was seeking public comments on the project. Public informational meetings were held in Winnemucca and Battle Mountain, Nevada. A total of ten members of the public attended the Winnemucca meeting on August 14 and five members of the public attended the Battle Mountain meeting on August 15. No comments were received at either of these meetings. Nine written comment letters were received by the BLM within the public comment period.

Consultation with Native American tribal organizations was initiated with a letter describing the proposed project and a request to be added to the agenda of the regularly scheduled monthly Native American-BLM coordination meeting. BLM and GMMC provided an overview of the project and fielded questions at meetings on August 21, 2002 and November 7, 2002. Native American tribal organizations were also invited to tour the existing and proposed mining areas in an effort to identify cultural and ethnographic issues. A tour was conducted on September 17, 2002, with three tribal representatives in attendance.

As a result of the public scoping process and initial Native American Consultation, the following potential project issues were identified by the public:

- <u>Water Resources and Geochemistry</u>
  Impacts to wetland and riparian areas
  Impacts to water quality and quantity (surface and groundwater)
  Red Rock Pit highwall stability
  Impacts to existing water rights
  Change in current permitted uses for GMMC
  Mobilization of arsenic
  Pit lake water quality
  Pit backfilling
  Heap leach closure

- <u>Geology and Minerals</u>
  Pit backfill

- <u>Air Quality</u>
  Impacts to air quality
  Fugitive dust – off site from mine vehicles

- <u>Soils</u>
  Impacts to soil quality

- <u>Cultural</u>
  Potential impacts to cultural sites

- <u>Ethnography</u>
  Access to historic hunting/food gathering areas

- <u>Vegetation Resources</u>
  Trace metal impacts to vegetation

- <u>Wildlife and Fisheries Resources</u>
  Impacts to terrestrial and aquatic wildlife and their habitats
  Impacts to migratory birds from land clearing activities and process solutions
  Dermal exposure to burrowing animals from contaminants in reclaimed facilities
  Noise impacts to wildlife
  Impacts to mule deer winter habitat
  Reclamation measures should include vegetation and habitat beneficial to wildlife
  Cumulative impacts to wildlife

- <u>Special Status Species</u>
  Impacts to sage grouse
  Impacts to invertebrates in springs
  Impacts to springsnails

Impacts to bats

- Range Resources
  Loss of forage during and after mining
  Impacts to sheep movements
  Loss of livestock water sources
  Availability of reclaimed vegetation
  Impacts to amount of land available for shearing areas

- Land Use and Access
  Access to private land and mineral claims
  Water rights impacts
  Impacts to grazing leases
  Impacts to roads from transportation of mine materials

- Hazardous Materials
  Transportation and storage of hazardous materials

- Cumulative Impacts
  Cumulative impacts from mining and other land uses in the area need to be analyzed

1.7 Authorizing Action

In addition to the SEIS, implementing the proposed project or alternatives would require authorizing actions from other federal, state, and local agencies with jurisdiction over certain aspects of the proposed project. Table 1-2 lists the required permits or approvals and the responsible regulatory agency.

1.8 Organization of the Supplemental Environmental Impact Statement

This SEIS follows the Council on Environmental Quality (CEQ) recommended organization (40 CFR 1508.9): Chapter 1.0 provides descriptions of the Proposed Action, relevant history of the project vicinity, purpose of and need for the Proposed Action, the environmental review process, applicable regulatory requirements and coordination, and organization of the SEIS; Chapter 2.0 describes the Proposed Action and alternatives in detail; Chapter 3.0 describes the affected environment, environmental consequences, mitigation and monitoring, and residual adverse impacts; Chapter 4.0 describes the cumulative impacts of the Proposed Action and other past, present, and reasonably foreseeable actions within the region. Chapter 5.0 summarizes public comments received during the scoping period. Chapter 6.0 summarizes consultation and coordination for preparation of the SEIS. Chapter 7.0 presents the list of preparers and reviewers and Chapter 8.0 is a glossary and list of acronyms. Chapter 9.0 is a list of references, and Chapter 10.0 is topical index. Copies of supporting documents are on file in the BLM's Winnemucca Field Office and the BLM NSO in Reno.

Table 1-2: Major Permits and Authorizations Required for the Proposed Millennium Expansion Project

Permit/Approval	Granting Agency
Federal Permits	
Plan of Operations Amendment N26-88-005P/NVN065034	U.S. Bureau of Land Management
Explosives Permit 9-NV-013-20-2A-12169	U.S. Bureau of Alcohol, Tobacco, and Firearms
Nevada State Permits	
Class II Air Quality Permit AP1041-0158	NV Division of Environmental Protection/ Bureau of Air Pollution Control
Reclamation Permit No. 0108	NV Division of Environmental Protection/ Bureau of Mining Regulation & Reclamation
Water Pollution Control Permit NEV88040	NV Division of Environmental Protection/ Bureau of Mining Regulation & Reclamation
Solid Waste Class III Landfill Waiver SWMI-08-41	NV Division of Environmental Protection/ Bureau of Solid Waste
General Storm water Discharge Permit NVR300000	NV Division of Environmental Protection/ Bureau of Water Pollution Control
Permit to Appropriate Waters	NV Division of Water Resources
Permit to Construct Impoundments	NV Division of Water Resources
Industrial Artificial Pond Permits	NV Division of Wildlife
Liquefied Petroleum Gas License - 3482	NV Board of the Regulation of LPG
Septic System Permit GNEV9201-4006	NV Division of Environmental Protection
County Permits	
Special Use Permit UH-88-08	Humboldt County Regional Planning Commission

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2.0 DESCRIPTION OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

2.1 Introduction

GMMC currently operates the Glamis Marigold Mine under the existing PoO No. N26-88-005P/N-65034, amended July 3, 1997, May 27, 1998, August 6, 1998, September 19, 2001, and March 2002; Reclamation Permit No. 0108; and Water Pollution Control Permit NEV88040. GMMC proposes to expand the current mining operation, develop new facilities, and modify the closure of heap leach facilities at the Glamis Marigold Mine.

GMMC submitted a modification to the existing PoO describing the Millennium Expansion Project. In preparing the PoO Modification, GMMC attempted to minimize environmental impacts by the placement and configuration of facilities, limiting surface disturbance, and incorporating measures to protect the environment. However, during the scoping process another issue was identified from which alternatives to the Proposed Action have been developed to further reduce potential environmental impacts. The issue identified was the long-term stability of the existing Trout Creek Diversion as a result of the proposed deepening of the Red Rock Pit. Consequently, this SEIS analyzes and compares the impacts of the Proposed Action, Alternative 1 that addresses the Realignment of the Trout Creek Diversion, Alternative 2 that addresses the highwall stability of the Red Rock Pit as it relates to the stability of the Trout Creek Diversion, and the No Action Alternative. The Proposed Action and alternatives are described in detail below.

2.2 Proposed Action

The Glamis Marigold Mine has been in commercial operation since 1988 and under the direction of Glamis Marigold Mining Company since 1999. The mine is located on the northwestern flank of Battle Mountain approximately three miles south of the town of Valmy, Nevada, at elevations ranging between 4,600 and 5,900 feet above mean sea level (amsl) (Figure 1-3). The current Project Area includes approximately 8,500 acres of public and private lands within Township 32 North [T32N], Range 43 East [R43E], Section 6, T33N, R43E, Sections 4, 5, 6, 7, 8, 9, 16, 17, 18, 19, 20, 30, and 31; T34N, R43E, Sections 28, 32, and 33.

GMMC owns or controls the majority of mining claims on approximately 8,320 acres of private land and 10,480 acres of public land in the project vicinity (Figure 2-1 and Appendix A). Existing operations (described in Section 1.2) comprise approximately 1,831 disturbance acres, of which approximately 747 acres are located on public land administered by the BLM, and approximately 1,084 acres are on private land (see Table 2-1). There is no State of Nevada-administered property within the Project Area of operations. However, there is private land owned by the University of Nevada, Reno, a state institution. Surface disturbance of that land is included in the private land category.

The proposed Millennium Expansion Project would disturb approximately 667 acres of private land and 807 acres of BLM-administered public land, for a total additional surface disturbance of 1,474 acres (see Table 2-1). The Proposed Action would include expansion and consolidation of the Top Zone and Red Rock pits into the Terry Zone Pit; development of five new mining areas; expansion of the Old Marigold Waste Rock Storage Area; development of three new waste rock storage areas (North, South, and West Waste Rock Storage Areas); development of two new heap leach processing areas (Section 30 Heap Leach Facility and Section 16 Heap Leach Facility); expansion of the existing heap leach pad and processing facilities; development of the Millennium Project ADR Facility; development of new support facilities in Section 31; development of ancillary facilities (infill disturbance, storm water control structures, fencing, power transmission system, substations, water supply system, interior haul and access roads, lime silo, explosives storage, and materials storage area); and modification of the heap closure measures for the proposed new heap leach facilities and existing heap leach facilities. The Proposed Action would extend the mine operations a maximum of six years through 2013.

A summary of the existing and proposed surface disturbance is presented in Table 2-1. The layout of the existing facilities is illustrated in Figure 1-3 and the layout of proposed facilities is illustrated in Figure 2-2.

2.2.1 Work Force and Schedule

The Proposed Action would extend the life of the mine through the year 2013, with reclamation extending approximately five years beyond active mining operations. A construction work force of 30 or fewer would be employed during construction of expanded facilities (e.g., additional carbon columns, heap leach pads and solution ponds, diversion ditches, truck shop warehouse, and fences). The construction payroll is estimated to be up to $600,000 annually during the construction phases of the project. It is anticipated that the construction work force would be hired from the local areas. The Glamis Marigold Mine currently has approximately 115 employees. This number is not expected to exceed peak employment of 125 during mining operations through 2013. The average annual operations payroll between 2003 and 2013 would be approximately $6.0 million. A conceptual schedule showing possible sequencing of principal pre-development, construction, operation, and reclamation activities is presented in Figure 2-3.

2.2.2 Mining Operations

2.2.2.1 Open Pit Development

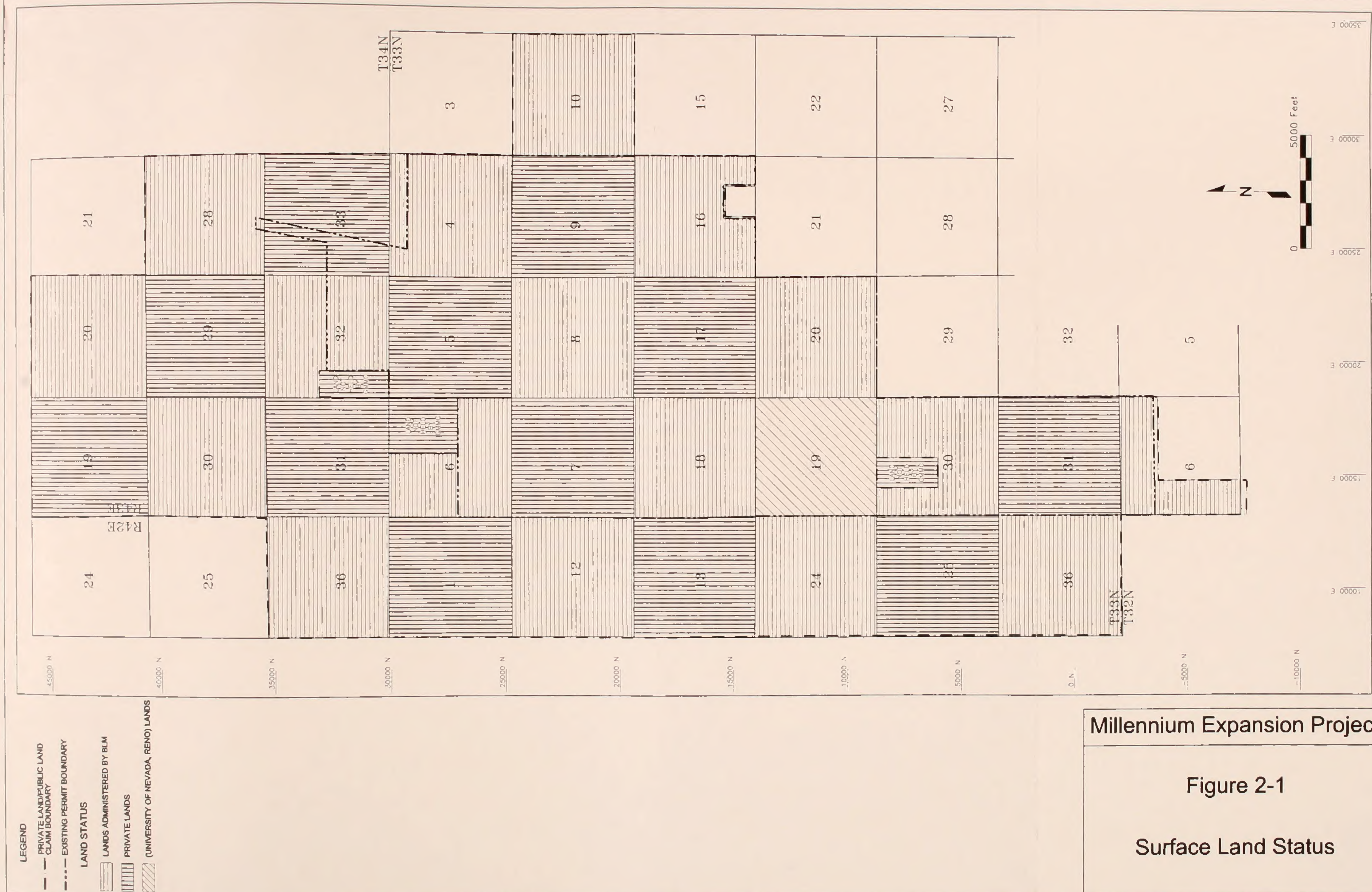
__Open Pits__

The Proposed Action involves deepening the Top Zone and Red Rock Pits into a consolidated pit called the "Terry Zone Pit" and the development of five new mining areas: Target No. 1 Pit, Target No. 2 Pit, Antler Pit, Basalt Pit, and Mackay Pit. Figure 2-2 shows the locations of these mining areas. Table 2-2 shows the size, land status, generalized pit bottom elevations, and amount of ore proposed to be produced from each pit. The Proposed Action open-pit mining areas would create a combined total of 414 acres of new surface disturbance (164 acres of public land and 250 acres of private land), and would produce approximately 80.6 million tons of ore and 244.0 million tons of waste rock.

The drilling, blasting, and mining procedures currently being used at the Glamis Marigold Mine would be used to develop the pit areas for the Proposed Action. Unconsolidated gravels and growth media that do not require drilling and blasting would be ripped with a dozer, as required, for removal. Ore and waste rock would be drilled on approximately 14-foot centers using diesel-powered rotary hammer drills. The drill holes would be charged with an ammonium nitrate/fuel oil (ANFO) mixture by means of a truck-mounted mixing and dispensing unit. Blasting would occur during daylight hours and would comply with applicable safety standards. Typically, two blasts would occur daily at mid-day and in the late afternoon.

Material would be mined on 20- to 40-foot benches. Mining equipment may include electric or diesel shovels, Cat 16G Motor Graders, D9 or D10 dozers, 85-ton and 190-ton haul trucks, loaders, blast hole drills, water trucks, service trucks, tire trucks, and supply delivery trucks. The slope angles in the open pits would range from 34 to 55 degrees depending on the pit and specific locations within the pit.

Mining associated with the Proposed Action would commence in 2003 and continue through 2013, and would be sequential to enable backfilling of the Target No. 1 Pit and Target No. 2 Pit. Mining would occur first in the Terry Zone Pit, the Mackay Pit, Target No. 1 Pit and Target No. 2 Pit, followed by the Basalt Pit, and finally the Antler Pit. Mining activities may occur on 24-hour, 7-days per week basis, with two to three shifts. No groundwater issues due to potential pit lakes are anticipated for the Proposed Action mining areas because the planned pit bottom elevations for all of the Millennium Expansion Project pits would be at or above the water table except for the Terry Zone Pit. Figure 2-4 presents cross sections showing the expected pit bottom elevations and the depth to groundwater.



Millennium Expansion Project

Figure 2-1

Surface Land Status

Table 2-1: Glamis Marigold Mine Authorized and Proposed Millennium Expansion Project Facilities

Project Component	Previously Authorized Surface Disturbance (acres)		Millennium Expansion Project Proposed Surface Disturbance (acres)		Grand Total (acres)
	Public Land	Private Land	Public Land	Private Land	
Open Pit Mines					
8-South Pit	110	14	0	0	124
East Hill Pit	55	90	0	0	145
Top Zone Pit	65	34	see Terry Zone	see Terry Zone	99
Red Rock Pit	21	44	see Terry Zone	see Terry Zone	65
Old Marigold Pit	24	0	0	0	24
5-North Pit	0	29	0		29
8-North Pit	49	0	0	0	49
Terry Zone Pit Consolidation (Top Zone & Red Rock Deepening)	N/A	N/A	0	0	0
Section 30 - Target 1	N/A	N/A	19	0	19
Section 30 - Target 2	N/A	N/A	90	35	125
Section 31 - Antler Pit	N/A	N/A	34	43	77
Section 31 - Basalt Pit	N/A	N/A	21	153	174
Mackay Pit	N/A	N/A	0	19	19
Total Pits	324	211	164	250	949
Waste Rock Storage Areas					
8-South[1]	30	0	0	0	30
Top Zone	80	55	0	0	135
Old Marigold	73	23	9	7	112
Resort	10	163	0	0	173
5-North	0	55	0	0	55
North Storage Area	N/A	N/A	155	133	288
South Storage Area	N/A	N/A	53	0	53
West Storage Area	N/A	N/A	11	133	144
Total Waste Rock Areas	193	296	228	273	990
Heap Leach Facilities					
Heap Leach Pads No. 1 - 10	56	74	0	0	130
Process Ponds	5	0	0	0	5
Storm water Ponds	1.5	1.5	0	0	3
SW Pad Expansion[2] (Cell 11)	0	60	0	0	60
Process Ponds	0	0	0	0	0
Storm water Ponds	0	2	0	0	2
5-North Heap Leach Pad	0	30	0	0	30
Process Ponds	0	2	0	0	2
Storm water Ponds	0	1	0	0	1
Plant Facilities	0	1	0	0	1
Section 17 Heap Leach Pad (Cell 12)	0	0	78	0	78
Solution Conveyance Ditch	0	0	0	2	2
Process Ponds[3]	0	0	0	0	0
Storm water Pond[3]	0	0	0	0	0

Project Component	Previously Authorized Surface Disturbance (acres)		Millennium Expansion Project Proposed Surface Disturbance (acres)		Grand Total (acres)
	Public Land	Private Land	Public Land	Private Land	
Carbon columns & storage tanks[3]	0	0	0	0	0
Section 30 Heap Leach Pad	N/A	N/A	125	30	155
Process Ponds	N/A	N/A	14	2	16
Storm water Pond (freeboard on Process Ponds)	N/A	N/A	0	0	0
ADR, lime silo, & infill (includes fresh water pond)	N/A	N/A	24	0	24
Section 16 Heap Leach Pad	N/A	N/A	76	0	76
Process Ponds	N/A	N/A	2	0	2
Storm water Pond	N/A	N/A	1	0	1
Carbon columns & storage tanks	N/A	N/A	1	0	1
Total Heap Leach	62.5	171.5	321	34	589
Plant and Support Facilities New Support Facility					
Existing Mill and Plant Facilities	35	17	0	0	52
New truck shop, warehouse, fuel dispensing	N/A	N/A	0	7	7
Total Plant and Support Facilities	35	17	0	7	59
Tailings Disposal Facilities					
Existing Tailings Facility	0	234	0	0	234
New Tailings Facility	N/A	N/A	0	0	0
Total Tailings	0	234	0	0	234
Growth Media Stockpiles					
Pre-FEIS	5	15	0	0	20
5-North (2 stockpiles)	0	10	0	0	10
8-North	5	0	0	0	5
New Tailings	0	8	0	0	5
SW Heap Leach Pad	0	5	0	0	5
Section 19	N/A	N/A	0	5	5
Section 16	N/A	N/A	5	0	5
Total Growth Media	10	38	5	5	58
Surface Water Diversion Structures					
Heap Leach - Old Tailings	0.1	2.9	0	0	3
5-North/Cottonwood Creek	4	6	0	0	10
8-North/Trout Creek	5	3	0	0	8
SW Heap Leach	5	8	0	0	13
New storm water diversion structures[4]	N/A	N/A	0	0	0
Total Diversion Structures	14.1	19.9	0	0	34
Haul and Access Roads					
Pre-FEIS Haul Roads	22	38	N/A	N/A	60
5 North	14	14	0	0	28
Millennium Expansion Project	N/A	N/A	27	25	52

Project Component	Previously Authorized Surface Disturbance (acres)		Millennium Expansion Project Proposed Surface Disturbance (acres)		Grand Total (acres)
	Public Land	Private Land	Public Land	Private Land	
Haul and Access Roads					
Total Haul and Access Roads	36	52	27	25	140
Water Supply Facilities					
Pre-FEIS Water Supply	4	5	N/A	N/A	9
Lone Tree Water Line	0.1	3.9	N/A	N/A	4
Millennium Expansion Project Water Supply	N/A	N/A	11	10	21
Total Water Supply	4.1	8.9	11	10	34
Infill Surface Disturbance					
Infill Areas(2)	50	10	0	0	60
Millennium Expansion Project Infill Areas	N/A	N/A	51	63	114
Total Infill Disturbance Areas	50	10	51	63	174
Miscellaneous Ancillary					
Miscellaneous and Ancillary Facilities	1.5	0.5	N/A	N/A	2
Millennium Expansion Project Miscellaneous and Ancillary Facilities	N/A	N/A	0	0	0
Total Ancillary Facilities	1.5	0.5	0	0	2
Surface Exploration					
Drill roads, pads, trenches	17	25	N/A	N/A	42
Millennium Expansion Project Surface Exploration	N/A	N/A	0	0	0
Total Surface Exploration	17	25	0	0	42
Authorized Disturbance Grand Totals	747.2	1,083.9	N/A	N/A	**1,831.1**
Millennium Expansion Project Proposed Disturbance Total	N/A	N/A	807	667	**1,474**
AUTHORIZED AND PROPOSED CUMULATIVE TOTAL					**3,305.1**

Notes: (1)The total authorized disturbance does not include the 150 acres of reclaimed and recently released acres at the 8-South Waste Rock Storage Area.

(2)The acres shown for previously authorized disturbance for the Southwest Leach Pad and the infill areas reflect the changes authorized in the March 2002 Minor Modification DNA to eliminate 12 acres of disturbance on private land from the authorized infill disturbance, and to reconfigure the layout of the Southwest Heap Leach Pad to cover an additional 12 acres of private land.

(3)The acres for the modification of the Process Facilities for the Section 17 Heap Leach Pad are accounted for in previously authorized disturbance for the existing heap leach facilities and in fill areas.

(4)Surface disturbance for Millennium Expansion Project storm water diversion structures is accounted for in the acres shown for the Millennium Expansion Project pits and waste rock storage facilities.

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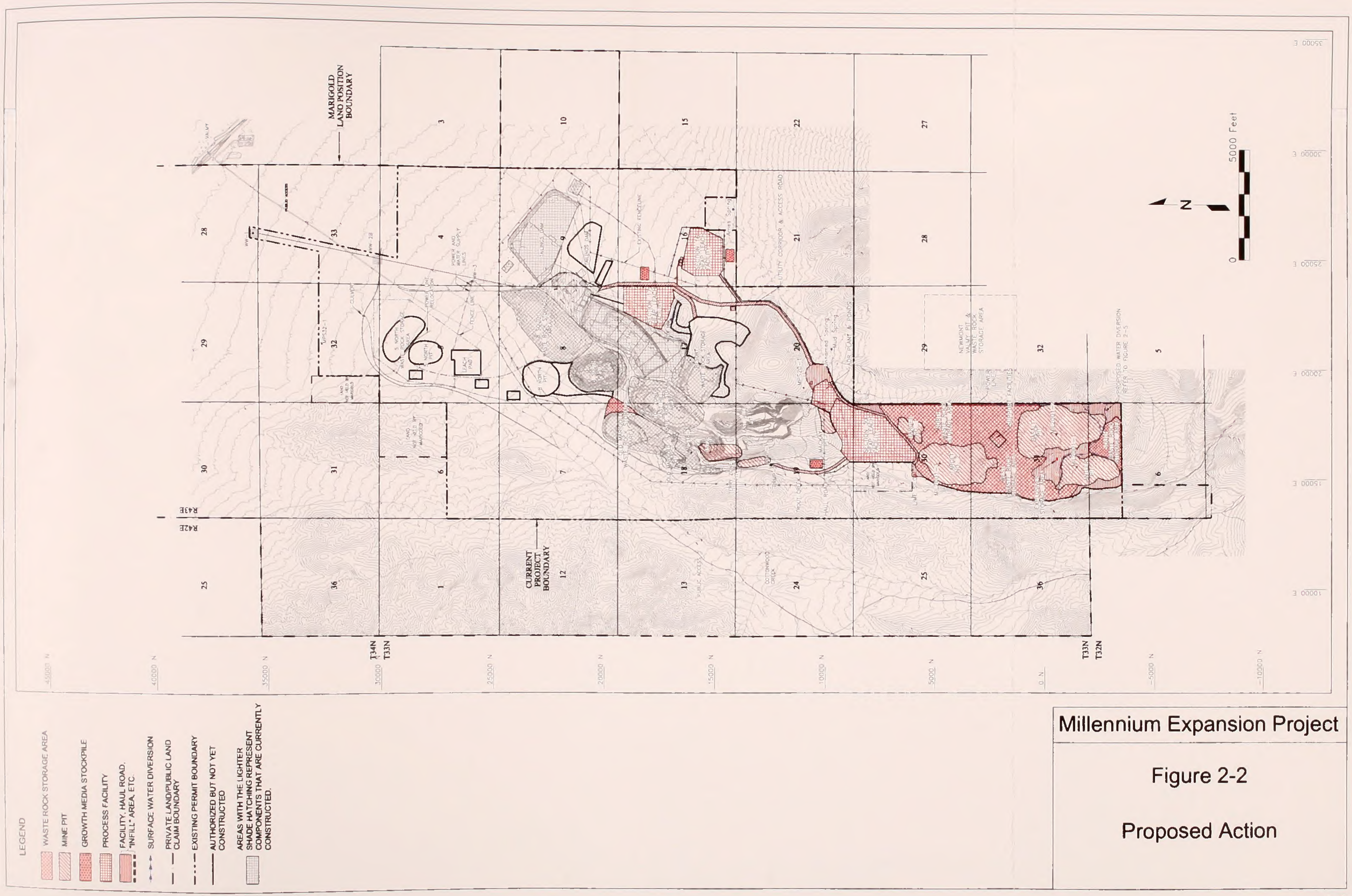


Millennium Expansion Project

Figure 2-2

Proposed Action

Glamis Marigold Mining Company
Millennium Expansion Project

ID	Task Name
1	**Open Pit**
2	Terry Zone Expansion
3	*Construction*
4	*Reclamation*
8	Mackay
9	*Construction*
10	*Reclamation*
11	Target 1
12	*Construction*
13	*Reclamation*
14	Target 2
15	*Construction*
16	*Reclamation*
17	Basalt
18	*Construction*
19	*Reclamation*
20	Antler
21	*Construction*
22	*Reclamation*
23	**Waste Rock Dumps**
24	North Storage Area
25	*Construction*
26	*Concurrent Reclamation*
27	*Reclamation*
28	West Storage Area
29	*Construction*
30	*Construction of Trout Creek Berm*
31	*Concurrent Reclamation*
32	*Reclamation*
33	South Storage Area
34	*Construction*
35	*Concurrent Reclamation*
36	*Reclamation*
37	**Heap Leach Facilities**
38	Pad Construction
39	*Phase I and Phase II*
40	*Leaching Phase I and Phase II*
41	Reclamation
42	*Final Draindown Solution Disposal*
43	Earthwork
44	*Concurrent*
45	*Final*
46	Ponds
47	*Construction*
48	*Reclamation*
49	**Roads**
50	*Construction*
51	*Reclamation*
52	**Ancillary Facilities**
53	*Construction*
54	*Reclamation*
55	**Buildings**
56	*Construction*
57	*Reclamation*

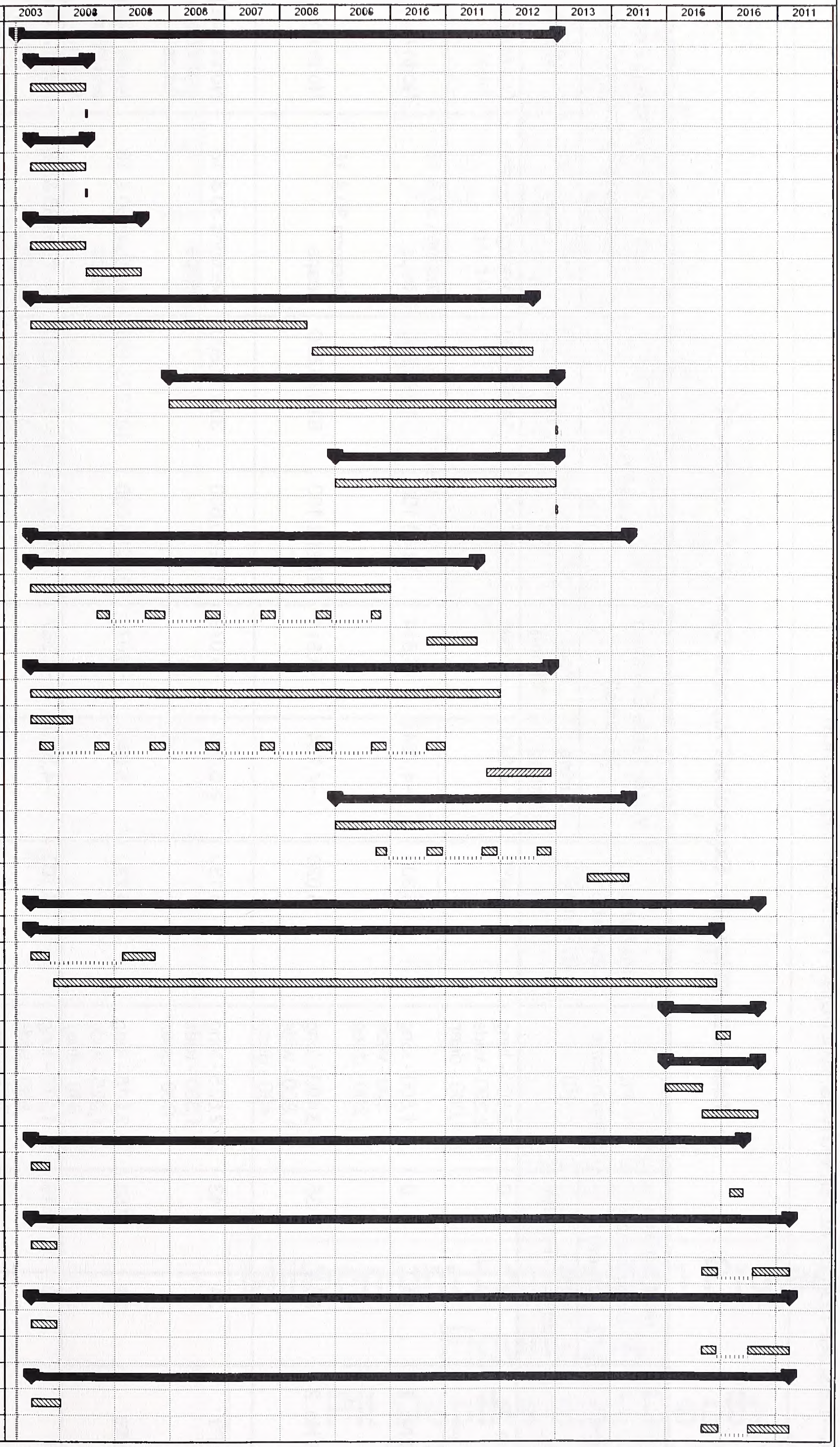


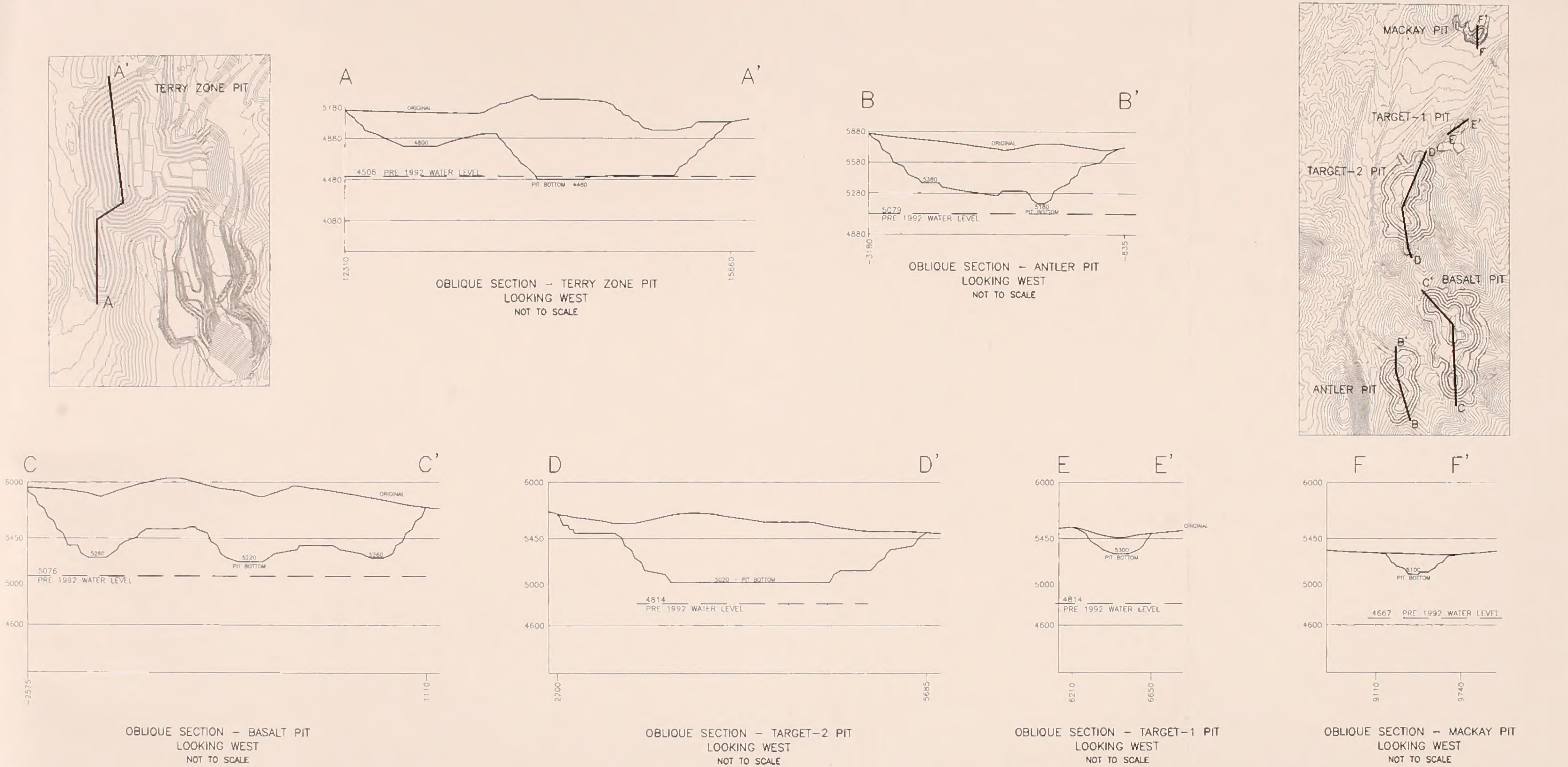
Figure 2-3
Millennium Expansion Project Schedule

Table 2-2: Millennium Expansion Proposed Open Pit Development

Pit Name	New Surface Disturbance (acres)		Pit Dimensions (ft)	Pit Bottom Elevation (ft - amsl)	Water Table Elevation (ft - amsl)		Tons Produced		Leach Pad and Waste Rock Storage Area Destinations	
	Public	Private			During Mining	Post Mining	Ore	Waste	Ore	Waste
Terry Zone Pit	0	0	3,800 - long 2,200 - wide 1,000 - deep	4,480	4,341	~4,508	7,197,200	14,231,100	existing & Section 30 heap	Old Marigold Area
Section 30 Target No. 1	19	0	1,500 - long 500 - wide 200 - deep	5,300	~4,784	~4,814	1,666,100	1,793,600	Sections 30 & 16 heaps	North Area
Target No. 2	90	35	3,400 - long 1,800 - wide 480 - deep	5,020	~4,784	~4,814	21,602,100	83,123,600	Sections 30 & 16 heaps	North Area
Section 31 Antler Pit	34	43	2,625 - long 1,380 - wide 600 - deep	5,180	~5,049	~5,079	11,950,600	35,159,800	Sections 30 & 16 heaps	North, South and West Areas
Basalt Pit	21	153	3,975 - long 1,925 - wide 840 - deep	5,220	5,046	~5,076	37,386,600	107,273,100	Sections 30 & 16 heaps	North, South and West Areas
Mackay Pit	0	19	1,275 - long 980 - wide 200 - deep	5,100	~4,330	~4,667	765,400	2,461,500	Sections 30 & 16 heaps	North Area
Grand Totals	164	250					80,568,000	244,042,700		

Note: Consolidating the Red Rock and Top Zone pits into the Terry Zone Pit will involve deepening the existing pits. The footprint of the rim of the pit will coincide with the authorized footprint for these pits. Thus no new surface disturbance will be created in conjunction with development of the Terry Zone Pit. The pit dimensions are approximate; the pit acres are calculated by neat line and represent actual disturbance.

The generalized pit bottom elevations shown above represent approximate average elevations. As mining occurs, the actual pit bottoms may change slightly, with local pit bottom elevations varying from the estimate. These minor variations would accommodate site-operating specifics and would not change the surface disturbance for the pits or the waste rock storage areas shown above.



Millennium Expansion Project

Figure 2-4

Pit Depths and Depth to Groundwater Cross Sections

The generalized pit bottom elevations shown in Table 2-2 and discussed below represent approximate average elevations. As mining occurs, the actual pit bottoms may change slightly, with local pit bottom elevations varying from the estimate. These minor variations would accommodate site-operating specifics and would not change the surface disturbance for the pits or the waste rock storage areas shown in Table 2-1 and Table 2-2. However, with the exception of the Terry Zone Pit, these minor variations would not extend the pit bottom elevation below the known or projected pre-Lone Tree dewatering groundwater level. The details associated with each pit are provided below.

Terry Zone Pit

Deepening and combining portions of the existing Top Zone and Red Rock open pits would create one large pit, hereafter called the Terry Zone Pit. Mining would commence in 2003. The Terry Zone Pit would not expand the existing approved surface disturbance foot print, but would be deeper than the pit bottom elevations currently authorized for the Top Zone and Red Rock Pits. The deepest planned bottom elevation of the Terry Zone Pit would be approximately 4,480 amsl, approximately 28 feet below the estimated pre-dewatering groundwater level (WMC 2002). The currently authorized deepest pit bottom elevation for this mining area is 4,740 feet amsl.

Deepening of the Terry Zone Pit to below the previously approved depth of the Top Zone and Red Rock Pits would produce an additional 7,197,200 tons of ore and 14,231,100 tons of waste rock. This ore may be processed at the existing heap leach facility, the expanded Section 17 Heap Leach Facility, or the proposed Millennium Expansion Project Section 30 Heap Leach Facility. If the ore is milled, the tailings would be stored in the authorized, but not yet constructed, tailings facility. Waste rock generated from the Terry Zone Pit is scheduled for disposal at the Old Marigold Waste Rock Storage Area (Table 2-2).

Target No. 1 Pit

Mining of the Target No. 1 Pit would produce approximately 1,666,100 tons of ore and 1,793,600 tons of waste rock. Ore would be processed at the Section 30 and Section 16 Heap Leach Facilities, or the expanded Section 17 Heap Leach Facility. Waste rock would be disposed at the North Waste Rock Storage Area.

This pit would disturb about 19 acres of public land and would be approximately 1,500 feet long, 500 feet wide, and 200 feet deep, with a planned bottom elevation of approximately 5,300 amsl.

Upon completion of mining, this pit would be completely backfilled with approximately 3,000,000 tons of waste rock from the Target No. 2 Pit. Current plans have mining of the Target No. 1 Pit starting in 2003 or as soon as all project permits and approvals have been acquired and would continue for approximately one year.

Target No. 2 Pit

Mining of the Target No. 2 Pit would produce approximately 21,602,100 tons of ore and 83,123,600 tons of waste rock. Ore from this pit would be processed at the Section 30 and Section 16 Heap Leach Facilities or the expanded Section 17 Heap Leach Facility. The waste rock from this pit would be used to backfill Target No. 1 Pit. Once Target No. 1 Pit is completely backfilled, the additional waste rock would be placed above ground as part of the North Waste Rock Storage Area.

This pit would disturb about 125 acres (90 acres of public land and 35 acres of private land). Target No. 2 Pit would be approximately 3,400 feet long, 1,800 feet wide, and 480 feet deep, with a planned bottom elevation of about 5,020 amsl.

This pit would be completely backfilled upon completion of mining with approximately 81,000,000 tons of waste rock obtained from the mining of the Basalt Pit. Mining of the Target No. 2 Pit would begin in 2003 or as soon as all project permits and approvals have been acquired and would continue for approximately five years.

Antler Pit

Mining of the Antler Pit would produce approximately 11,950,600 tons of ore and 35,159,800 tons of waste rock. Ore would be processed at the Section 30 and Section 16 Heap Leach Facilities and waste rock would be disposed at the North, South, and West waste rock storage areas.

This pit would disturb about 77 acres (34 acres of public land and 43 acres of private land) and would be approximately 2,625 feet long, 1,380 feet wide, and 600 feet deep, with a planned bottom elevation of approximately 5,180 amsl. Mining of the Antler Pit is scheduled to begin in the year 2009 and continue for approximately four years.

Basalt Pit

Mining of the Basalt Pit would produce approximately 37,386,600 tons of ore and 107,273,100 tons of waste rock. The ore from this pit would be processed at the Section 30 and Section 16 Heap Leach Facilities. The North, South, and West waste rock storage areas would be used for waste rock from the Basalt Pit.

This pit would disturb about 174 acres (21 acres of public land and 153 acres of private land) and would be approximately 3,975 feet long, 1,925 feet wide, and 840 feet deep, with a planned bottom elevation of approximately 5,220 amsl. Mining of the Basalt Pit is scheduled to begin in the year 2006 and continue for approximately seven years.

Mackay Pit

Mining of the Mackay Pit would produce approximately 765,400 tons of ore and 2,461,500 tons of waste rock. Ore would be processed at the Section 30 and Section 16 Heap Leach Facilities. Waste rock would be disposed of at the North Waste Rock Storage Area.

This pit would disturb about 19 acres of private land (owned by the University of Nevada-Reno), and would be approximately 1,275 feet long, 980 feet wide, and 200 feet deep, with a planned bottom elevation of approximately 5,100 amsl. Mining is scheduled to begin in the Mackay Pit in 2003, or as soon as all project permits and approvals have been acquired, and would be completed within one year. Mining of the Mackay Pit would be concurrent with mining of the Terry Zone Pit.

2.2.2.2 Loading and Hauling

Blasted ore and waste rock would be loaded by hydraulic loader onto 85- to 190-ton capacity haul trucks. The haul trucks would transport the mined material to the heap leach facilities and waste rock storage areas, as applicable.

2.2.3 Waste Rock Disposal

2.2.3.1 Waste Rock Storage Areas

The expanded and new waste rock storage areas would cover 501 acres (228 acres of public land and 273 acres of private land) as shown in Figure 2-2. The waste rock storage areas developed in conjunction with the Proposed Action would be constructed in the same manner as previously authorized waste rock storage areas. After stripping and stockpiling the growth media from the site, the waste rock storage area would be created by end dumping waste rock material onto the active bench face of the storage area at the angle of repose. The waste rock storage areas would be built at an overall slope of 3H:1V[1], with average bench heights of 50 to 60-feet. Table 2-3 shows the size, land status, height and amount of waste rock to be stored in each waste rock storage area.

Development of these waste rock storage areas would be timed to optimize operational flexibility, and to provide the base for the access road from the Section 30 Heap Leach Facility and new shop and maintenance area, to the Basalt and Antler Pits in the southern portion of the Project Area. This road would be relocated periodically to facilitate waste rock storage area development. Land status, approximate dimensions, and storage capacities of the proposed waste rock storage areas are described in Table 2-3.

[1] The slope of each individual bench would be angle of repose. However, by using 50- to 60-foot bench heights and setbacks of 150 - 180 feet, the overall slope from bench crest to bench crest would be 3H:1V. This type of construction facilitates achievement of the final reclaimed slopes at 3H:1V.

Table 2-3: Millennium Expansion Waste Rock Storage Areas

Waste Rock Storage Facility	New Surface Disturbance (acres)		Storage area/Backfill Capacity (tons)	Storage area Height/ Backfill Thickness (ft)	Waste Rock Source	Stratigraphic Unit[1]
	Public	Private				
Old Marigold Expansion	9	7	5,000,000	100	Terry Zone Pit	Valmy Formation
North Storage Area	155	133	119,000,000	280 to 590	All pits except Terry Zone Pit	Valmy Formation, Havallah Formation, and Antler Sequence
West Storage Area	11	133	31,000,000	310	All pits except Terry Zone Pit	Valmy Formation, Havallah Formation, and Antler Sequence
South Storage Area	53	0	5,000,000	200	All pits except Terry Zone Pit	Valmy Formation, Havallah Formation, and Antler Sequence
Target No. 1 Pit Backfill	n/a	n/a	3,000,000	200	Target No. 2 Pit	Valmy Formation, Havallah Formation, and Antler Sequence
Target No. 2 Pit Backfill	n/a	n/a	81,000,000	480	Basalt or Antler Pit	Valmy Formation, Havallah Formation, and Antler Sequence
Terry Zone Pit Partial Backfill	n/a	n/a	421,730	28	8-North Pit	Havallah Formation, Edna Mountain Formation, Alluvium
Total Acres and Millennium Waste Rock Storage Capacity	228	273	244,000,000			

[1]Valmy Formation consists of interbedded quartzite, sandstone, chert, argillite, and metabasalt; Havallah Formation consists of conglomerate, shale, sandstone, limestone, metavolcanics, chert, and siltstone; Antler Sequence consists of Battle Formation conglomerate, and sandstone with minor shale, Antler Peak Limestone with calcareous conglomerate and sandstone, and Edna Mountain Formation conglomerate, siltstone, sandstone, and very minor limestone.

The Proposed Action includes expansion of the Old Marigold Waste Rock Storage Area and development of three new waste rock storage areas to accommodate the estimated 244 million tons of waste rock that would be mined as a result of the Millennium Expansion Project. This waste rock storage capacity includes 84 million tons that would be backfilled in the Target No. 1 and Target No. 2 pits as shown in Table 2-3 and Figures 2-2 and 2-5.

As shown in Figure 2-2, the Old Marigold Waste Rock Storage Area would be expanded by 16 acres (nine acres of public land and seven acres of private land) to accommodate waste rock mined from the Terry Zone Pit.

Mining of the Millennium Expansion Project Area would entail development of five separate pits as described in Section 2.2.2.1. Pit development would be sequenced to optimize pit backfilling of the Target No. 1 and Target No. 2 pits. The North Waste Rock Storage Area would be created first, receiving waste rocks from the Target No. 1 Pit, followed by waste rocks from the Target No. 2 Pit. Once mined out, the Target No. 1 Pit would be backfilled with waste rocks from the Target No. 2 Pit. The remaining waste rock from the Target No. 2 Pit would expand the North Waste Rock Storage Area. After mining of the Target No. 2 Pit is completed, this pit would be backfilled with material from the Basalt or Antler pits. Following complete backfilling of the Target No. 1 and Target No. 2 pits, the area encompassing the former pits would continue to receive waste rock until the area over and surrounding the former pits is one continuous waste rock storage area. The final configuration of the North Waste Rock Storage Area would occupy 288 acres (155 acres of public land and 133 acres of private land) as shown on Figures 2-2 and 2-5.

2.2.3.2 Pit Backfill

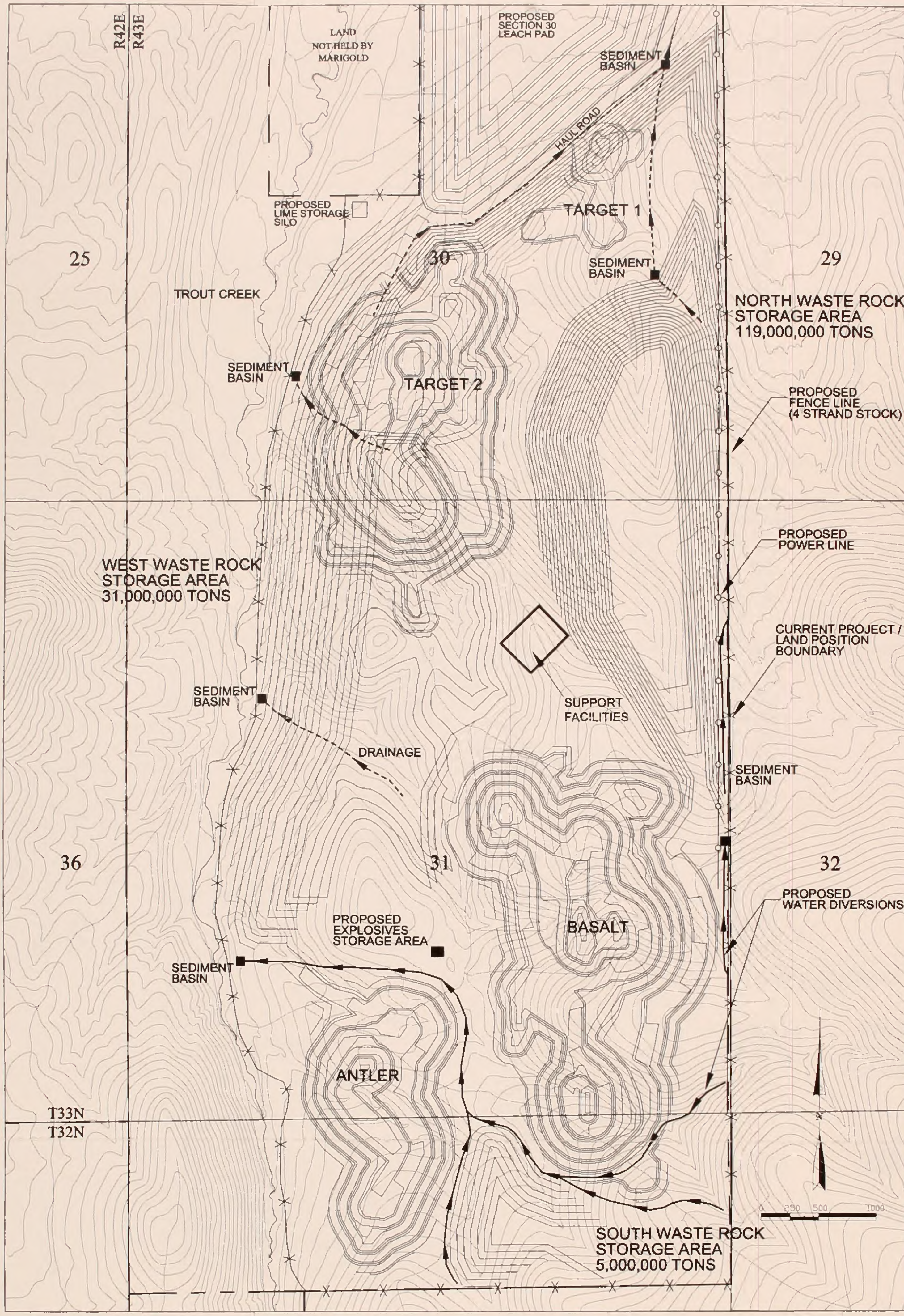
The Proposed Action includes backfilling of the Target No. 1 and Target No. 2 pits as shown in Figure 2-6. The Target No. 1 Pit would be backfilled with about three million tons of waste rock from the Target No. 2 Pit. The Target No. 2 Pit would be backfilled with approximately 81 million tons of suitable waste rock from the Basalt Pit and/or the Antler Pit. This amount of backfilling would be sufficient to completely fill both pits. Additional waste rocks would be placed on top of the backfilled pits to form one continuous waste rock storage area as shown in Figure 2-5.

The Terry Zone Pit is proposed for mining below the projected pre-Lone Tree dewatering groundwater level estimated at 4,508 feet amsl. Therefore, GMMC proposes to partially backfill the Terry Zone Pit to 4,520 feet amsl. Approximately 421,730 tons of waste rock from the 8-North Pit would be used for the Terry Zone Pit partial backfill. In the event that the 8-North Pit is not developed, other sources of suitable backfill material would be identified for use before mining below the pre-Lone Tree Mine dewatering water level.

GMMC would also backfill or partially backfill other pits with suitable waste rock material as the opportunity exists. Under the current mining sequence, the Target 1 and Target 2 pits would be completely backfilled and Terry Zone Pit would be partially backfilled. As changes in mining schedule, mine plan modifications, or other economic changes result in additional opportunities for below surface waste rock disposal, GMMC would contact BLM and NDEP for approval.

Pit backfilling would be contingent upon the conditions that were analyzed in the Glamis Marigold Mine Expansion FEIS (BLM 2001). The FEIS established the following requirement for determining whether a waste rock type is suitable for use as pit backfill (BLM 2001, page 2-15):

> "To ensure that the overburden used to backfill any of the pits does not have the ability to degrade waters of the state, any material to be placed in the pits would be characterized for its potential to generate acid and/or release metals. Testing would include both the Acid Base Accounting (ABA) and Meteoric Water Mobility Procedure (MWMP), and if necessary, kinetic testing. Material determined from these tests to have the potential to generate acid or release metals and non-metals to surface water or groundwater would not be placed in the pits and would be subject to a material management plan, as necessary."



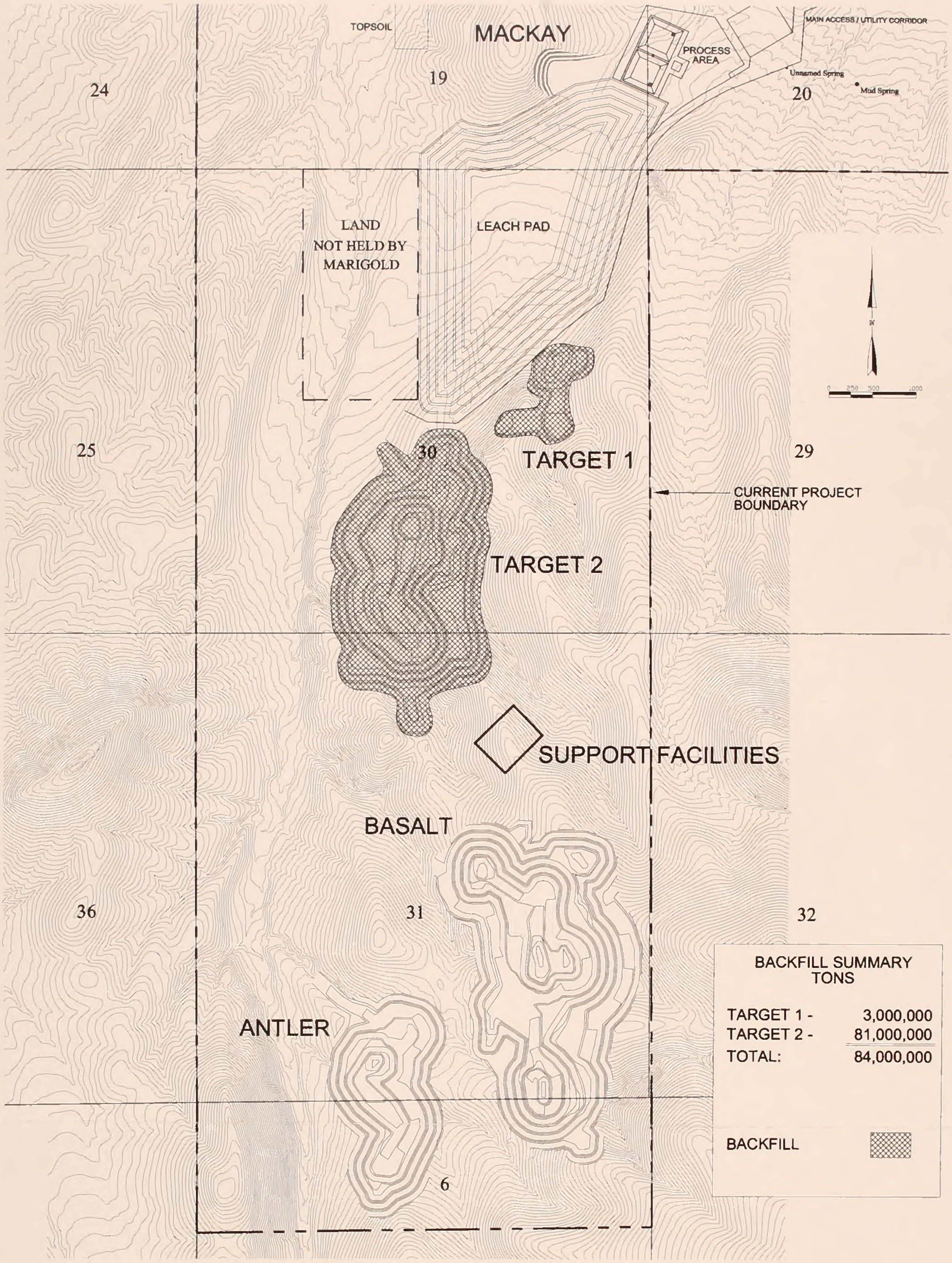
DRAINAGE

DIVERSIONS

Millennium Expansion Project

Figure 2-5

Waste Rock Storage Areas



Millennium Expansion Project

Figure 2-6

Pit Backfilling Map

In response to this requirement, GMMC has submitted additional data to BLM in conjunction with the Millennium Expansion Project to demonstrate that the waste rock material from the expanded and proposed new pits would be suitable for use as backfill material. The additional data consists of waste rock characterization tests performed on a representative suite of waste rock material and infiltration modeling (See Section 3.3, Geochemistry and Water Resources).

As shown in Figure 2-4, the pit bottom elevations of both the Target No. 1 and Target No. 2 pits would be above the known groundwater level. The proposed bottom elevation of the Target No. 1 Pit at 5,300 amsl is approximately 486 feet above the estimated pre-dewatering groundwater elevation (4,784 feet amsl) as determined in a groundwater monitoring well. The proposed bottom elevation of the Target No. 2 Pit at 5,020 amsl would be at least 206 feet above the estimated pre-dewatering groundwater elevation. The monitoring well drilled in the vicinity of the Target No. 2 Pit was dry at 4,780 ft. amsl, the total depth of the well.

Waste rock mined to date at the Glamis Marigold Mine includes Valmy Formation quartzites and shales; the Antler Sequence which is comprised of the Battle Formation siltstones, conglomerates, and breccias, the Antler Peak limestone, and the Edna Mountain Formation siltstones, conglomerates, and breccias; and the Havallah Formation quartzites and cherts (see BLM 2001, Sections 3.1.1 and 3.2). GMMC has performed waste rock characterization tests on the mined waste rock to comply with BLM and Nevada state permit requirements. As described in the FEIS (see BLM 2001, page iii and Sections 3.1.1.1 and 3.1.2.1), the paste pH and ABA tests performed on the Glamis Marigold Mine waste rock indicate this material is not acid generating. The data presented in the FEIS (Appendix B, Table B-2) indicate that the ratio of Acid Neutralizing to Acid Generating material is variable, but generally satisfies BLM's 3:1 criterion for classifying the waste rock as non-acid generating. Additionally, as discussed in Section 3.1.1.1 and Appendix B of the EIS, the pyrite content of the Glamis Marigold Mine waste rock is typically less than 0.5 percent, indicating very low potential to generate acid.

The waste rock generated from the new pits would be comprised of the same suite of rocks, which has been mined to date at the Glamis Marigold Mine. The majority of the waste rock would include the Valmy, Havallah, and Antler formations. Given the waste rock characterization results obtained to date from these lithologies, it is anticipated that the Millennium Expansion Project waste rock material would be similarly non-acid generating. The waste rock characterization baseline for these units in the expanded pits and proposed new pits is provided and discussed in Section 3.3. GMMC conducts regular waste rock monitoring in accordance with the approved *Glamis Marigold Mine Waste Rock Management Plan*. If, during mining of the new pits, the waste monitoring program identifies waste rocks that have the potential to be acid generating, these rocks would not be used as pit backfill and would be managed in accordance with the Glamis Marigold Mine Sulfide Waste Management Plan that BLM approved on May 19, 2000.

GMMC has performed an infiltration study for the heap leach pads, pit backfill, waste rock facilities, and tailings cover materials. These studies consist of infiltration modeling of on-site materials and empirical infiltration data obtained from existing waste rock storage areas, pit walls immediately down gradient from waste rock storage areas, and leached heaps. Information from the waste characterization tests and the infiltration study would be used to identify waste rock and growth media material types that are suitable for use as backfill material and for the ET cover for the existing Marigold, authorized 5-North, and proposed Section 30 and Section 16 heap leach pads.

2.2.4 Heap Leach Facilities

2.2.4.1 Heap Leach Design and Construction

All of the ore extracted under the Proposed Action is anticipated to be processed as run-of-mine heap leach ore at the existing heap leach facility and the proposed heap leach facilities. None of the ore would be crushed or processed through the existing mill. However, if higher-grade ore is unexpectedly encountered during mining, and processing the higher grade ore through the mill would be advantageous, then as part of the Proposed Action, GMMC would mill that portion of the Millennium Expansion Project ore. The existing mill, and authorized, but as yet not constructed tailings disposal facility, would have ample capacities for this purpose.

The 81 million tons of ore from the Proposed Action would require developing two new heap leach facilities and expansion of the existing heap leach facilities (Figure 2-2). The source of the ore to be processed at each heap leach pad, as well as the size, land status, capacity, and height of the heap leach pads, are identified in Table 2-4.

The expanded heap leach pad (Section 17 Heap Leach Pad [Cell 12]) would be constructed on the gently sloping area in the northeastern portion of Section 17. The Section 17 Heap Leach Pad would disturb 78 acres of private land. Ore would be stacked in lifts to a maximum heap height of 300 feet, providing a 23-million ton capacity. The pad would be constructed with a conventional composite liner system consisting of either a 60-mil high density polyethylene (HDPE) geomembrane overlying a compacted 12-inch layer of low permeability (1×10^{-6} cm/sec) soil liner, or a 60-mil HDPE geomembrane overlying a synthetic clay liner. Other geomembranes may be used as approved by NDEP-BMRR. A protective layer of gravel drain rock would be placed on top of the HDPE liner to facilitate drainage and to provide cushioning to protect the liner during ore stacking. The liners would be extended beyond the pad area to allow for final reclaimed slopes of 3H:1V. All construction design and installation would be consistent with NDEP-BMRR requirements as specified in the Water Pollution Control Permit. A field quality control program would be implemented during construction that includes membrane seam testing and seam welding equipment inspection.

The Section 17 Heap Leach Pad would be connected to the existing secondary pregnant solution pond system. The solution conveyance channel would be lined with a synthetic liner (60-mil HDPE) and would provide secondary containment for process piping from the Section 17 Heap Leach Pad. This channel would account for an additional two acres of disturbance. The pregnant, barren, and storm water pond system would be expanded onto existing disturbance to accommodate the Section 17 Heap Leach Pad. The expanded pond system would have a cumulative capacity of approximately 18 million gallons, while maintaining a two-foot freeboard.

Solution from the Section 17 Heap Leach Pad would be processed in the existing ADR plant.

The proposed new heap leach facilities consist of heap leach pads, solution ponds (pregnant, barren, fresh water, and storm water ponds), an ADR facility, and lime silo. The two proposed heap leach pads would be constructed using an approved design as described for the Section 17 Heap Leach Pad. The heap leach piles would be developed with run-of-mine ore stacked in 30- to 50-foot lifts. Each lift would be placed at the natural angle of repose. The top of each lift would be cross-ripped to a depth of four feet, and solution distribution lines would be placed on the prepared surface.

The Section 30 Heap Leach would be built on the gently sloping area in Sections 19 and 30 as shown in Figure 2-7. This facility would cover 125 acres of public land and 30 acres of private land. Ore would be stacked on this pad in successive lifts to a height of 300 feet. At this heap height, the capacity of the Section 30 Heap Leach Pad would be approximately 51 million tons. This heap leach pad would be constructed in phases starting in 2003, or as soon as all project permits and approvals are acquired. Phased construction would allow operation of the heap leach pad concurrent with mining the Mackay Pit (Figure 2-3). The west side of the pad would be constructed at a 2H:1V slope, but sufficient space would be left between the constructed pad toe and the permit boundary to create a final reclaimed slope of 3H:1V. The area between the Section 30 Heap Leach Pad and the private land west of the facility would be used as an access road during the project life. The heap leach pad would be extended over the

Table 2-4: Millennium Expansion Heap Leach and Plant Processing Facilities

Processing Facility	New Surface Disturbance (acres)		Capacity Pads (tons)/ Ponds (gallons)	Maximum Heap Height (ft)	Ore Source
	Public	Private			
Existing Marigold Heap	0	0	7 million tons	300	Terry Zone Pit
Section 17 Facilities					
Pad	78	0	23 million tons		
Ponds (process and storm water)	0	0	18 million gallons	300	All pits
Columns, reagent storage, and in fill disturbance)	0	0	6,000 gallons/minute		
Conveyance channel	0	2			
Section 30 Facilities					
Pad	125	30	51 million tons		
Ponds (process and storm water)	14	2	36 million gallons	300	All pits
ADR, lime silo, fresh water pond, and infill disturbance	24	0	6,000 gallons/minute		
Section 16 Facilities					
Pad	76	0	23 million tons		
Ponds (process and storm water)	3	0	18 million gallons	300	All pits
Columns, reagent storage, and infill disturbance	1	0	6,000 gallons/minute		
Total New Surface Disturbance (acres)	321	34			

Notes: The February 2002 Minor Modification authorized increasing the height of cell numbers 3, 4, 5, 6, 9, 10, and 11 at the Marigold Heap Leach Facility from 160 feet to 300 feet, and reconfiguring the layout of Cell No. 11 (the Southwest Pad) to cover an additional 12 acres of private land. Some of the increased heap capacity derived from these changes will be used for the seven million tons of ore mined from the Terry Zone Pit.

The acres shown for the infill disturbance include the Millennium Expansion fresh water storage pond.

road prior to final reclamation grading of the Section 30 Heap Leach Pad.

The Section 16 Heap Leach Facility would be built on a gently sloping area in the southwestern portion of Section 16. The heap leach pad would cover 76 acres of public land (Figure 2-7). Ore would be stacked in successive lifts to a maximum heap height of 300 feet. At this heap height, the Section 16 Heap Leach Pad would have a capacity of 23 million tons. This facility is not scheduled for construction until near the end of mining.

Leak detection/collection systems for heap leach pads would be installed subject to NDEP and BLM concurrence. The leak detection systems would be designed to provide detection, containment and collection of leaks through the primary liner. The leak detection/collection systems would be based on NDEP-BMRR regulations and BLM Nevada Cyanide Management Plan.

2.2.4.2 Solution Ponds/ Collection System

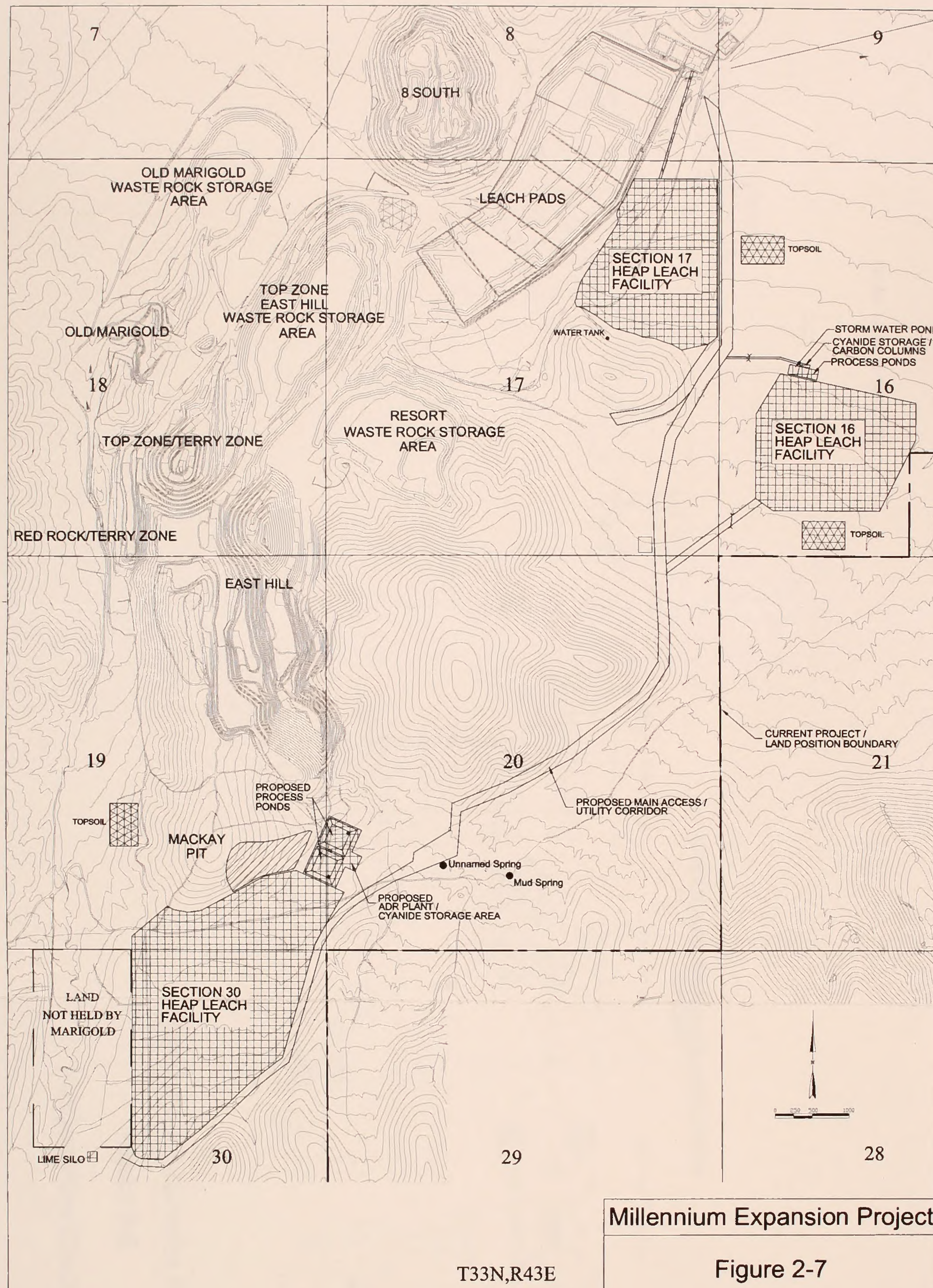
Sodium cyanide solution would be applied to the stacked ore via a spray or drip irrigation system. Leaching would be concurrent with stacking as only a portion of each pad would be under leach at any time. The total solution flow rate would be approximately 6,000 gpm. The sodium cyanide solution would percolate through the ore to the leachate collection system, and gravity feed to a collection ditch. The collection ditch would be lined with a synthetic liner placed over a compacted clay base that would have a hydraulic conductivity of 1×10^{-6} cm/sec or lower. Flow reporting to the collection ditches would be directed, via HDPE pipes, to the pregnant solution ponds (Figure 2-8).

The process ponds at both proposed heap leach facilities would be constructed with a primary 60-mil HDPE liner over a secondary 60-mil HDPE liner above a compacted clay base. The ponds would be designed to hold the working volume of solution while maintaining a two-foot freeboard following a 100-year, 24-hour storm event. As a result, the Section 30 pregnant, barren, and storm water ponds would have a cumulative capacity of 36 million gallons. The Section 16 pregnant, barren, and storm water ponds would have a cumulative capacity of approximately 18 million gallons. These ponds would be covered with one-inch mesh bird exclusion netting, attached to cables and to tie-downs off the edge of the liner. In addition, fencing that meets NDOW requirements would be installed around the solution ponds, solution channels, and solution overflow ponds to prevent access by wildlife and livestock (see Section 2.2.16). The Section 30 pregnant and barren ponds would each cover eight acres. The storm water pond would be included in the free board of the process ponds. Two acres of private land and 14 acres of public land would be associated with the process/storm water ponds. The fresh water pond is included in the infill disturbance, all on public land. The Section 16 ponds would be smaller in size with a combined area of three acres, all on public land.

Pregnant solutions would be pumped to carbon columns where gold would be adsorbed onto the carbon (see Section 2.2.4.4, ADR Facilities). The solution would then gravity feed to the barren pond for reagent concentration adjustment and subsequent reuse in the heap leach process.

2.2.4.3 Solution Pond Leak Detection/Collection System

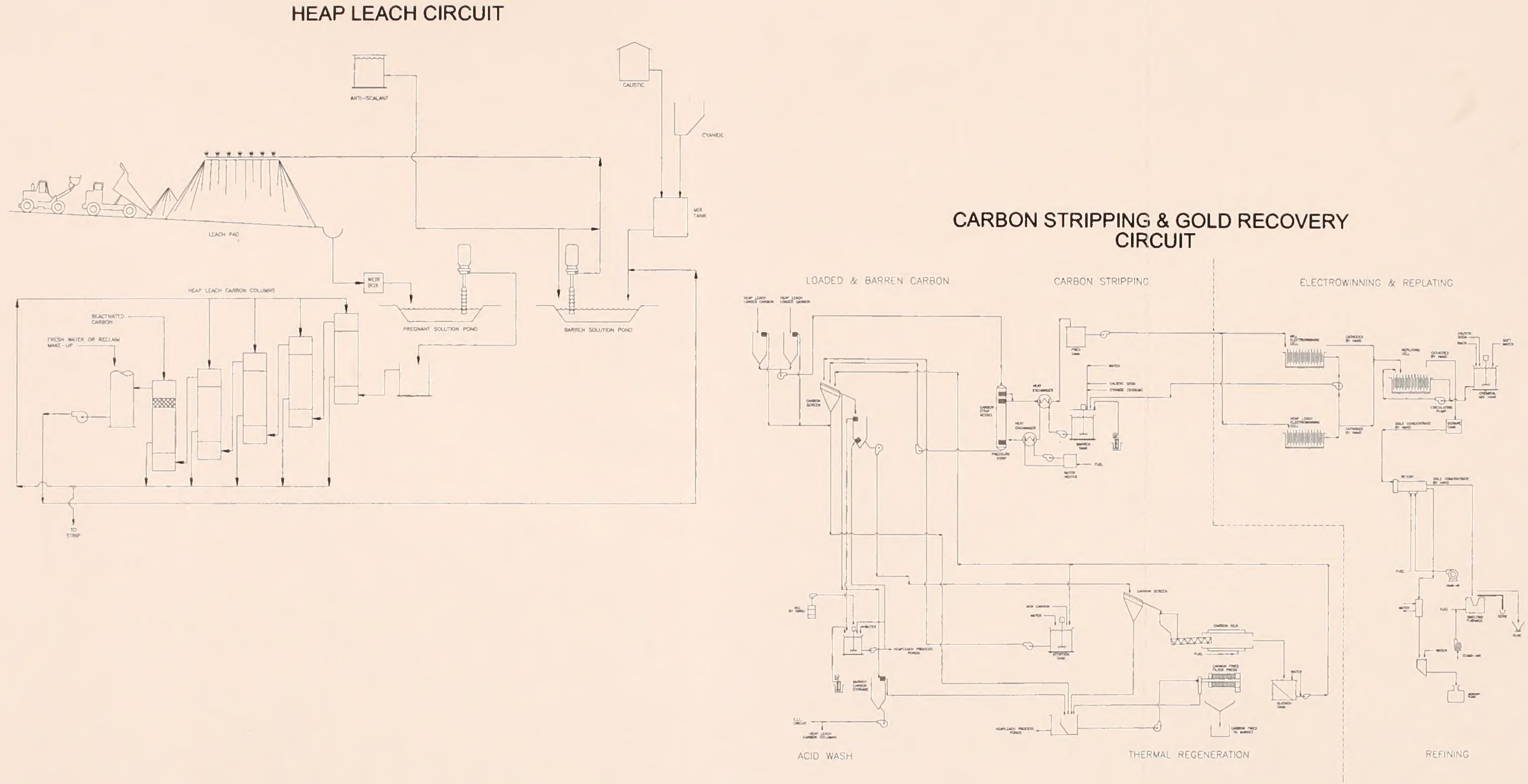
Leak detection/collection systems would be installed between the HDPE liner and compacted clay base in the collection ditches and the pregnant and barren solution ponds. The leak detection systems would be designed to provide detection, containment, and collection of leaks through the primary liner. The leak detection/collection systems would be based on NDEP-BMRR regulations and BLM Nevada Cyanide Management Plan.



Millennium Expansion Project

Figure 2-7

Process Areas



Millennium Expansion Project

Figure 2-8

Process Flow Circuits

2.2.4.4 Adsorption-Desorption Recovery (ADR) Facilities

Both heap leach facilities would include processing facilities. The Section 30 Heap Leach Facility would include an ADR facility and lime silo, plus associated infill disturbance for a total of 24 acres on public land. The proposed ADR plant would be constructed on a concrete pad with curbs for containment of spills. The pad and curbs would provide capacity for 110 percent of the largest vessel, as per NDEP-BMRR regulations. The concrete pad beneath the ADR facility would drain to and be integral with the process pond system. The process ponds would provide containment for the ADR facility. The ADR facility would consist of carbon columns with a capacity of 6,000 gpm, an acid wash plant, a carbon regeneration kiln, an electrowinning circuit, a retort, a refinery, an assay lab, reagent storage facilities, an office, and enclosures. Reagents would be stored in an approved manner on the concrete pad within the ADR facility containment system. A 200-ton lime silo would be installed southwest of the Section 30 Heap Leach Pad. Lime from the silo would be added to the trucks carrying ore enroute to the leach pads.

The Section 16 Heap Leach Facility would have a truncated ADR facility consisting of carbon columns and reagent storage facilities placed within a concrete pad built with curbs that would meet or exceeded the NDEP-BMRR regulation of 110 percent capacity of the largest vessel for containment of spills. The concrete pad beneath the plant facility would drain to and be integral with the process pond system, providing containment for the ADR facility. Loaded carbon from the Section 16 Heap Leach Facility would be taken to the Section 30 ADR or the existing Marigold ADR facilities for further processing. Reagents needed for the Section 16 Heap Leach Facility would be stored in an approved manner on the concrete pad within the curbed containment area.

Gold-bearing pregnant solutions from the proposed heap leach pads would be pumped to the ADR system where the gold would be adsorbed onto the carbon (Figure 2-8).

Once the loaded carbon is transferred to the stripping section of the ADR facility, a hot alkaline solution would be used to strip the precious metals from the loaded carbon. The temperature of the alkaline solution would be approximately 285 degrees Fahrenheit (°F), with a pH of 13 or greater. The solution containing the precious metals would be passed through an electrowinning circuit where the metals would be electroplated. The resultant gold-bearing material would be processed in the mercury retort, then taken to the crucible furnace, mixed with a flux, and smelted. The stripped carbon would be cleaned by acid washing and then reactivated by heating and quenching in a rotary kiln. The crucible furnace, mercury retort, and rotary kiln would be operated in accordance with air quality operating permit No. AP1041-0158. Barren solution would gravity drain to the barren pond for reagent buffering and re-use in the heap leach circuit.

2.2.4.5 Heap Leach Closure

GMMC is proposing to stabilize all the heap leach pads by constructing an ET cover system over the spent heaps. This represents a modification of the currently approved closure and reclamation measures for the Marigold (existing and proposed expanded) and 5-North Heap Leach Facilities, and a new proposal for the Section 30 and Section 16 Heap Leach Facilities.

The construction of an ET cover system would stabilize the heap leach pads to prevent drain down solutions from having potential to degrade waters of the State, as defined in the NAC 445A.430. The details of the closure are provided in the Reclamation Section, 2.2.17.7

2.2.5 Roads

Approximately 52 acres of disturbance (27 acres of public land and 25 acres of private land) would be associated with access and haul roads. Figure 2-2 shows the location of the proposed access and haul roads needed for the Proposed Action. Dust control measures for all road surfaces would include direct water application and the use of chemical binders or wetting agents.

Existing public access would remain to areas outside of the Glamis Marigold Mine and of the proposed Millennium Expansion Project operations boundary. No relocation of public access roads is necessary under the Proposed Action.

2.2.5.1 Access Roads

A mine access road and utility corridor would be constructed from the existing office complex area to the Millennium Expansion Project Area. Access roads would generally be two-way thoroughfares with adequate size to safely accommodate mine traffic utilizing optimum widths based on the largest anticipated vehicle size. The access roads would consist of recompacted native materials exposed during clearing and grubbing operations. In-situ native materials, which are not suitable for the intended sustained design traffic, would be augmented with suitable on-site native materials to enhance road-bed performance. When practical during clearing and grubbing operations, growth media would be stockpiled for future reclamation purposes.

Access roads would be graded to promote positive drainage off of the rolling surfaces to adjacent side ditches for storm water removal. Steeper grades would include appropriate Best Management Practices (BMPs) to limit erosion and sediment transport. The BMPs may include, but would not be limited to, breaks in the berms to direct storm water to sediment ponds or creation of sediment barriers.

2.2.5.2 Haul Roads

Haul roads would be constructed from the Terry Zone Pit and the Antler and Basalt pits to the Section 30 Heap Leach Facility and the new shop area. Haul roads from the proposed new pits to the Section 30 Heap Leach Facility, new truck shop, and waste rock storage areas would be constructed in concert with the construction of the waste rock storage areas and would not require additional disturbance (i.e., the disturbance is included in the waste rock storage area disturbance).

Haul roads would be constructed in conformance with Mine Safety and Health Administration (MSHA) regulations. Traffic control signs (i.e., stop, yield speed limit, etc.) would be posted for all haul roads. In general, haul roads would be sized to safely accommodate two-way haul truck traffic, utilizing optimum widths based on the largest anticipated vehicle at the site. Haul roads would be crowned to allow drainage of water off the travel surface. Roads would be graveled, with limited cut-and-fill in steep terrain. Culverts would be installed under the haul roads at required locations. The roads would be continually maintained to ensure safety and efficiency and to minimize dust emissions. Surface compaction and binding agents would be used on roadways.

2.2.6 New Support Facilities

New support facilities consisting of a truck shop, large equipment wash bay and adjacent sump, offices, fuel and oil storage and dispensing areas, warehouse, septic system, propane tank, equipment parking area, communications system, and fresh water and fire water storage and supply distribution facilities, would be constructed in Section 31. The new support facilities would cover seven acres of public land. The buildings would be constructed on a concrete base. The fuel and oil storage and dispensing facilities would be constructed on a liner within a bermed area with sufficient capacity to contain 110 percent of the capacity of the largest tank. All of the fuel storage vessels would be above ground tanks.

2.2.7 Growth Media Stockpile Areas

Prior to construction of the proposed new and expanded facilities, growth media would be removed and stockpiled in existing or new stockpiles for subsequent use in reclamation. To accommodate the anticipated volume of growth media that would be salvaged, two new growth media stockpiles would be developed in Sections 19 and 16 (Figure 2-2). The stockpiles would cover approximately five acres. The soil stockpiles are sufficiently sized to handle the topsoil that would be stockpiled. In addition, the berm created around each of the waste rock facilities and heap leach pads would be created with growth media salvaged prior to construction of these facilities and would be available for reclamation.

Interim stabilization measures would be implemented to protect the new and existing stockpiles from wind and water erosion, and from invasion by invasive and noxious weeds. The interim measures would consist of seeding with perennial grass species, and shaping the facilities to slopes of less than 2.5H:1V to reduce erosion. On-site trials using different seed species may be conducted on portions of the stockpiles to determine the most effective species for stabilization.

2.2.8 Storm Water Control

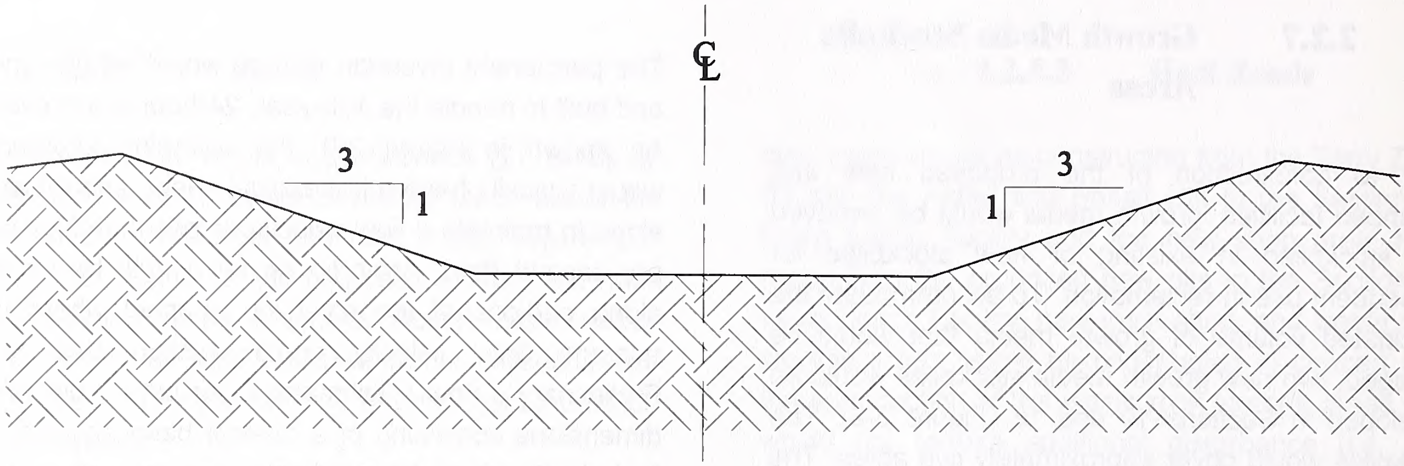
The Proposed Action would require new storm water control structures to protect project structures from inundation by storm flows, prevent surface runoff from entering pit areas, and to prevent degradation of waters of the state from increased sedimentation. Storm water surface flows would be routed away from the Project Area by installation of new diversion (temporary and permanent) ditches and culverts, and sedimentation would be reduced by installation of sediment traps or sediment settling ponds. These features would be constructed based on operational needs and in accordance with GMMC's General Storm Water Discharge Permit (Permit NVR 300000) and would conform to established BMPs. Figure 2-5 shows the location of the planned storm water diversions. The surface disturbance associated with constructing these structures is accounted for in the disturbance acreage shown for each facility.

The permanent diversion ditches would be designed and built to handle the 100-year, 24-hour storm event. As shown in Figure 2-9, the diversion structures would typically have a trapezoidal shape and minimal slope to maintain a flow velocity of less than four feet per second (fps). Armored rip rap would be placed along portions of the diversion channel where the average flow velocity could exceed this rate. Preliminary flow estimates indicate diversion dimensions consisting of a six-foot base and a four-foot depth would be adequate in most cases. The side slopes would be constructed with 3H:1V slopes. The surface disturbance width created by constructing the diversion ditches is estimated conservatively to be 45 feet to provide ample room for disturbance created during equipment access. These diversion dimensions would be modified as necessary to fit site topography and hydraulic conditions in order to accommodate the flow from the 100-year, 24-hour design storm event. The surface disturbance associated with the storm water control measures is included in the disturbance acreage for each facility, rather than as a separate disturbance category.

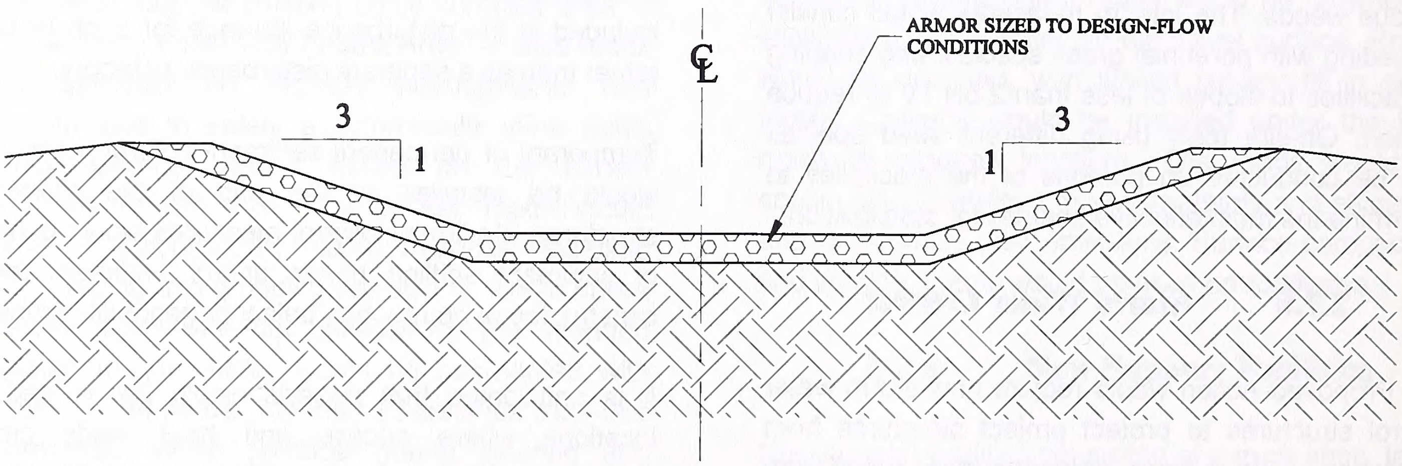
Temporary or permanent sediment control measures would be installed at the end of the diversion structures. Sediment control measures would consist of sediment settling ponds and/or sediment traps constructed of rip rap, hay bales, or geotextile fences.

It is anticipated that culverts would be needed at locations where access and haul roads cross drainages. The culverts would be sized using appropriate Hydrologic Engineering Center 1 methodology and as dictated by site-specific construction conditions. As presently planned, culverts would range in size from 24 to 42 inches in diameter. Multiple culverts may be required at some drainage crossings to provide a measure of redundancy to ensure proper flood flow control.

Storm water would be monitored in accordance with state requirements for storm water pollution prevention that would be effected as a result of permitting activities under the Nevada Storm Water General Discharge Permit NVR 300000. These permitting activities would be an ongoing part of the project, and permit approval would be obtained prior



TYPICAL EARTHEN CHANNEL
VELOCITY < 4 FT/S
(Dimensions to accommodate the design flow plus freeboard)



TYPICAL REINFORCED CHANNEL
VELOCITY > 4 FT/S
(Dimensions to accommodate the design flow plus freeboard)

Not to scale

Millennium Expansion Project

Figure 2-9

Storm Water Diversion Structures

to beginning operations. A storm water monitoring plan would be developed as a part of related permit applications and submittals to the state. General monitoring schedules that may be specified include quarterly or monthly monitoring in addition to monitoring after major storm or snowmelt events. Additional monitoring and control technologies may be further specified as part of Water Pollution Control permitting activities with the state.

Runoff from the waste rock storage areas, due to extreme meteoric events, would generally be directed via berms constructed around the storage areas to diversion ditches and eventually to the storm water sediment basins.

Storm water that contacts solutions containing cyanide would be managed as process solutions. Design criteria for storm water management are addressed in the facility design. Storm water that collects in the storm water storage pond located adjacent to the existing solution ponds would be utilized for make-up process water.

Access roads would be graded to promote positive drainage to adjacent side ditches for storm water removal. BMPs would be used to limit erosion and sediment transport on steeper grades. None of the proposed access roads would cross any perennial or intermittent streams. Culverts would be installed for crossing significant drainage swales, and low water crossings would be utilized on minor topographic rills and gullies. Sediment basins would be constructed as necessary to control sediments from storm water runoff.

2.2.9 Water Supply

The existing, authorized water supply system, including three existing water wells and water provided from dewatering operations at the nearby Newmont Mining Corporation's Lone Tree Mine, would be used for the Proposed Action. GMMC has the necessary water rights for these water supply wells from the State Engineer, Nevada Division of Water Resources.

Expanded fresh water storage capacity would be required to meet the expansion needs of the Proposed Action. The existing fresh water storage tank would be connected by pipeline to a fresh water storage pond and then to storage tanks placed on existing disturbance in a pit, infill area or waste rock storage area. The fresh water storage pond would be constructed at the Section 30 Heap Leach Facility. A pumping booster station would be constructed in an area of existing disturbance at the existing water tank. Water would be distributed from the water tank via a buried pipeline that would be located in the utility corridor. A total of 21 acres (11 acres of public land and ten acres of private land) would be disturbed to accommodate the new water supply system. The disturbance acreage associated with the fresh water storage pond is included in the infill disturbance area.

The use of recycled water from the heap leach facilities would continue in order to minimize the amount of fresh water needed for the operation. The interconnect to the supply system serving Lone Tree's Trenton Canyon facility can supply approximately 90 to 95 percent of the processing water requirements, up to an additional 1,000 gpm; however, the amount may be less than 60 percent of the processing requirement, depending on availability. The well system is capable of providing approximately 600 gpm. The existing fresh water supply systems and the continued use of recycled water would supply sufficient water for the existing and proposed operations.

2.2.10 Electric Power

Power needs for the proposed new facilities in Sections 16, 19, 20, and 30 would be supplied by extending the existing power line from the Glamis Marigold Mine facilities to the expansion areas. The new system would consist of a surface power line, up to two stationary substations, and one mobile substation. A portion of the power system would be confined to the proposed utility corridor associated with the access road that would extend from the existing facilities in Section 8 to the new ADR plant in Section 20 with a branch extending to the Section 16 ADR plant. The power line would then leave the utility corridor and extend along the eastern project boundary from the ADR plant area to the Section 31 shop/warehouse/office complex and mining areas show on Figure 2-2. Appropriate substations would be connected to this power line to maintain power at the currently approved processing area, shop/office/warehouse complex and mine facilities, while extending power to the proposed facilities. The disturbance acreage associated with the power system expansion is included in the utility corridor and access roads described in Section 2.2.4.

2.2.11 "Infill" Areas

The Proposed Action includes 114 acres of surface disturbance (51 acres of public land and 63 acres of private land) as "infill" surface disturbance. The infill areas are small areas adjacent to and in between project facilities as shown in Figure 2-2. Although not identified for any specific purpose, these areas may be used for access or may be disturbed during construction of project components. These areas may also be used for temporary laydown yards for storage of extra pipe, culverts, and other non-hazardous materials. Inclusion of these infill areas in the project surface disturbance calculations is a conservative measure to ensure that all land near active project components that could be affected by project operations is reflected in the surface disturbance totals.

2.2.12 Security and Fencing

Security in the Project Area would be the responsibility of GMMC. The security system would include direct security measures, supported by employees involved in the day-to-day operation. Persons entering and leaving the area would be required to gain clearance through a gate located near the entrance to the mine site. A four-strand barbed wire fence exists around the current disturbance footprint. Additional chain link fencing and electronic gates prevent unauthorized access to the mill area, administration building, and shop facilities. The current permit boundary would be partially enclosed with a BLM-approved range control fence, consisting of three strands of barbed wire and a fourth bottom strand of smooth wire (Figure 2-5). Fencing that meets both BLM and NDOW requirements would be installed around facilities such as ADR plant, solution ponds, open solution channels, and storm water ponds to prevent access by wildlife and livestock; this fencing currently surrounds existing process ponds and channels. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences or controls would be installed as necessary.

2.2.13 Fire Protection

GMMC has a Fire Protection and Suppression Plan within the Emergency Response Plan, to comply with MSHA requirements. The Fire Protection and Suppression Plan outlines appropriate fire fighting, evacuation, and notification procedures to be used in the event of a fire. Fire extinguishers are located throughout all work areas and on all mobile equipment. Mobile equipment also has spark arrestors. Dry chemical or carbon dioxide (CO_2) extinguishers are located in areas in which an electrical fire may occur.

GMMC employees are provided with appropriate instruction in the use and location of the fire extinguishers, the site evacuation plan, and the emergency notification protocol in the event of a fire. If a fire extinguisher is used, the used fire extinguisher must be turned in to the supervisor for replacement. In compliance with MSHA fire extinguisher inspection and maintenance requirements, the fire extinguishers are inspected monthly and serviced annually. Smoking, building fires, or using open-flame appliances in posted areas or locations where gasoline, chemicals, or similar flammable substances are stored or handled is prohibited.

Supervisors are responsible for notifying fire-fighting agencies in the event there is a fire that cannot be extinguished using on-site personnel and equipment. Supervisors would take appropriate measures to shut off propane and electrical supply lines in areas affected by the fire. GMMC personnel would guide fire-fighting personnel to the fire scene and would cooperate fully with fire department officials. After the fire has been extinguished, the supervisor would remain at the scene and complete a thorough report of the event and the damage caused by the fire.

BLM and GMMC have a Mutual Aid Agreement for fire suppression. Range fires detected within the project vicinity would be reported to GMMC's Safety Supervisor. The Safety Supervisor would report the range fire to the BLM and adjacent landowners. Support equipment available to fight range fires includes one water truck with hose, a fire trailer equipped with two 100-pound extinguishers, hoses, nozzles, and fittings. In addition, fire suppression systems are installed on haul trucks, loaders, drills, and dozers to extinguish equipment fires.

2.2.14 Exploration Drilling Pads, Access Roads, and Sumps

Exploration drilling activities would continue under the Proposed Action. The objectives of the drilling program would be to identify new ore reserves and to provide support data for short- and long-term mine planning. Drilling would be conducted within the proposed permit boundary. Exploration activities conducted outside of the proposed permit boundary would be performed under an exploration notice.

Drill pads and sumps, when used, would typically be 40 feet wide by 40 feet long. Access roads to the drill pad sites would be approximately 20 feet wide with an operating width of 12 feet. Existing roads would be used, where possible, to minimize new disturbance. New roads would only be constructed when existing roads or overland travel would not provide safe, efficient access. Track drills are used whenever possible to reduce the need to construct drilling facilities.

In steep terrain, growth media from drill pads and roads would be stripped and stockpiled for use during reclamation activities. Each drill pad would be constructed with two mud pits; one would be used for settling of the drill cuttings, and the second would be used for settling of the mud solids. A berm would be constructed on the downhill side of each drill pad to provide containment and prevent runoff from the drill pad area. Track drills would be used to limit surface disturbance. Exploration activities would take place primarily in previously mined pits to take advantage of the lower elevation from which to drill, or would occur on areas proposed for waste rock disposal.

2.2.15 Hazardous Materials and Wastes

2.2.15.1 Reagent Transport and Storage

No changes to the types of chemicals utilized would occur under the Proposed Action. However, the quantities used and stored on site would change for some chemicals. All process chemicals and petroleum products would continue to be handled and disposed of in accordance with applicable Nevada and MSHA laws and regulations. The list of reagents and fuels used and stored at the mine site are provided in Table 2-5. The hazardous materials utilized at the mine are handled pursuant to manufacturers' Material Safety Data Sheets (MSDS) and applicable regulations. Transportation and handling of chemicals are conducted by licensed carriers and properly trained workers. All vehicles and containers display the appropriate placards. All chemicals would continue to be transported to the mine by licensed commercial carriers on public roadways in accordance with applicable regulations. Routes used to transport chemicals include I-80 and the Buffalo Valley Road.

Chemicals would be stored in an approved manner on the concrete pads, within the plant containment systems. Petroleum fuels would be stored at the new support facilities area in Section 31 (see Section 2.2.6) in aboveground tanks and surrounded with a containment structure to accommodate at least 110 percent of the volume of the largest tank within the containment area. The tanks would be located in compacted clay basins with a clay berm covered by waste rock.

Chemicals used in the ADR plant are stored nearby in concrete-lined basins with concrete side walls and capacity for 110 percent of the largest vessel.

Table 2-5: Millennium Expansion Reagent and Fuel Storage Information

Reagent of Fuel	Existing Amounts On-Site	Proposed Amount to be Stored On-Site	Total Amount to be Stored On-Site
Sodium Cyanide	40,000	80,000	120,000 gallons
Muriatic (Hydrochloric) Acid	3,000	No increase	3,000 pounds
Sodium Hydroxide	30,000	40,000	70,000 gallons
Antiscalant	2,000	3,000	5,000 gallons
Lime	75,000	400,000	475,000 pounds
Activated Carbon	20,000	No Change	20,000 pounds
ANFO	100,000	200,000	300,000 pounds
Diesel	40,000	60,000	100,000 gallons
Gasoline	10,000	10,000	20,000 gallons

GMMC has been issued a Hazardous Materials Permit by the State Fire Marshal Division, Hazardous Materials Section. The issuance of this permit is contingent on GMMC meeting the state standards for hazardous material storage and containment. If required, additional spill containment facilities would be installed to reduce the probability of a significant release.

2.2.15.2 Spill Prevention and Emergency Response

A Hazardous Material Spill and Emergency Response Plan has been prepared for the existing mine facilities in accordance with the State of Nevada regulations governing the design, construction, operation, and closure of mining operations (NAC 445A.242 through 445A.243).

The type of chemicals and petroleum products utilized by and consumed at the Glamis Marigold Mine are not expected to change as a result of the Proposed Action (Table 2-5). Of the chemicals stored and utilized on-site, sodium cyanide, muriatic acid (hydrochloric acid), and sodium hydroxide are hazardous substances that are listed in 40 CFR 302.4 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (including The Emergency Planning and Community Right-to-Know Act); and the hazardous substances appendices of the Superfund Amendments and Reauthorization Act (SARA). CERCLA provides a framework for Federal response to the release of hazardous substances. For purposes of emergency response planning under SARA, Title III, a threshold planning quantity and reportable quantity are established for each hazardous substance. In conformance with these regulations, GMMC has developed and implemented an Emergency Response Plan (ERP) for the Glamis Marigold Mine. The ERP would be amended to include the Millennium Expansion Project. These plans provide for the tracking and required reporting of hazardous substances used on-site as well as provide a system for prevention, discovery, notification, and safe cleanup of all spills or discharges that may impact the environment.

Materials that are classified as hazardous for transportation purposes are regulated by the U.S. Department of Transportation (USDOT) per 49 CFR 172.101. The USDOT hazardous materials list includes hazardous substances regulated under CERCLA, as well as other types of chemicals. In addition to the hazardous substances described above, transportation of ammonium nitrate, Class A explosives, diesel fuel, cement, and calcium oxide (lime) must comply with USDOT hazardous materials packaging and labeling requirements. All chemicals would continue to be stored and handled in accordance with the manufacturer's recommendations and state regulations. The MSDSs for all chemicals used at the mine site would continue to be kept at locations accessible to employees.

2.2.15.3 Explosives Storage

Explosives would be stored in approved explosive storage facilities adjacent to the pits. Storage of these materials would comply with the Bureau of Alcohol, Tobacco, and Firearms (BATF) permit and regulations.

2.2.15.4 Waste Management

Non-hazardous solid waste generated at the Glamis Marigold Mine would continue to be disposed of in the approved waivered-Class III landfill located on private lands in accordance with state and federal regulations. No hazardous wastes, liquid wastes, or petroleum products would be disposed of at the site. The landfill would continue to be inspected weekly to ensure that only non-hazardous solid waste is deposited in the landfill.

GMMC currently recycles all used oil, solvents, antifreeze, and batteries through licensed contractors. Hydrocarbon contaminated soils are currently managed within the NDEP-BMRR permitted bio-remediation facility. All domestic wastes would continue to be disposed of in the existing or new septic systems.

2.2.16 Environmental Protection Measures and Monitoring

Environmental protection measures and monitoring for the Proposed Action would include sediment control, waste rock monitoring, spill prevention, groundwater sampling and monitoring, stability monitoring of facilities, wildlife and livestock protection structures, dust control, cultural and paleontological resource protection, and an employee environmental education program.

2.2.16.1 Sediment Control

Sediment control would be provided by a combination of BMPs at each facility. The heap leach and chemical/petroleum storage areas would be contained within an exclusionary berm. The waste rock storage areas would have storm water containment berms and sediment basins to reduce runoff impacts to receiving waters. The waste rock storage areas would be reclaimed concurrently to reduce sediment loss. This would include ripping compacted surfaces and an application of growth media to increase permeability to the vegetation root zone. Temporary storm water diversions would be installed where appropriate and armored where flow velocities exceed approximately four fps, dependent on channel material. Permanent diversion structures would be designed to withstand flow from the 100-year, 24-hour event.

2.2.16.2 Waste Rock Characterization

Waste rock samples would be submitted as determined by the Water Pollution Control Permit requirements for analysis as required by the NDEP-BMRR. Waste rock analyses may include MWMP and ABA analysis, as outlined in the site's Water Pollution Control Permit. Analyses would be reported to the NDEP-BMRR and BLM. If the ABA tests exceed the NDEP-BMRR and BLM criteria and MWMP and/or pH analysis is below the state standards, then kinetic testing (humidity cell tests) may be performed.

To date, waste rock analyses have indicated low potential for acid generation due to the low sulfide content of the waste rock. If waste rock monitoring were to indicate the material had the potential to generate acid, that portion of the waste rock would be subject to a BLM-approved materials management plan (i.e., Sulfide Waste Management Plan). The plan provides for early identification of and blending and/or encapsulation of potential sulfide waste rock in oxide material at one of the out-of-pit waste rock storage areas. A minimum blending ratio of 3:1 acid-neutralizing to acid-generating material would be used. A minimum depth of 20 feet of oxide material would be used to encapsulate unblended potential sulfide material, and a minimum depth of 15 feet would be used to encapsulate blended material. These measures would reduce the potential for generation of acid rock drainage, thereby reducing the potential impact on surface and groundwater.

2.2.16.3 Spill Prevention Monitoring

Storm Water Discharge
The various storm water diversion and sediment control structures would be monitored by visual inspection to ensure the integrity of the berms. If necessary, precipitation accumulated within process component containment areas after major storm events would be removed by pumping, and disposed of in the heap leach processing facilities. Storm water diversion structures at the waste rock storage areas would be visually inspected after major storm events and during spring snowmelt to verify the integrity of the diversion structures and to remove accumulated debris that could impede water flow. These monitoring efforts comply with the requirements in the General Storm Water Permit (NVR 300000). Monitoring data would be reported to the NDEP Bureau of Water Pollution Control (BWPC) on an annual basis. Additional monitoring and control technologies would be further specified as part of state permitting activities (i.e., General Storm Water Permit), which includes applications and reviews for Storm Water General Discharge and Water Pollution Control permits as identified in Table 1-2.

Groundwater Monitoring
Groundwater monitoring would be conducted on a quarterly basis. Water quality samples would be collected from the existing monitoring wells and from new groundwater monitoring wells that may be developed in association with the new heap leach facilities. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP-BMRR and BLM on a quarterly basis.

Production Wells
Samples would continue to be collected from the fresh water production wells on an annual basis. The samples would be analyzed for the constituents specified in the site's Water Pollution Control Permit. Monitoring data would be submitted to the NDEP-BMRR and BLM on an annual basis.

Process Solutions
Monitoring of the heap leach facilities would include daily inspection to verify the liner containment system is functioning properly. Flow rates for the heap leach pad leak detection, and pregnant pond and barren pond leak detection sumps, would be monitored weekly. If fluid is present at the monitoring ports, then the sumps must be evacuated and monitoring must be conducted on a more frequent basis. The daily, weekly, and quarterly monitoring and sampling must be documented in the quarterly monitoring report submitted to NDEP-BMRR and BLM. Samples from the pregnant ponds, barren ponds, tailings solution, and tailings reclaim water must be collected and analyzed annually for the constituents specified in the Water Pollution Control Permit.

2.2.16.4 Stability of Facilities

Waste rock storage areas, dam structures, and heap leach facilities would be designed and constructed to ensure stability during construction, operation, and post-closure. Stability modeling results for the heap leach pads and dam structures would be included in applications for the NDEP, Division of Water Resources (NDWR) – Dam Safety Branch and NDEP-BMRR permits. These facilities would be monitored on a regular basis during operations to identify any visible stability problems.

2.2.16.5 Wildlife and Livestock Protection

To prevent access by wildlife and livestock, fencing that meets NDOW requirements would be installed around solution ponds, storm water ponds, and open conveyance solution channels. The proposed permit boundary would be partially enclosed with a BLM-approved range control fence. Any monitoring wells located outside the fenced area would be clearly marked and locked. Additional fences and controls would be installed as necessary.

Additional protection measures that have been incorporated into the operation for the protection of wildlife and livestock include: 1) installation of netting over open conveyance solution channels and ponds to prevent access by birds and bats, 2) proper management of the waivered-Class III landfill, 3) formalized procedures for verbal and written reporting of wildlife mortalities to the NDOW, and 4) monitoring and managing cyanide concentrations of the process solutions.

GMMC has committed to contracting with a qualified biologist to conduct breeding bird surveys within all suitable habitats prior to ground disturbance, if construction activities were to occur from March through July. This survey would identify either breeding adult birds (i.e., by territorial defense behavior) or nest sites within the areas to be disturbed. If active nests are present, GMMC would then coordinate with the BLM to develop appropriate protection measures for these sites, which may include avoidance, construction constraints, buffer establishment, etc. An option to conducting breeding bird surveys would be to avoid ground disturbance activities between March and July, allowing construction to proceed outside of the breeding season without clearance surveys.

2.2.16.6 Air Quality

GMMC has incorporated a number of measures into the existing operation to control the generation of PM_{10}. These measures would also be incorporated into the operation of the Proposed Action. To control fugitive dust, water or chemical stabilizers would be applied to haul and access roads within the Project Area. Speed restrictions would be enforced to further minimize particulate emissions from roadways. Concurrent reclamation during the life of the operation, as project components are completed, would reduce the acreage of disturbed lands, thereby reducing fugitive dust. Enclosures, baghouses, binder chemicals, and water sprays would be used as appropriate to control dust emissions from existing crushers, screens, crusher transfer points, and dry chemical transfer points (lime).

2.2.16.7 Cultural and Paleontological Resources

Protection measures have been incorporated into the existing operation to prevent and minimize potential impacts to cultural and paleontological resources within the Project Area. These measures, identified below, also would provide protection of resources during development and operation of the Proposed Action. GMMC has developed the Proposed Action with regard to the location of sites known to be eligible for inclusion on the National Register of Historic Places (NRHP). Avoidance of these sites has been incorporated into the PoO. However, to avoid inadvertent impacts to these sites, GMMC has proposed a Cultural Resource Protection Program for the Millennium Expansion Project.

- Employee and equipment access would be prohibited in known eligible cultural sites to prevent the potential for direct impacts to resources. Mine exploration and operations equipment would be limited outside of the proposed permit boundary, which would be clearly marked. Employee access to known archaeological and paleontological sites on private land in the vicinity of the mine would be prohibited;
- Establish a 30-meter "buffer zone" around the eligible site boundary by installing a two-strand smooth wire fence with signage "No Off Road Travel." The buffer zone would be established by a qualified, third party archaeologist approved by the BLM.
- Employee education programs for employees;
- Known site locations would be avoided by exploration activities;
- Secondary effects to eligible sites resulting from road and drill pad construction and use would be minimized through the implementation of erosion control measures

such as water bars, double sumps for drill water, and appropriate road design;

- If a previously undocumented archaeological site or subsurface components of documented sites are discovered during exploration, construction, operation, or reclamation activities, GMMC would cease activities in the area of the discovery until resources could be examined by a BLM-approved archeologist. If resources are identified as eligible for the National Register of Historic Places (NRHP), impacts would be mitigated through an appropriate treatment plan approved by the BLM, the State Historic Preservation Officer (SHPO), GMMC, and the Advisory Council, or through site avoidance; and
- If significant fossiliferous deposits, specifically vertebrate fossil deposits, are located during exploration, construction, operation, or reclamation activities, the BLM would be notified, and measures would be taken to identify and preserve or avoid the fossils.

2.2.16.8 Employee Environmental Education Program

GMMC currently provides environmental education for its employees. This training includes information on management practices incorporated into the operation of the facility to minimize impacts to the environment and ensure compliance with environmental permit criteria. This program would be continued throughout the operation of the Proposed Action. GMMC also is developing an operator's Environmental, Health, and Safety Compliance Handbook, in addition to maintaining detailed compliance schedules.

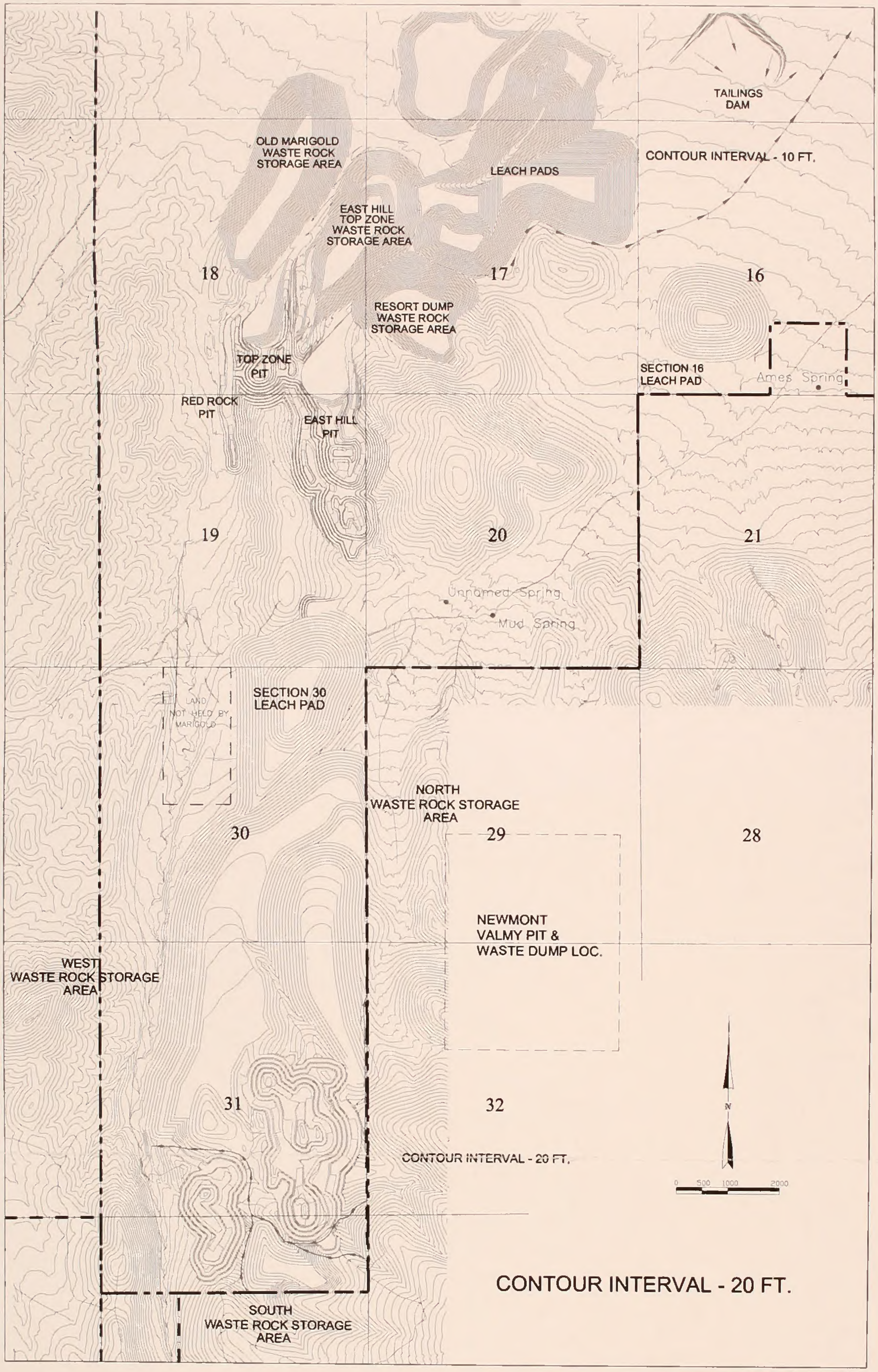
2.2.17 Reclamation

GMMC proposes to increase the authorized surface disturbance at the Glamis Marigold Mine from approximately 1,831 acres to approximately 3,305 acres. Most of the disturbance associated with the Proposed Action would result from the development of the five new pits, associated waste rock storage areas, development of the Section 30 and Section 16 Heap Leach Facilities, ancillary facilities, and infill areas. Reclamation would be both concurrent and post-use, following the plans currently approved for and utilized by GMMC at the existing operation. Post-mining topography for the Proposed Action is presented in Figure 2-10.

A summary of reclamation acreages by project facility is presented in Table 2-6. Approximately 2,964 acres of the 3,305 acres disturbed as a result of the implementation of the Proposed Action and existing disturbance would be reclaimed after mine operations.

A detailed Reclamation Plan has been submitted as part of the BLM Plan of Operations and NDEP-BMRR Reclamation Permit. The Reclamation Plan includes bond calculations that estimate the cost of closure and reclamation for all facilities, including decommissioning facilities, heap leach closure, interim fluid management, all recontouring and regrading work, seeding, and post-reclamation monitoring. The bond approval is part of the permitting process and the bond must be secured prior to any project-related disturbance.

The reclamation approach and procedures were developed based on the site-specific conditions at the mine site. These procedures were designed so that the mining-related disturbance would be reclaimed to a productive use similar to the pre-mining land uses, and the reclaimed areas would be visually and functionally compatible with the surrounding topography. The goal of the reclamation plan is to promote public safety, minimize visual impacts, and to re-establish stable topographic features that support a diverse, self-sustaining vegetative community. Pre-mining land uses included wildlife habitat, domestic



Millennium Expansion Project

Figure 2-10

Post Reclamation Topography

livestock grazing, dispersed recreation, and mineral exploration.

The reclamation procedures currently used at the Glamis Marigold Mine incorporate five basic components:

- Establishment of stable topographic surface and drainage conditions that would be compatible with the surrounding landscape and serve to control erosion;
- Establishment of soil conditions most conducive to establishment of a stable plant community through stripping, stockpiling, and reapplication of suitable growth media;
- Revegetation of disturbed areas to establish a long-term productive biotic community compatible with proposed post-mining land uses;
- Consideration of public safety through stabilization, removal, and/or fencing of structures or landforms that could constitute a public hazard; and
- Consideration of the long-term visual character of reclaimed areas.

Revegetation success would be determined based on criteria outlined in Nevada Guidelines for Successful Revegetation (NDEP-BMRR and BLM 2000).

2.2.17.1 Growth Media Stockpiling and Use

Prior to development of the facilities under the Proposed Action, suitable growth media would be salvaged and stored in the existing (three) or new (two) growth media stockpiles (Figure 2-2) and as berms around the various facilities, such as the berm between the West Waste Rock Storage Area and Trout Creek. Suitable alluvial material also would be used to supplement the growth media. The stockpiles would be seeded with an interim seed mix to minimize wind and water erosion or establishment of invasive and noxious weeds.

2.2.17.2 Grading and Stabilization

Concurrent reclamation would be conducted at the earliest economically and technically feasible time (e.g., waste rock storage areas). For other facilities (e.g., heap leach pads, ADR plant, etc.), grading and stabilization would be conducted when the individual components are no longer required for mine operations or when facilities are decommissioned and site closure begins.

Slopes would be contoured in preparation for reclamation. Final grading of cuts and fills in unconsolidated material would be conducted to create stable, undulating landforms to prevent pooling or ponding, and to blend with the surrounding undisturbed topography. Final grading would minimize erosion potential and additional surface disturbance, and would facilitate the establishment of post-mining vegetation.

After cessation of mining, the pits would be bermed and fenced as determined by the Nevada Division of Minerals ranking system. Highwalls would be left in a stable configuration, and subject to natural processes. Slope angles in the open pits would range from approximately 34 to 55 degrees, depending on the pit and the specific location within the pit. Final pit wall configurations would be determined by pit economics, rock type and strength, geologic structure, and the results of previous studies and construction. The pit walls would gradually ravel and slough over time to the natural angle of repose for the individual rock types.

2.2.17.3 Surface and Seedbed Preparation

Prior to growth media application, disturbed areas would be inspected for slope stability, topographic diversity, surface water drainage capabilities, and compaction. Compacted surfaces would be loosened and left in a rough condition by ripping, followed by disking or other mechanical manipulation. Tillage implements may be used as needed for all areas to be reclaimed that could safely be worked by surface

Table 2-6: Acreages Disturbed and Reclaimed After the Proposed Action

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	488	461	949	433	246	679
Waste Rock Storage Areas	421	569	990	421	569	990
Heap Leach Pads	360	198.5	558.5	360	198.5	558.5
Crushing/Mill/Plant Facilities[2]	42	17	59	42	7	49
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	17	4	21	17	4	21
Storm Water Ponds	6.5	3	9.5	6.5	3	9.5
Growth Media Stockpiles	15	43	58	15	43	58
Haul Roads/Access Roads	63	77	140	49	64	113
Water Supply System	15.1	18.9	34	15.1	18.9	34
Diversion Ditches/Creek Diversions[3]	14.1	19.9	34	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
Infill/Miscellaneous Areas	102.5	73.5	176	102.5	73.5	176
Total Acreage	**1,561.2**	**1,743.8**	**3,305**	**1,478.1**	**1,485.9**	**2,964**

[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.

equipment to create a friable surface with favorable bulk density. Other grading and stabilization would be performed to ensure long-term stability. Growth media would then be distributed over the prepared surface at varying depths, depending on the facility being reclaimed. Soil amendments would be applied as needed, and the surface disked, raked, or treated to incorporate the amendments into the top four to six inches of growth media.

2.2.17.4 Seed Mixtures and Rates

The proposed seed mixtures (Table 2-7) that would be used to revegetate disturbance areas are based on pre-mining vegetation and habitat types in the area, climatic and soil conditions of the Project Area, and seed availability. The final selection of seed mixes would depend on the results of site-specific reclamation studies and commercial availability of seed. Commercial certified weed-free seed would be purchased from local sources, if possible.

Revegetation activities would be conducted in the fall to take advantage of winter moisture. On steep slopes and in rocky areas, broadcast seeding would be used for seed application. Broadcast or drill seeding would be employed on level to gently sloping areas where coarse fragment content is low.

2.2.17.5 Weed Control

Weed control measures would be implemented during vegetation establishment in order to limit the spread of noxious weeds and to ensure that the site is successfully reclaimed with desirable species. GMMC would coordinate noxious weed controls with the BLM. Noxious weed occurrences within the reclaimed areas would be reported to the BLM, and an

Table 2-7: Proposed Seed Mixes[1]

Scientific Name	Common Name	Seeding Rate (PLS lbs/acre)[2]	
		Interim Seed Mix[3]	Reclamation Seed Mix
GRASSES			
Agropyron desertorum	Crested wheatgrass	7.0	--
[4,5]*Sitanion hystrix*	Bottlebrush squirreltail	--	2.5
[4,5]*Pseudoroegneria spicata* ssp. *spicata*	Bluebunch wheatgrass (var. Secar)	--	2.0
[4,5]*Leymus cinereus*	Great Basin wildrye	--	2.0
[5]*Oryzopsis hymenoides*	Indian ricegrass	--	2.5
FORBS			
[5]*Sphaeralcea coccinea*	Scarlet globemallow	--	0.5
[4]*Linum lewisii*	Blue flax	--	0.5
[4]*Achilliea millefolium*	Western yarrow	--	0.5
SHRUBS			
[4,5]*Atriplex canescens*	Fourwing saltbush	--	3.0
[5]*Atriplex confertifolia*	Shadscale	--	3.0
[5]*Ceratoides lanata*	Winterfat	--	0.5
[4]*Artemisia tridentata* spp.*wyomingensis*	Wyoming big sagebrush	--	0.25
Total lbs/acre		**7.0**	10.75[5] *to* 16.0[4]

[1]Seed would be tested for noxious weed seeds prior to application.
[2]PLS = Pure live seed (pounds per acre).
[3]Soil stockpiles, road berms, and/or other temporary facilities.
[4]Species to be used at the upper elevation sites that currently support a sagebrush community.
[5]Species to be used at the lower elevation sites that currently support a shadscale community.

appropriate eradication plan would be developed. If herbicides are used to control noxious weeds, the application rates and methods would conform to BLM standards, thereby avoiding potential risks to human health.

2.2.17.6 Reclamation Schedule

At the conclusion of operations, reclamation would be initiated at the earliest feasible time. Removal of facilities, rough grading, and scarifying activities may occur at any time during the project. Concurrent reclamation of select disturbed areas has been performed and may continue at any time until mine closure. Post-mining reclamation would be initiated when ore reserves have been exhausted and mining operations cease.

Soil distribution and revegetation activities are limited by the time of year during which they can be effectively implemented. General scheduling of revegetation activities would include:

- Grading, drainage control, and maintenance that would be conducted year-round;
- Seedbed preparation in early fall just prior to reseeding; and
- Completion of seeding in fall to winter in order to take advantage of winter and spring moisture.

Table 2-8 outlines the anticipated revegetation schedule, which would be followed during the life of the mine and five years beyond mine closure to achieve the reclamation goals. Site conditions and/or yearly climatic variations may require modifications to the revegetation schedule.

2.2.17.7 Facility Reclamation

Reclamation procedures, as outlined in GMMC's currently approved PoO (GMMC 2001) would be used for reclamation of the various components included in the proposed mine expansion. Reclamation of these facilities is discussed below.

Table 2-8: Reclamation and Re-Seeding Schedule

Reclamation Activity	Optimal Months											
	J	F	M	A	M	J	J	A	S	O	N	D
Regrading												
Soil Distribution												
Seedbed Preparation and Seeding												

Facility removal could occur year-round.

<u>Open Pit</u>

The primary goals for reclamation of the open pits would be to ensure long-term stability of the final configurations and public safety. For the pits that would not be backfilled, pit walls would gradually ravel and slough over time to the natural angle of repose for the individual rock types. Pit bottoms would be ripped and seeded to encourage absorption of precipitation. Pits that would be partially backfilled would have the near horizontal surfaces of the in-pit backfill reclaimed similar to reclamation of the out-of-pit waste rock storage areas. Growth media would be applied and the areas subsequently seeded with an appropriate seed mix to create an ET storage and release cover. A perimeter berm with warning signs would be placed around the pits during reclamation with a sufficient setback to accommodate the projected, final pit crest. Pits would be bermed and fenced as approved by BLM and the NDEP, taking into consideration the Nevada Division of Minerals ranking system. Pits that would be completely backfilled and have additional waste rock surface applied to create a waste rock storage facility, would be reclaimed as a waste rock storage facility (see below).

Road beds in and around the pit areas and pit floors would be rebladed and ripped and/or scarified to prepare a seedbed or a surface for application of growth media; the area to be reclaimed would depend on engineering feasibility and safety considerations. The prepared surfaces would subsequently be seeded with an appropriate seed mixture.

<u>Waste Rock Storage Areas</u>

Prior to reclamation, the waste rock storage areas would be recontoured, regraded to overall slope angles of 3H:1V, and crowned to prevent water from ponding. Perimeters would be irregular to allow blending with the existing topography and to break up long, linear features. Large boulders would be placed on the ridges or benches to provide wildlife habitat. All flat benches and other areas of the storage area with recontoured slopes accessible by heavy machinery would be ripped and/or scarified to produce a rough surface for anchoring of reapplied growth media. Growth media would be applied to the side slopes as well as the top surfaces of the waste rock storage areas to a depth of a minimum, of six inches. These areas would be reseeded with an appropriate seed mixture. The growth media and vegetation would create an ET cover to reduce infiltration of meteoric water into the waste rock storage facilities, decreasing the potential for mobilization of metals or other constituents of the waste rock.

Processing Facilities

Processing facilities would be decommissioned following the completion of ore processing. Equipment, electrical facilities, instrumentation, aboveground piping, miscellaneous fencing, and mobile and permanent structures would be removed from the site in accordance with appropriate federal and state regulations. Foundations would be broken up and buried in place prior to growth media application and seeding.

Heap Leach Pads

GMMC proposes to stabilize the heap leach pads (existing and proposed) by constructing an ET cover system over the spent heaps. The purpose of the ET cover system is to reduce the amount of meteoric water infiltrating the heap leach materials. A reduction in infiltration would reduce drain down solutions, decreasing the potential for drain down solutions to degrade waters of the State, as defined in NAC 445A.430. GMMC would be responsible for monitoring discharge effluent for a minimum of five years and up to 30 years, as directed by NDEP-BMRR, to establish that the drain down solutions would not degrade waters of the state. BLM's closure policy and guidelines for heap leach facilities has been provided in Appendix B.

The heaps would be leached until economic recovery has been achieved. Following leaching, the liner and drain pipes would be left under the heaps. The heaps would be allowed to drain, with ongoing monitoring of drain down quantity and quality to establish compliance of key constituents (weak acid dissociable [WAD] cyanide and pH) in the drain down solutions. The drain down solution would be managed to promote evaporation by recirculating drain down solution onto the side slopes of the heap using a fogger system designed to facilitate evaporation. The ponds would also continue to collect solution and promote evaporation. The recirculation-evaporation would continue until the drain down volume begins to stabilize.

The heaps would be re-sloped to an overall slope of 3H:1V to eliminate catchment benches with all spent ore material maintained on existing and cushioned liner systems. Drainage to the collection system would be maintained. GMMC would place a minimum of one-foot of growth media on the heaps. The growth media would be waste rock, identified through cover system modeling and waste characterization tests, as being suitable for use as cover material. The waste rock material would be selected and re-handled in a manner to provide sufficient coarse fraction to form resistance to erosion and sufficient fines to hold meteoric water for use in revegetation. No additional growth media placement is anticipated based on the successful revegetation of the 8-South Waste Rock Storage Area with similar waste rock material and the infiltration modeling results of the ET cover (Hydro-Engineering 2002). This layer would serve as an ET cover that would hold and release incident precipitation and limit meteoric water infiltration through the cover and into the heaps. The covered heaps would be revegetated to promote evapo-transpiration of meteoric waters as well as interstitial solutions within the heaps.

Heap drain down solutions would be managed in passive water treatment facilities consisting of either wetland-woodland facilities or attenuation/ET basins. The optimal method to treat the heap drain down solution would be determined by the chemistry and volume of this solution. The wetland-woodland system, designed to accentuate evapotranspiration, would be constructed at the Marigold, 5-North, Section 30, and Section 16 Heap Leach Facilities. The wetland-woodland system would be created on a liner system of the process solution ponds (and storm water pond as needed) to contain solution, and have sufficient growth material for the plant life form required for the design parameters.

The wetland-woodland system would be designed to accommodate the anticipated long-term drain down, as determined during the heap closure process, and any meteoric water that may infiltrate the ET cover system. Similar systems have been used at Glamis Dee Gold Mine in Elko County and Glamis Daisy Gold Mine in Nye County, Nevada. The system would be designed for normal variation in precipitation (i.e., would take into account normal yearly precipitation fluctuations) and to minimize infiltration.

In the event that drain down monitoring data indicates that volume of the long-term drain down exceeds projections, construction of one or more evapotranspiration basins (ET basins) is necessary. The ET basin(s) would either be in addition to or in place of the wetland-woodland water treatment facility. If the ET basins are constructed in lieu of the wetland-woodland system, then the process solution and storm water ponds would be available for use as the ET basins. If the ET basin(s) is constructed in addition to the wetland-woodland system, then one solution pond would be used for the wetland-woodland and the other solution pond and/or storm water pond would be used for the ET basin(s).

The pond(s) would be cleaned of residual sludge. The pond liners would be left in place and protected with a cover of geotextile fabric and/or soil. The pond(s) would then be backfilled with soils to a level below the drain down point to allow for drainage to filter across the pond. Perforated pipe would used to distribute the drain down across the backfilled pond(s) to promote a broad infiltration area. The soils would be selected to accentuate attenuation of solution constituents. The pond(s) would then be backfilled with growth medium and seeded. A vertical piezometer would be installed during construction to monitor solutions levels within the pond(s), as well as solution chemistry. Glamis Gold Ltd. has constructed a similar agency-approved attenuation basin at the Glamis Daisy Gold Mine in Nye County, Nevada.

The wetland-woodland system alone, or the wetland-woodland system in combination with the ET basin(s) would be designed to accommodate all normal (i.e., long-term drain down and natural variation in precipitation events). As such, the facility would be designed as a zero-discharge facility. However, as a contingency for exceptional, unforeseen events, a leach field would be designed to accommodate volume that may exceed the capacity of the wetland-woodland system. The leach field system would be located near the process ponds in each heap leach area. The relatively deep groundwater table makes these sites suitable for leach fields, provided the surrounding materials have attenuating capacity for constituents in the overflow.

The leach fields would be constructed by excavating surface soils to a depth of five feet, of which two feet would be backfilled with coarse gravel to promote drainage. A manifold would be placed in the leach field to distribute flow across two or three perforated HDPE distribution pipes placed over the coarse gravel. The distribution pipes would be covered with an additional foot of gravel, which would be covered with the remaining excavated soil. The surface of the leach field would be graded to promote runoff of meteoric waters. Overflow from the wetland-woodland system or the ET basins would be conveyed via HDPE pipe to a dosing tank at the head of the leach field. The dosing tank would release approximately 100 gallons of effluent at a time to the manifold to achieve uniform distribution.

The intent of the heap leach pad closure is to continue the facilities as zero-discharge facilities, but they would also include a contingency for exceptional events. The contingency would be designed to prevent degradation of waters of the state.

Process Solution Ponds

The process solution ponds may be used as part of the passive water treatment for closure of the heap leach facilities, in which case, the ponds would be used as evapotranspiration basins (see above). In the event that treatment of the heap leach drain down is not necessary, the process solution ponds would be reclaimed. Reclamation of the process solution ponds and water storage ponds would consist of draining, removal or perforation and burial in place of the synthetic liners, reshaping, seedbed preparation, and seeding. Following evaporation of all liquid from the ponds, any sludges in the ponds would be analyzed using both the MWMP and the Toxicity Characterization Leaching Procedure (TCLP). If the results are within the limits as defined by each procedure, the synthetic liners would be folded around the evaporate and buried in-place five feet below the surface. In the event that the test results are not within limits as defined by each procedure, the evaporate would be removed and disposed of in accordance with state and federal regulations, or stabilized and buried on-site.

All pond sites and ditches would be filled and recontoured to prevent ponding of runoff and allow for natural drainage. The pond areas would be graded and contoured to blend in with the natural topography. The prepared surfaces would be scarified and reseeded.

Roads, Drill Pads, and Sumps

All roads and drill pads within the Project Area would be ripped, scarified, and revegetated, following the completion of mining, unless designated as a county road. Roads would be contoured as near as possible to the surrounding terrain. Sumps would be filled prior to seeding. All culverts and other water diversion structures would be removed and the natural drainage patterns restored. Water bars or other structures may be left in place to reduce any undue erosion. The prepared surfaces would be seeded with an appropriate seed mix.

Removal of Stored Fuels, Chemicals, and Blasting Supplies

Fuels, chemicals, and blasting supplies would be consumed prior to the end of mining, if feasible. Remaining inventories would be returned to vendors or removed and properly disposed of off-site.

Exploration Drill Hole Abandonment

All exploration drill holes completed after April 9, 1990, have been plugged according to standards stipulated by the NRS 534.421 through NRS 534.428. Any additional drill holes resulting from ongoing exploration also would be plugged according to these requirements.

Ancillary Facilities

Prior to decommissioning of mine facilities, GMMC would modify the existing detailed closure plan for Glamis Marigold Mine to include the decommissioning of the Millennium Expansion Project facilities and submit the modified plan to NDEP-BMRR for approval. Structures would be properly removed and/or buried. Following removal or burial, the ground surface would be recontoured, prepared, and seeded. Disposition of other project components on public grounds would consist of:

- Fresh water rinsing or active treatment of any piping which contained cyanide solutions;
- Concrete foundations would be broken-up and buried in place;
- Buried piping and conduits would be drained, rinsed, capped or sealed, as needed, and buried in place;
- Scrap metal, trash, and other non-hazardous debris would be placed in the existing waivered-Class III landfill or disposed of off-site at an appropriate facility; and
- All power lines and electrical systems not required for future post-mining use would be removed.

Facilities Not Reclaimed

The following components would not be subject to post-mining reclamation:

- Main access road from the Buffalo Valley Road;
- Certain buildings and structures located on private property in Section 9;
- Fencing to protect evapotranspiration facilities;
- Electric power lines or equipment necessary for post-mining uses; and
- Water wells, water lines or other utilities required for post-mining uses.

2.3 Alternative 1 –Trout Creek Diversion Realignment

Trout Creek was originally diverted to permit mining of the 8-South Pit and construction of the 8-South Waste Rock Storage Area. The stabilization of the diversion has been previously analyzed in the Resort EA (BLM EA # N26-88-005P) and March 2001 FEIS with respect to the Red Rock Pit. The analysis identified concerns with the long-term stability and potential failure of the west highwall in the Red Rock Pit, which could result in flow from Trout Creek entering the Red Rock Pit.

The proposed consolidation of the Red Rock and Top Zone pits into the Terry Zone Pit by combining and deepening of portions of the two pits has created concern over the long-term stabilization of the Trout Creek Diversion/Red Rock Pit high wall. The issues associated with this alternative are:

- Pit high wall stabilization;
- Groundwater quality (potential to degrade waters of the state); and
- Surface water quantity (maintenance of ephemeral flows downstream of the diversion).

This Alternative is the same as the Proposed Action except for the additional disturbance associated with the Trout Creek Diversion Realignment. All other components of the Proposed Action are part of this Alternative.

Under this Alternative a new diversion channel would be constructed with the diversion point located in the SW ¼ of T33N, R43E, Section 19. The diversion would parallel the existing Trout Creek channel and eventually flow into the north end of the existing Trout Creek Diversion. The new diversion channel would be 100 to 200 feet west of the existing channel and excavated into bedrock. To achieve the required channel elevation and stream gradient, the new diversion would need to be excavated into the side of a small hill in the NW ¼ of Section 19. The new channel would be approximately 2,300 feet in length. The depth and width would vary depending final design of the diversion and the amount of excavation required to achieve the proper channel elevation while maintaining 3H:1V side slopes. The new diversion would be designed to accommodate the 100-year, 24-hour event within the constructed channel. Approximately 12 acres of disturbance would be associated with the new channel diversion (Figure 2-11, 2-12). The diversion would generally have a trapezoidal shape (Figure 2-9) similar to the storm water diversion structures, and would be armored with rip rap along alignments with flows that exceed a velocity of four fps. Native material would be used for the portions of the channel where flow is anticipated to be less than four fps. The average diameter (D50) of the rip rap would be based on the design criteria for the 100-year, 24-hour storm event.

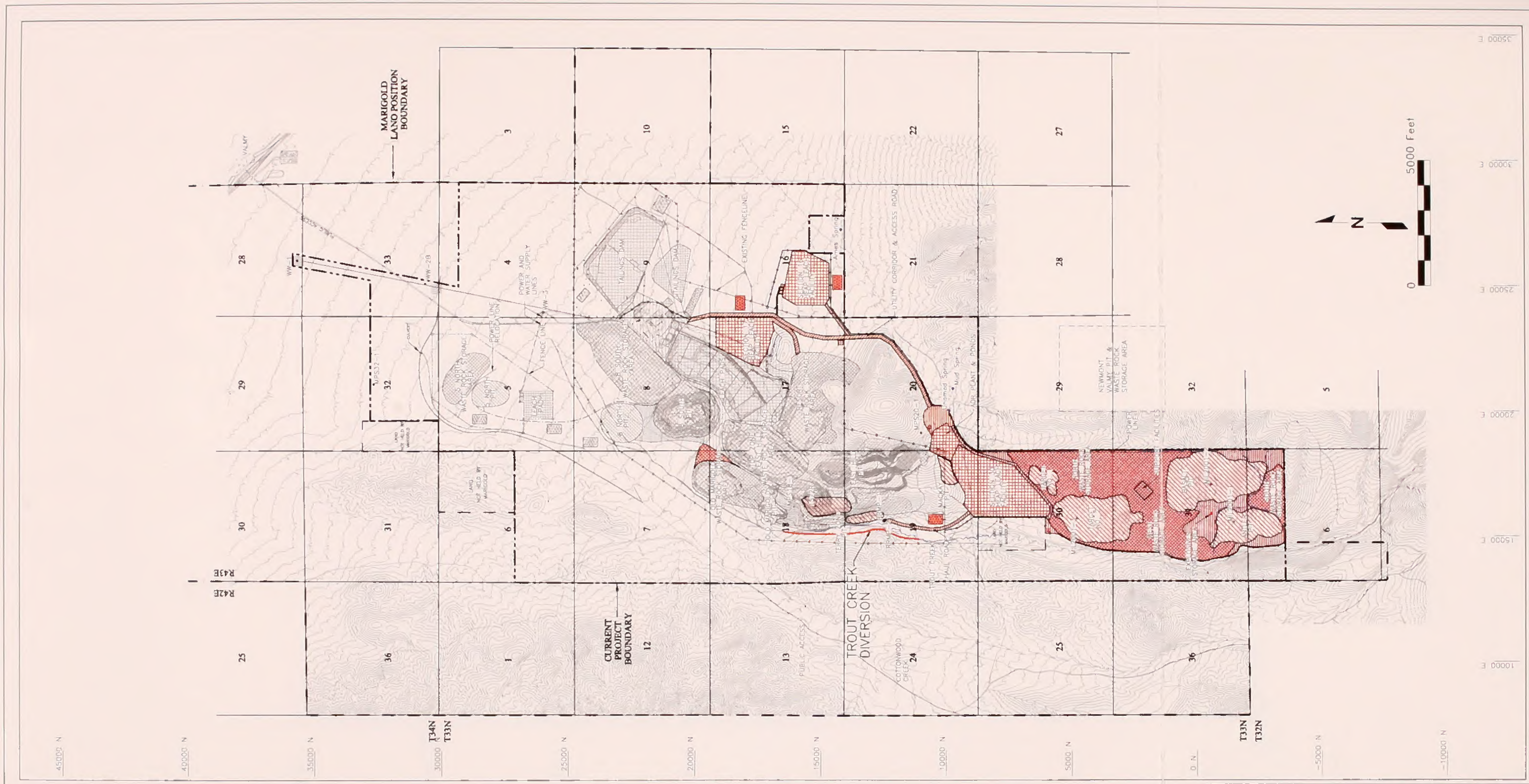
A summary of reclamation acreages by project facility for Alternative 1 is presented in Table 2-9 and post-reclamation topography is displayed in Figure 2-13.

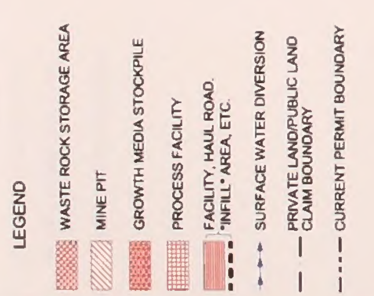
2.4 Alternative 2 - Expanded Red Rock Pit Stabilization

This Alternative is also intended to address the same issues identified in Alternative 1. The upper portion of the west highwall of the Red Rock Pit/Terry Zone Pit consists predominately of alluvium material. The previous NEPA analysis resulted in the development of a backfill buttress of the west highwall as mitigation and an environmental protection measure with regard to the potential impacts to the stability of the alluvium material from raveling or seepage from the Trout Creek Diversion. The purpose of the buttress is to increase the stability of the west highwall against potential failures from pit wall raveling or seepage from the Trout Creek Diversion which is located approximately 100 to 200 feet west of the Red Rock Pit highwall crest.

This Alternative is the same as the Proposed Action except for the expanded pit backfill/buttress that would be constructed to prevent Trout Creek from flowing into the pit. All other components of the Proposed Action are part of this Alternative.

Under this Alternative the authorized buttress would be expanded to provide additional long-term stability. The expanded buttress would consist of backfilling the west side of the Red Rock Pit to an elevation ten feet above the west pit crest and ten feet beyond the pit footprint along the entire length of the west highwall (Figure 2-14). Run of mine material would be backfilled into the pit to form the buttress. The buttress would be designed to divert or withstand the flow from the 100-year, 24-hour event. The backfill would be graded to approximately 3H:1V within the pit



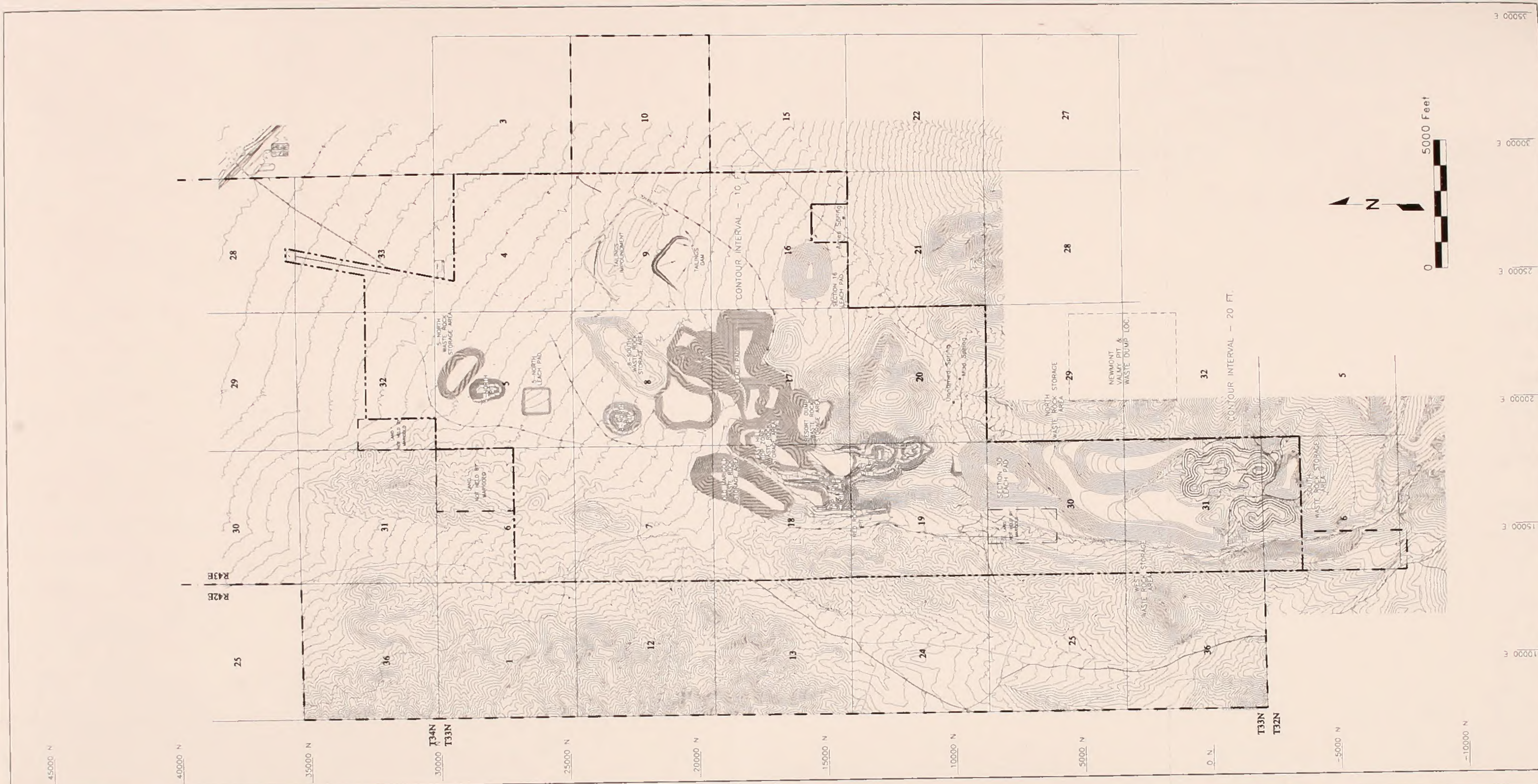


Millennium Expansion Project

Figure 2-11

Alternative 1

Trout Creek Diversion Realignment



LEGEND
SURFACE WATER DIVERSION
PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
EXISTING PERMIT BOUNDARY

Millennium Expansion Project

Figure 2-12

Alternative 1
Post Reclamation Topography

Table 2-9: Acreages Disturbed and Reclaimed After Alternative 1

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	488	461	949	433	246	679
Waste Rock Storage Areas	421	569	990	421	569	990
Heap Leach Pads	360	198.5	558.5	360	198.5	558.5
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Tailings Impoundment	0	234	234	0	234	234
Process Ponds	17	4	21	17	4	21
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Growth Media Stockpiles	15	43	58	15	43	58
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Water Supply System	15.1	18.9	34	15.1	18.9	34
Diversion Ditches/Creek Diversions[3]	21.1	24.9	46	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
infill/Miscellaneous Areas	102.5	73.5	176	102.5	73.5	176
Total Acreage	**1,568.2**	**1,748.8**	**3,317**	**1,478.1**	**1,485.9**	**2,964**

[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.

and 2H:1V on the Trout Creek side of the buttress (i.e., the portion that would be resloped and extend beyond the pit footprint). The buttress would have a crest width of 30 feet after re-sloping to 3H:1V, growth media would be placed and reseeded. Approximately three to four million tons of waste rock material would be necessary to create the extended buttress. Backfill material would be subject to the constraints that have been applied to backfilling the other mine pits.

A summary of reclamation acreages by project facility for Alternative 2 is presented in Table 2-10 and the post-reclamation topography is displayed in Figure 2-15.

2.5 Alternative 3 - No Action Alternative

Under the No Action alternative, currently permitted operations at the Glamis Marigold Mine would cease after 2007, with final reclamation extending approximately ten years beyond closure. Additional mineral resources in the Project Area would remain undeveloped, and no construction or expansion of mine pits, waste rock storage areas, heap leach pads, or other ancillary facilities would occur. A summary of reclamation acreages by project facility for the No Action Alternative is presented in Table 2-11. Post-reclamation topography for this alternative is illustrated in Figure 2-16.

2.6 Alternatives Considered but Eliminated from Detailed Analysis

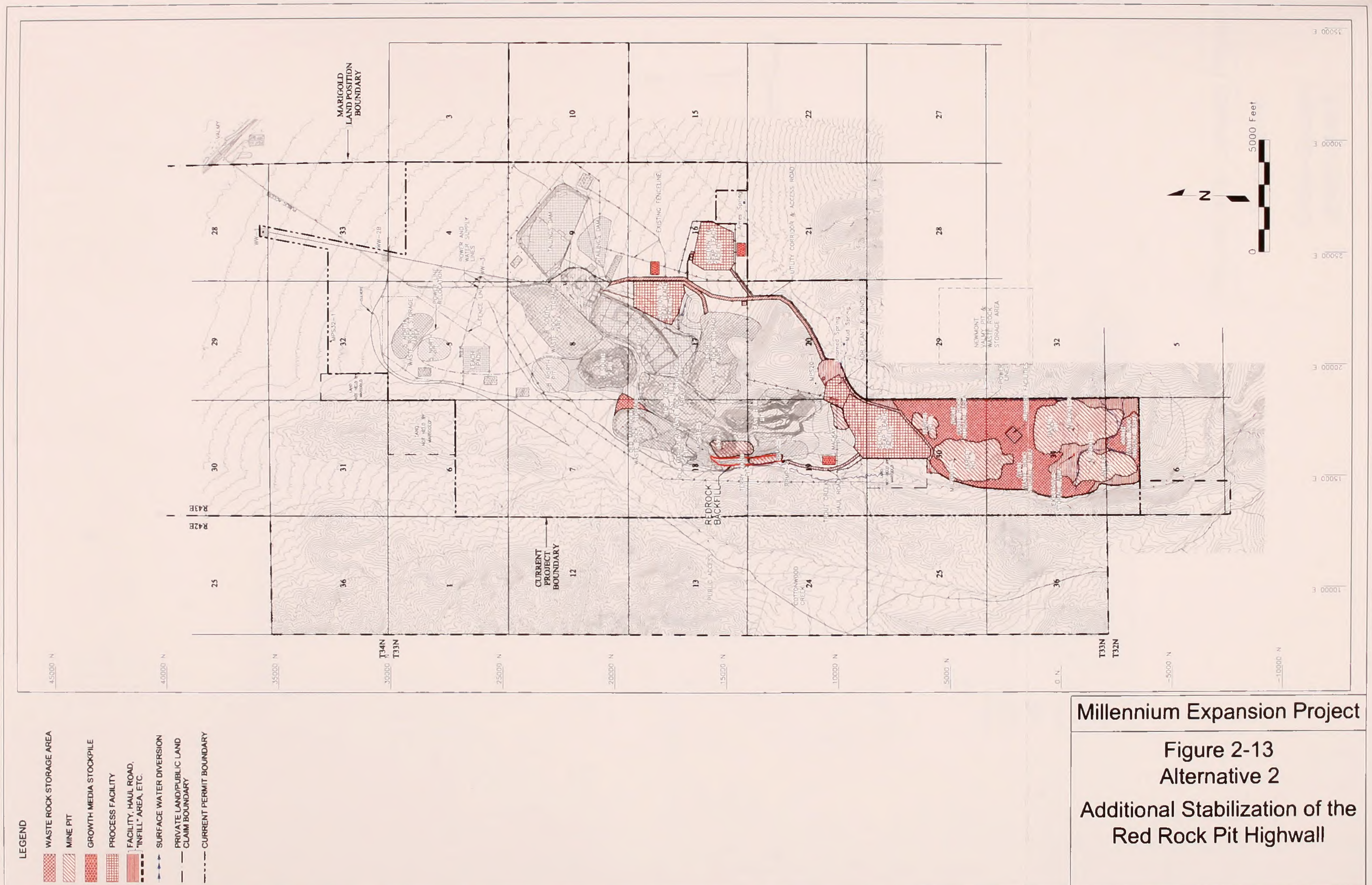
In the process of developing the PoO Modification, GMMC considered various environmental constraints in relation to the placement and construction of facilities. These constraints included locations of known cultural sites, surface water locations, visual contrasts, depth to groundwater, and wildlife resources. In addition to environmental constraints, GMMC also had to consider land status and operational constraints. These alternatives included:

1) *Creating a waste rock storage area on the west side of Trout Creek in Section 31.*

This alternative was eliminated from further consideration due to the existence of cultural sites west of Trout Creek and because of the potential impacts to surface waters during the periods of flow in Trout Creek. Construction and operation of a crossing over the Trout Creek Diversion increases the risk of impacts to surface water quality from sedimentation during periods of flow. The crossing would also be at risk during any period that the design flow event is exceeded. Potential impacts for this scenario would include increased sedimentation to failure of the crossing resulting in impacts to surface water and operational downtime. Condemnation drilling results and haul distances also precluded this alternative from further consideration.

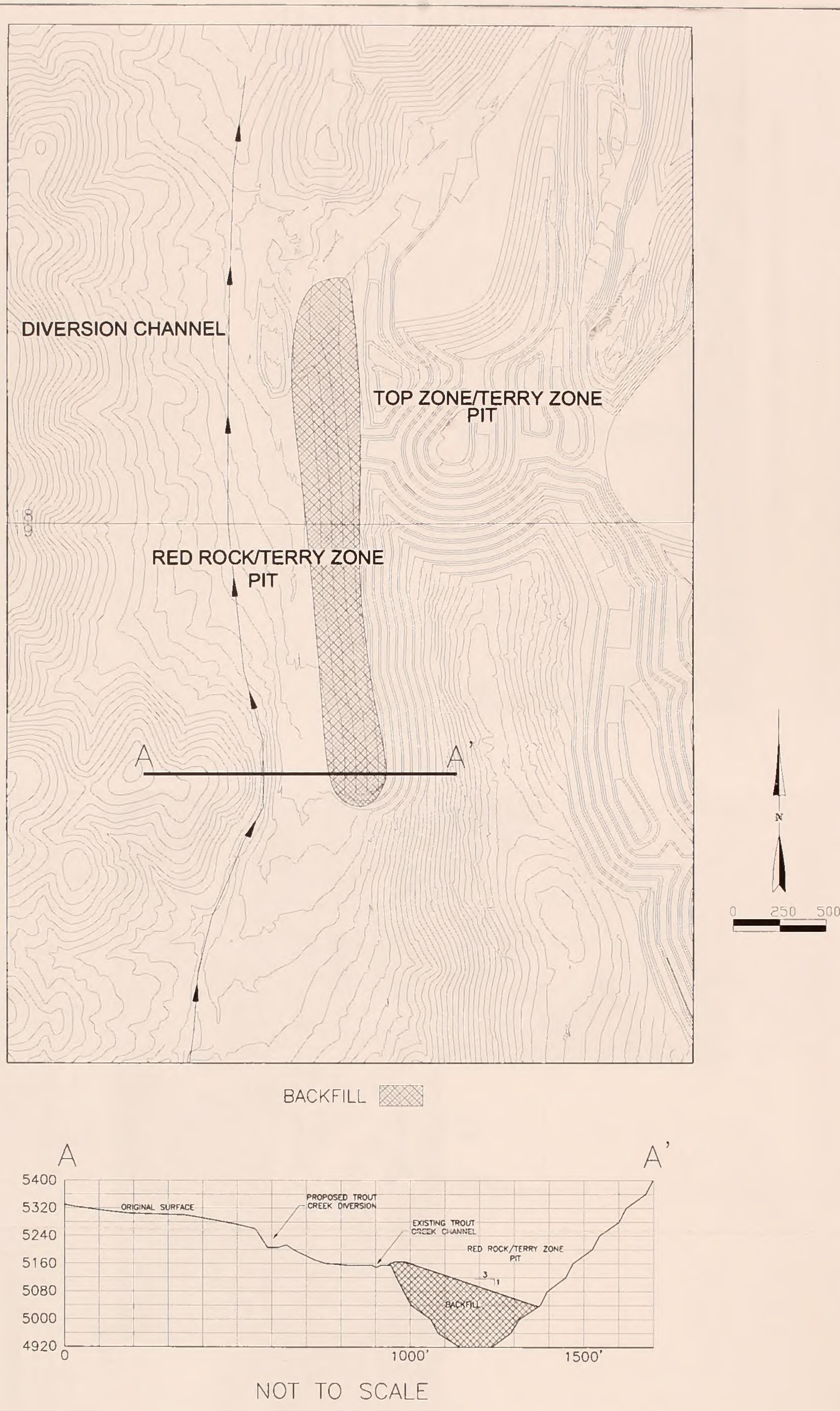
Configuring waste rock storage areas onto adjacent mining properties to effect a synergy for reclamation.

Section 30 includes 80 acres of private land not owned or controlled by GMMC. Newmont Mining Corporation (NMC) controls and/or owns lands east of Sections 30 and 31. Configuring waste rock storage areas onto adjacent mining properties to affect a synergy for reclamation was not considered a viable alternative. Each mining company has a different set of circumstances that govern mine planning and operations. These circumstances, such as differing ore grades, haul distances, operational costs, and scheduling, make this alternative impractical to implement as long-term plans for both mining companies would necessarily change as the price of gold changes. Bonding issues further complicate the ability to combine facilities.



Millennium Expansion Project

Figure 2-13
Alternative 2
Additional Stabilization of the Red Rock Pit Highwall



Millennium Expansion Project

Figure 2-14

Cross-Section
Alternative 2

Table 2-10: Acreages Disturbed and Reclaimed After Alternative No. 2

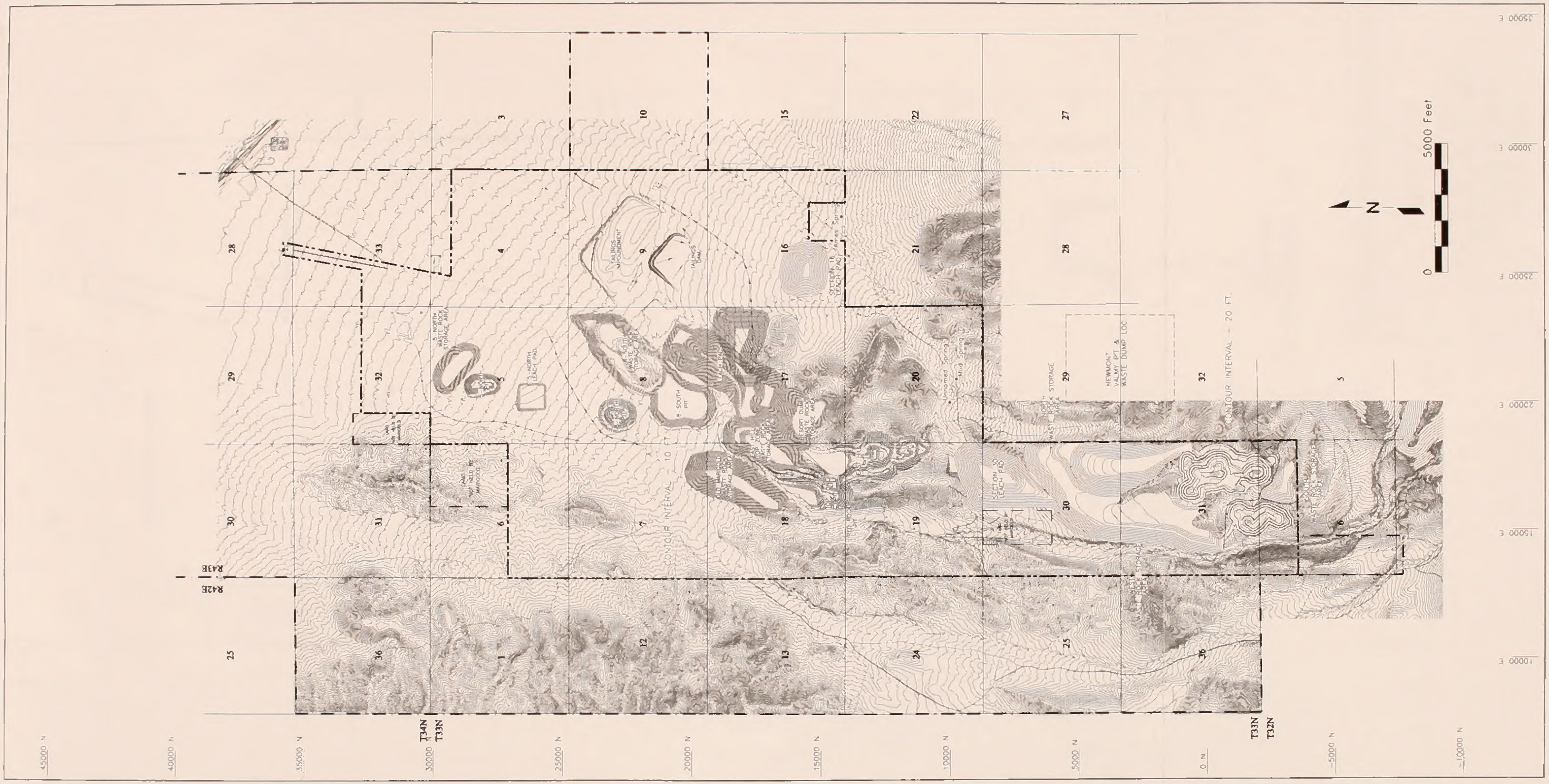
Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	488	461	949	433	246	679
Waste Rock Storage Areas	421	569	990	421	569	990
Heap Leach Pads	360	198.5	558.5	360	198.5	558.5
Crushing/Mill/Plant Facilities[2]	42	17	59	42	7	49
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	17	4	21	17	4	21
Storm Water Ponds	6.5	3	9.5	6.5	3	9.5
Growth Media Stockpiles	15	43	58	15	43	58
Haul Roads/Access Roads	63	77	140	49	64	113
Water Supply System	15.1	18.9	34	15.1	18.9	34
Diversion Ditches/Creek Diversions[3]	14.1	19.9	34	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
infill/Miscellaneous Areas	102.5	73.5	176	102.5	73.5	176
Total Acreage	**1,561.2**	**1,743.8**	**3,305**	**1,478.1**	**1,485.9**	**2,964**

[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.

Table 2-11: Acreages Disturbed and Reclaimed After the Alternative 3

Facility	Disturbed Acres[1]			Reclaimed Acres		
	Public Land	Private Land	Total	Public Land	Private Land	Total
Pits	324	211	535	0	0	0
Waste Rock Storage Areas	343	296	639	343	296	639
Heap Leach Pads	56	152	208	56	152	208
Crushing/Mill/Plant Facilities[2]	35	18	53	35	8	43
Tailings Impoundment	0	234	234	0	234	234
Process Ponds	5	2	7	5	2	7
Storm Water Ponds	1.5	4.5	6	1.5	4.5	6
Growth Media Stockpiles	10	38	48	10	38	48
Haul Roads/Access Roads	36	52	88	22	39	61
Water Supply System	4	9	13	4	9	13
Diversion Ditches/Creek Diversions[3]	13	18	31	0	0	0
Exploration Drill Pads and Roads	17	25	42	17	25	42
Infill/Miscellaneous Areas	51.5	22.5	74	51.5	22.5	74
Total Acreage	**896**	**1,082**	**1,978**	**545**	**830**	**1,375**

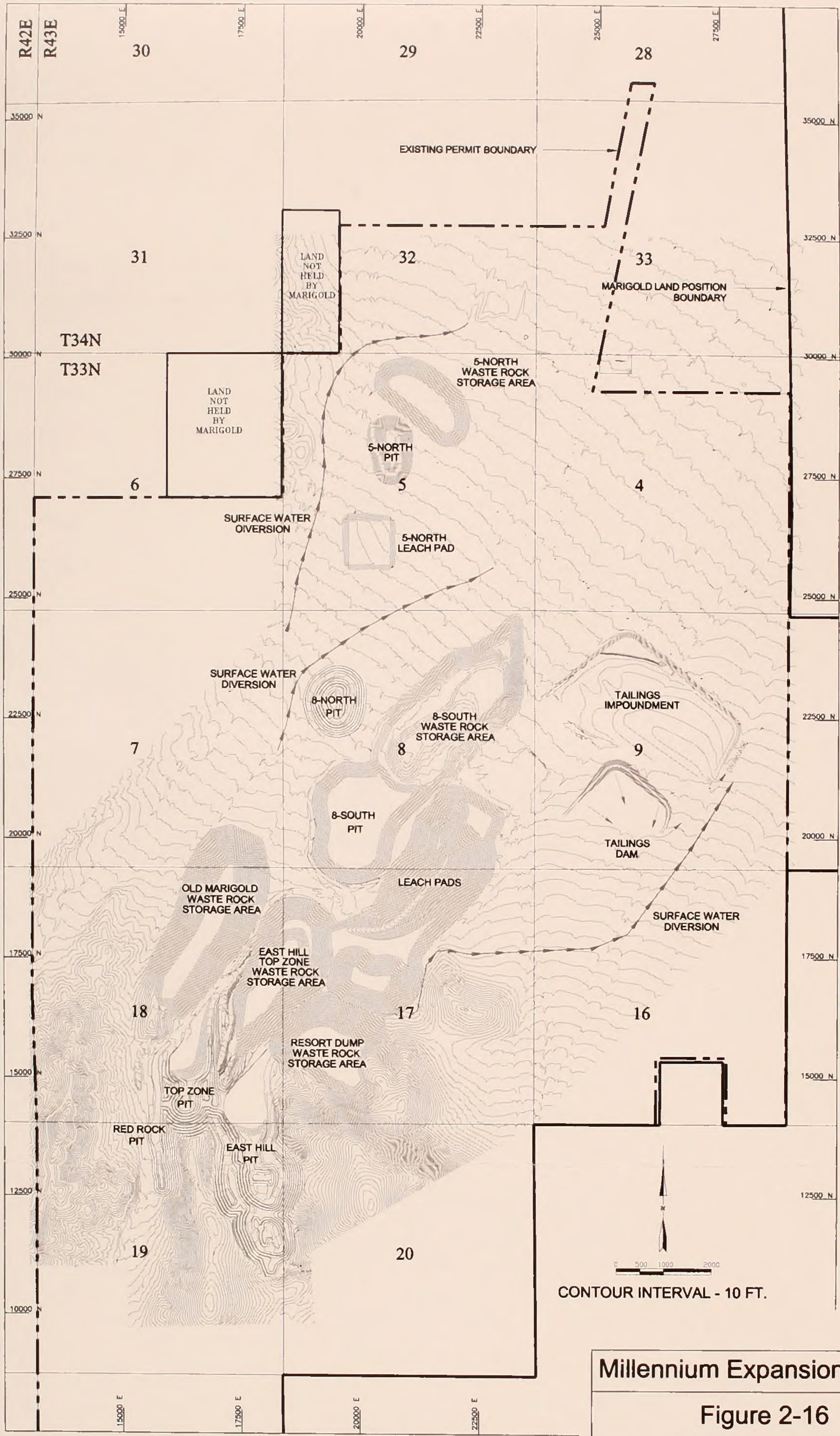
[1]Total of currently permitted and proposed disturbances.
[2]Although these facilities are not proposed to be reclaimed, the reclamation bond includes full reclamation cost estimates for these facilities.
[3]Diversions will be permanent features as part of the stabilization at facilities.



LEGEND
SURFACE WATER DIVERSION
PRIVATE LAND/PUBLIC LAND
CLAIM BOUNDARY
EXISTING PERMIT BOUNDARY

Millennium Expansion Project

Figure 2-15
Alternative 2
Post Reclamation Topography



Millennium Expansion Project

Figure 2-16

Post Reclamation Topography Under The No Action Alternative

BLM and NDOW identified the following alternatives:

1) *Combining the Section 16 and 30 heap leach facilities into one large facility in Section 30.*

   Both heap leach pads are designed to hold the ore removed from the proposed pits. Pad designs minimize the liner surface area while maximizing the height of the ore. The ultimate height of the stacked ore is constrained by the pad size and the final reclamation slope requirement of 3H:1V. The size of the Section 30 Heap Leach Pad is constrained to the west in Section 30 by property ownership. In addition, higher lifts decrease operational efficiency by increasing the elevational difference between the level at which the ore is mined (i.e., deeper in the pit) and the level at which the ore is processed (i.e., higher on the leach pad). Increasing the volume of ore on the heap leach pad also increases the time needed for drain down at the time of closure. The Section 30 Heap Leach Pad would have insufficient capacity to hold the amount of ore scheduled to be placed on Section 30 and Section 16 Heap Leach Pads.

2) *Underground mining of ore.*

   The ore is sufficiently disseminated between near surface and at depth to make underground mining unfeasible.

3) *Heap leach pads constructed over backfilled pits.*

   Constructing heap leach pads over backfilled pits was considered and eliminated from further detailed analysis. Although this alternative would create less new surface disturbance, the risk to surface and groundwater quality would be substantially increased. The backfill in the pits would undergo differential settling during pad construction and loading which would increase the potential for tearing the liner and releasing solution to the environment.

4) *Potential backfilling of the Valmy Pit.*

   The Valmy Pit is currently being mined by NMC. This alternative was not feasible given the time constraints for permitting at the Glamis Marigold Mine. This alternative would require agreement with NMC, and would depend on the ore grade within the pit walls and floor, as well as NMC's future plans for the Valmy Pit.

5) *Elimination of the Section 30 Heap Leach processing ponds and ADR plant by piping the leachate to the existing process ponds and ADR plant in Section 8.*

   Eliminating the Section 30 Heap Leach solution ponds and piping the process fluids to the existing ponds in Section 17 was not considered a viable alternative. The risk of a solution release, and hence the risk of impacts to surface and groundwater, would be increased by pumping over long distances. The extra power costs for pumping would rapidly offset any construction savings especially due to the need to pump upgradient in Section 20. If scheduling dictated that both heaps had to be operated concurrently, the solution ponds would have insufficient capacity to contain solution from both facilities. In addition, the disturbance for the construction of the passive drain down facilities would still be required.

6) *Using the existing or authorized tailings impoundments as alternatives to leach fields or evaporation basins for long-term heap leach drain down solutions.*

   The Proposed Action includes a change in the heap leach closure procedures for the existing and proposed heap leach facilities at the Glamis Marigold Mine. A component of the proposed modified closure is to use the existing process ponds as ET basins if long-term drain down effluent requires passive treatment to address water quality issues. The existing and authorized tailings impoundments were considered for use in lieu of the process ponds. This alternative was eliminated from further detailed analysis due to the current remediation and closure activities at the existing tailings impoundment and the unlikely need to construct the authorized tailings impoundment at this time.

2.7 Summary Comparison of the Proposed Action, Alternative 1, Alternative 2, and Alternative 3

Table 2-12 summarizes and compares the various components and disturbance associated with the Proposed Action, Alternative 1 – Trout Creek Diversion Realignment, Alternative 2 – Red Rock Pit Stabilization, and Alternative 3 - No Action Alternative. Detailed descriptions of impacts are contained in Chapter 3.0. The summary provided in Table 2-12 includes the implementation of mitigation measures presented as part of the resource discussions in Chapter 3.0.

2.8 Agency Preferred Alternative

In accordance with the NEPA, Federal agencies are required by the CEQ (40 FR 1502.14) to identify their preferred alternative for a project in the Draft SEIS, if a preference has been identified, and in the Final SEIS prepared for the project. The preferred alternative is not a final agency decision; it is rather an indication of the agency's preliminary preference. The alternative identified below is the BLM's preferred alternative at the Draft SEIS stage in the environmental review process. This preference may be changed based on the agency and public comments that are received on this Draft SEIS. The BLM's preference at this time considers all information that has been received and reviewed relevant to the proposed project. The agency preferred alternative is Alternative 2 as described in this Draft SEIS with all appropriate mitigation.

Table 2-12: Comparison of the Proposed Action, Alternative 1, Alternative 2, and Alternative 3

Project Component	Millennium Expansion Project Proposed Surface Disturbance (acres)		Alternative 1 – Trout Creek Diversion Realignment (acres)		Alternative 2 – Expanded Red Rock Pit Stabilization (acres)		Alternative 3 - No Action Alternative (Previously Authorized Surface Disturbance) (acres)	
	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land
Open Pit Mines								
8-South Pit	0	0	0	0	0	0	110	14
East Hill Pit	0	0	0	0	0	0	55	90
Top Zone Pit	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	65	34
Red Rock Pit	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	see Terry Zone	21	44
Old Marigold Pit	0	0	0	0	0	0	24	0
5-North Pit	0		0		0	0	0	29
8-North Pit	0	0	0	0	0	0	49	0
Terry Zone Pit Consolidation (Top Zone & Red Rock Deepening)	0	0	0	0	0	0	N/A	N/A
Section 30 - Target 1	19	0	19	0	19	0	N/A	N/A
Section 30 - Target 2	90	35	90	35	90	35	N/A	N/A
Section 31 - Antler Pit	34	43	34	43	34	43	N/A	N/A
Section 31 - Basalt Pit	21	153	21	153	21	153	N/A	N/A
Mackay Pit	0	19	0	19	0	19	N/A	N/A
Total Pits	164	250	164	250	164	250	324	211
Waste Rock Storage Areas								
8-South[(1)]	0	0	0	0	0	0	30	0
Top Zone	0	0	0	0	0	0	80	55
Old Marigold	9	7	9	7	9	7	73	23
Resort	0	0	0	0	0	0	10	163
5-North	0	0	0	0	0	0	0	55

Project Component	Millennium Expansion Project Proposed Surface Disturbance (acres)		Alternative 1 – Trout Creek Diversion Realignment (acres)		Alternative 2 – Expanded Red Rock Pit Stabilization (acres)		Alternative 3 - No Action Alternative (Previously Authorized Surface Disturbance) (acres)	
	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land
North Storage Area	155	133	155	133	155	133	N/A	N/A
South Storage Area	53	0	53	0	53	0	N/A	N/A
West Storage Area	11	133	11	133	11	133	N/A	N/A
Total Waste Rock Areas	228	273	228	273	228	273	193	296
Heap Leach Facilities								
Heap Leach Pads No. 1 - 10	0	0	0	0	0	0	56	74
Process Ponds	0	0	0	0	0	0	5	0
Storm water Ponds	0	0	0	0	0	0	1.5	1.5
SW Pad Expansion(2)(Cell 11)	0	0	0	0	0	76	0	60
Process Ponds	0	0	0	0	0	2	0	0
Storm water Ponds	0	0	0	0	0	1	0	2
5-North Heap Leach Pad	0	0	0	0	0	0	0	30
Process Ponds	0	0	0	0	0	0	0	2
Storm water Ponds	0	0	0	0	0	0	0	1
Plant Facilities	0	0	0	0	0	0	0	1
Section 17 Leach Pad (Cell 12)	78	0	78	0	78	0	0	0
Solution Conveyance Ditch	0	2	0	2	0	2	0	0
Process Ponds	0	0	0	0	0	0	0	0
Storm water Pond	0	0	0	0	0	0	0	0
Carbon columns & storage tanks	0	0	0	0	0	0	0	0
Section 30 Heap Leach Pad	125	30	125	30	125	30	N/A	N/A
Process Ponds	14	2	14	2	14	2	N/A	N/A
Storm water Pond (free board on Process Ponds)	0	0	0	0	0	0	N/A	N/A
ADR, lime silo, & infill (includes fresh water pond)	24	0	24	0	24	0	N/A	N/A
Section 16 Heap Leach Pad	76	0	76	0	0	0	N/A	N/A
Process Ponds	2	0	2	0	0	0	N/A	N/A

Project Component	Millennium Expansion Project Proposed Surface Disturbance (acres)		Alternative 1 – Trout Creek Diversion Realignment (acres)		Alternative 2 – Expanded Red Rock Pit Stabilization (acres)		Alternative 3 - No Action Alternative (Previously Authorized Surface Disturbance) (acres)	
	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land
Storm water Pond	1	0	1	0	0	0	N/A	N/A
Carbon columns & storage tanks	1	0	1	0	0	0	N/A	N/A
Total Heap Leach	321	34	321	34	321	34	62.5	171.5
Plant and Support Facilities New Support Facility								
Existing Mill and Plant Facilities	0	0	0	0	0	0	35	17
New Truck shop, warehouse, fuel dispensing	0	7	0	7	0	7	N/A	N/A
Total Plant and Support Facilities	0	7	0	7	0	7	35	17
Tailings Disposal Facilities								
Existing Tailings Facility	0	0	0	0	0	0	0	234
New Tailings Facility	0	0	0	0	0	0	N/A	N/A
Total Tailings	0	0	0	0	0	0	0	234
Growth Media Stockpiles								
Pre-FEIS	0	0	0	0	0	0	5	15
5-North (2 stockpiles)	0	0	0	0	0	0	0	10
8-North	0	0	0	0	0	0	5	0
New Tailings	0	0	0	0	0	0	0	8
SW Heap Leach Pad	0	0	0	0	5	0	0	5
Section 19	0	5	0	5	0	5	N/A	N/A
Section 16	5	0	5	0	0	0	N/A	N/A
Total Growth Media	5	5	5	5	5	5	10	38
Surface Water Diversion Structures								
Heap Leach - Old Tailings	0	0	0	0	0	0	0.1	2.9
5-North/Cottonwood Creek	0	0	0	0	0	0	4	6
8-North/Trout Creek	0	0	0	0	0	0	5	3
SW Heap Leach	0	0	0	0	0	0	5	8

Project Component	Millennium Expansion Project Proposed Surface Disturbance (acres)		Alternative 1 – Trout Creek Diversion Realignment (acres)		Alternative 2 – Expanded Red Rock Pit Stabilization (acres)		Alternative 3 - No Action Alternative (Previously Authorized Surface Disturbance) (acres)	
	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land
New Trout Creek Diversion	0	0	5	7	0	0	0	0
New storm water diversion structures(3)	0	0	0	0	0	0	N/A	N/A
Total Diversion Structures	0	0	5	7	0	0	14.1	19.9
Haul and Access Roads								
Pre-FEIS Haul Roads	N/A	N/A	N/A	N/A	N/A	N/A	22	38
5 North	0	0	0	0	0	0	14	14
Millennium Expansion Project Haul and Access Roads	27	25	27	25	27	25	N/A	N/A
Total Haul and Access Roads	27	25	27	25	27	25	36	52
Water Supply Facilities								
Pre-FEIS Water Supply	N/A	N/A	N/A	N/A	N/A	N/A	4	5
Lone Tree Water Line	N/A	N/A	N/A	N/A	N/A	N/A	0.1	3.9
Millennium Expansion Project Water Supply	11	10	11	10	11	10	N/A	N/A
Total Water Supply	11	10	11	10	11	10	4.1	8.9
Infill Surface Disturbance								
Infill Areas(2)	0	0	0	0	0	0	50	10
Millennium Expansion Project Infill Areas	51	63	51	63	51	63	N/A	N/A
Total Infill Disturbance Areas	51	63	51	63	51	63	50	10
Miscellaneous Ancillary								
Miscellaneous and Ancillary Facilities	0	0	0	0	0	0	1.5	0.5
Total Ancillary Facilities	0	0	0	0	0	0	1.5	0.5
Surface Exploration								

Project Component	Millennium Expansion Project Proposed Surface Disturbance (acres)		Alternative 1 – Trout Creek Diversion Realignment (acres)		Alternative 2 – Expanded Red Rock Pit Stabilization (acres)		Alternative 3 - No Action Alternative (Previously Authorized Surface Disturbance) (acres)	
	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land	Public Land	Private Land
Drill roads, pads, trenches	N/A	N/A	N/A	N/A	N/A	N/A	17	25
Millennium Expansion Project Surface Exploration	0	0	0	0	0	0	N/A	N/A
Total Surface Exploration	0	0	0	0	0	0	17	25
Disturbance by Land Status	807	667	812	674	807	667	747.2	1,083.9
Disturbance Total	1,474		1,486		1,474		1,831.1	

Notes: (1)The total authorized disturbance does not include the 150 acres of reclaimed and recently released acres at the 8-South Waste Rock Storage Area.

(2)The acres shown for previously authorized disturbance for the Southwest Leach Pad and the infill areas reflect the changes authorized in the March 2002 Minor Modification DNA to eliminate 12 acres of disturbance on private land from the authorized infill disturbance, and to reconfigure the layout of the Southwest Heap Leach Pad to cover an additional 12 acres of private land.

(3)Surface disturbance for Millennium Expansion Project storm water diversion structures is accounted for in the acres shown for the Millennium Expansion Project pits and waste rock storage facilities.

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3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Introduction

This chapter provides a description of the existing condition of the environment (i.e., affected environment) as the base for determining potential impacts (i.e., environmental consequences) from the implementation of the Proposed Action and alternatives. The baseline information summarized below was obtained from published and unpublished materials, contacts with local, state, and federal agencies, and from field and laboratory studies in the Project Area. The geographic area considered for analysis was based on previous NEPA analysis and the scoping process. For each of the resources analyzed, the area of affected environment was defined by the area of potential environmental impacts due to the Proposed Action and alternatives. For site-specific resources, such as vegetation, the affected environment was determined to be the physical location and immediate vicinity of the areas of potential disturbance. Other resources, that are not site-specific, water resources and geochemistry, and Native American Cultural Values, the affected environment was determined to be more extensive.

This SEIS adds to the analysis that was conducted in the FEIS (BLM 2001). The two documents are integrally related, and some of the text from the previous FEIS is included verbatim, some is summarized, and much is incorporated by reference. The attempt has been made to create a stand-alone document with sufficient detail to allow the public to make their own conclusions. However, for those that required additional detail, the information from the previous FEIS is referenced by FEIS Section and/or page numbers. The BLM determined during the development of the Data Adequacy Standards for this NEPA analysis that many of the impacts were of similar nature to the impacts identified in the FEIS (BLM 2001). Most of the components of the Proposed Action and alternatives extend the duration or result in an incremental increase in the magnitude of the previously identified impacts. However, the potential for new or different impacts existed because of the location of the Proposed Action, and the uncertainty regarding the base level of some resources (e.g., groundwater elevations).

For each resource, the regulatory framework governing the resource use, protection, or management is provided. These laws, regulations, and policies set the limits for impacts (e.g., water quality standards), or set conditions under which certain activities may take place (e.g., the Migratory Bird Treaty Act). The context of these laws, regulations, and policies guide the analysis.

The analysis also assumed that the environmental protection measures included in the Proposed Action would be implemented. These measures were designed to reduce potential impacts or comply with laws or stipulations of permits. The impacts were generally described as direct (i.e., a proximal cause of change to a resource), or indirect (i.e., a contributing factor to the change to a resource), and as short-term (i.e., occurring over the life of the mining activity through reclamation) or long-term (i.e., extending well beyond the life of the mining activity). Where impacts have been identified, mitigation measures have been developed by the BLM, depending on the level and nature of the impact. These measures are not part of the Proposed Action or alternatives, but may be included as conditions or stipulations for approval of the PoO. Residual adverse impacts are those impacts, which remain following implementation of the mitigation measures.

BLM has identified Critical Elements of the Human Environment that are required to be addressed in all NEPA documents. For those critical elements that are not present within the Project Area or affected environment area, or those critical elements that may be present but would not be affected, the elements are identified below and are not discussed further in the SEIS. This elimination of non-relevant issues follows the CEQ guidelines (40 CFR 1500.4).

Critical Elements of the Human Environment that have been determined to either not be present or not affected by the Proposed Action or alternatives include the following:

- Areas of Critical Environmental Concern – none present;
- Prime or Unique Farmlands – none present;
- Floodplains – none would be affected;
- Wetlands and Riparian Zones – none would be affected;
- Wilderness – none present;
- Environmental Justice – determined in the previous FEIS that the mine project would have insignificant economic and social impacts within the context of current conditions within Humboldt and Lander counties; and
- Wild and Scenic Rivers – none present.

The remaining Critical Elements of the Human Environment and other resources identified during the scoping process are addressed in the following sections of this chapter.

3.2 Geology and Minerals

Information detailing geological and mineral resources is provided in Section 3.2 of the FEIS (BLM 2001, pages 3-37 through 3-55) and is summarized below.

3.2.1 Regulatory Framework

The BLM is responsible for administering mineral rights access on certain federal lands as authorized by the General Mining Law of 1872. The law provides qualified prospectors reasonable access to mineral deposits on public domain lands that have not been withdrawn from mineral entry. BLM regulations for surface management of public lands mined under the General Mining Law are provided in 43 CFR 3809. The regulations require the BLM to review proposed operations to ensure that:

- Adequate provisions are included to prevent undue and unnecessary degradation of federal lands and to protect non-mineral resources on these lands;
- Measures are included to provide for reclamation of disturbed areas;
- The operations are in compliance with applicable federal, state, and local laws and regulations; and
- Bonding for reclamation is sufficient.

The Winnemucca Field Office operates under the guidance of the Sonoma-Gerlach MFP, which states that the BLM would "make public lands and Federally-owned minerals available for the exploration and development of mineral and material commodities."

Humboldt County Planning Department regulates mining operations in Humboldt County, Nevada through the Humboldt County Zoning Ordinance. The Humboldt County Zoning Ordinance requires the mining operator to obtain a Special Use Permit prior to conducting any mining operation. Construction of mine facilities is regulated by standards of the Uniform Building Code (UBC). Humboldt County uses the 1997 version of UBC.

3.2.2 Affected Environment

The Glamis Marigold Mine is located in the Battle Mountain Mining District of north-central Nevada, approximately 40 miles southeast of Winnemucca in Humboldt County, Nevada (Figure 3-1). The existing Marigold Mine has been operating since 1988 and consists of five active open pits and one inactive open pit developed within oxide gold ore deposits occurring along bedding faults and fault intersections in the Valmy Formation and the Antler sequence. The mineralization is disseminated and oxidized. The oxide gold ore zones are to be open-pit mined and heap leached for recovery of the gold. Sulfide gold mineralization is nearly absent; no sulfide ore is anticipated to be mined as part of the Millennium Expansion Project.

Waste rock mined to date at the Marigold Mine includes Valmy Formation quartzite, argillite and shale; the Antler sequence, which at Marigold consists of the Battle Formation (conglomerate), the Antler Peak Limestone (primarily gray limestone with some siltstone, sandstone, and conglomerate beds), and Edna Mountain Formation (siltstone, sandstone, and sedimentary breccia); and the Havallah sequence, which consists of conglomerate, shale, sandstone, limestone, metavolcanics, and chert.

Appendix B and Table B-1 in the FEIS provide detailed information on the volume of each waste rock mined from 1988 through 1998. The Millennium Expansion Project waste rock would comprise the same suite of rocks mined to date at the Marigold Mine. The dominant Millennium Expansion Project waste rock lithologies would be the Valmy Formation and the Antler sequence.

3.2.2.1 Regional Geological Setting

The Marigold Mine is located on the northwestern flank of Battle Mountain within the drainage of the Humboldt River. This part of northern Nevada is characterized by large block uplifts separated by deep structural valleys that contain alluvial gravels and sands as well as Tertiary lakebed sediments. The valleys can be up to 10,000 feet deep. North of the Marigold Mine, the valley alluvium is at least 2,000 feet thick. The Project Area encompasses an area of variably deformed, locally covered Paleozoic bedrock that is offset by mainly north-trending faults. Mineralization at the mine is surrounded by and frequently covered by alluvial fan sediments shed from Battle Mountain.

The gold deposits in the Marigold area are hosted in Paleozoic sediments and meta-sediments that have been variably folded and faulted during as many as three major orogenic episodes.

The Antler Orogeny of late Devonian to early Mississippian age is the oldest major structural event that affects the degree of deformation of ore-bearing lithologic units in the mining district (Table 3-1). This major mountain-building event was followed by the Sonoma Orogeny of Permian-Triassic age that resulted in the emplacement of the Golconda allochthon over rocks deformed by the Antler Orogeny (Roberts Mountain allochthon) and the younger Antler overlap sequence. This orogeny progressed by eastward movement of the upper plate along the Golconda thrust fault, which is a major structural control over mineralization in some of the gold deposits of the Marigold Mine. Tertiary Basin and Range faulting and uplift resulted in the formation of Battle Mountain.

Most of the gold deposits of the Battle Mountain district are believed to have been formed during an Eocene-earliest Oligocene period of extension and magmatism at about 38-41 million years ago (Ma) (McGibbon and Theodore 2002).

3.2.2.2 Stratigraphy

The stratigraphy of the Battle Mountain area is shown in Table 3-1. The regional geology of the district and surrounding areas is presented in Figure 3-2. The Paleozoic stratigraphy of the Project Area can be divided into three Paleozoic rock assemblages; the Roberts Mountain allochthon (Ordovician Valmy Formation), the autochthonous overlap assemblage (Pennsylvanian-Permian Antler sequence) deposited on the margins of the eroded Antler orogenic highland, and the Golconda allochthon (Havallah sequence) which structurally overlies both rock assemblages, above the Golconda thrust fault (Doebrich 1995).

Roberts Mountain Allochthon

The Roberts Mountain allochthon at Marigold is comprised of Ordovician quartzite, argillite, shale, metabasalt, chert, and sandstone deformed by the Antler orogeny. In the mine area the Roberts Mountain allochthon is represented by the Valmy Formation (Roberts 1964, Theodore 1991, and Doebrich 1995).

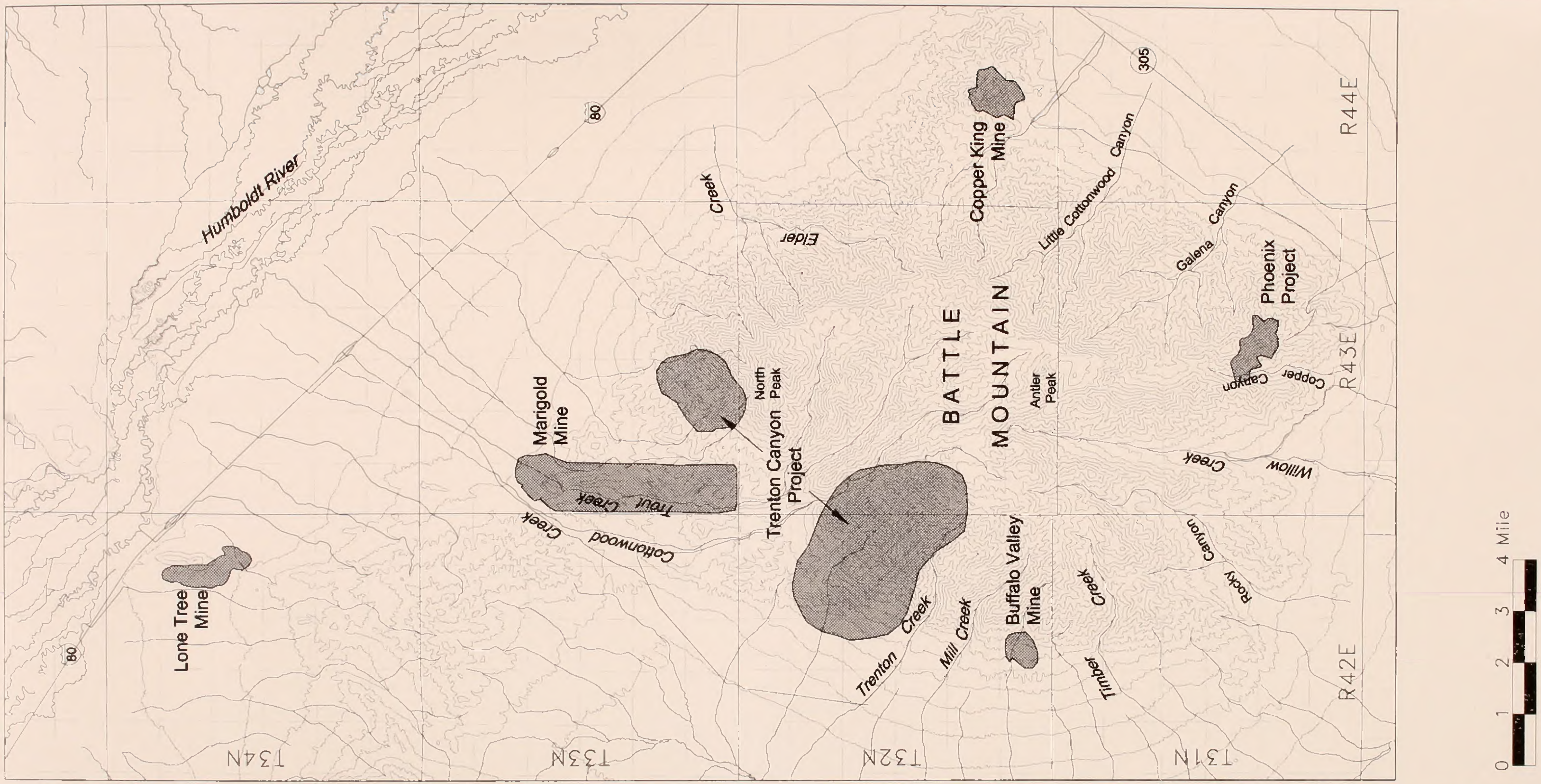
The Valmy Formation is one of the hosts to gold mineralization at the Marigold Mine.

Overlap Assemblage

The overlap assemblage, as represented by the Antler sequence, is autochthonous and is comprised of sediments eroded from the highlands of the Antler orogeny and deposited in shallow and marginal marine environments of a foreland basin during the Pennsylvanian through the early Permian (Roberts 1964). In the mine area, the Antler sequence is comprised of the following formations, from oldest to youngest:

- Battle Formation: Pennsylvanian chert-pebble conglomerate, and sandstone with minor shale;
- Antler Peak Limestone: Pennsylvanian and Permian limestone with calcareous conglomerate, sedimentary breccia, sandstone and siltstone; and
- Edna Mountain Formation: Permian conglomerate, siltstone, sandstone and minor limestone.

All three of these formations, as well as the Valmy Formation locally contain ore at Marigold (McGibbon and Wallace 2002).



Millennium Expansion Project

Figure 3-1

General Location Map with Area Mines

Table 3-1: Battle Mountain Area Stratigraphic Column

Geologic Time Period	Unit Thickness	Stratigraphic Unit	Description
Tertiary – Quaternary	Variable	Alluvium	Alluvial deposits including terrace deposits, stream gravels, and bench gravels
	--	Basalt flows	Basaltic flows that are locally interbedded with alluvial gravels
	--	Tuffs and ashflows	Felsic tuff and ashflows that are locally interbedded with alluvial gravels
Cretaceous – Tertiary	--	Intrusives	Felsic intrusives
GOLCONDA ALLOCHTHON (HAVALLAH SEQUENCE)			
Mississippian – Permian	5,000 feet	Pumpernickel Formation	Interbedded chert and siltstone
	10,500 feet	Havallah Formation	Interbedded conglomerate, shale, sandstone, limestone, metavolcanics, and chert
OVERLAP ASSEMBLAGE (ANTLER SEQUENCE)			
Permian	600 feet (Murchey, Theodore, and McGibbon 1995)	Edna Mountain Formation	Conglomerate, sedimentary breccia, calcareous siltstone, sandstone, and minor limestone
Pennsylvanian – Permian	200 feet	Antler Peak Limestone	Medium-dark gray bedded limestone with local calcareous conglomerate, sandstone, and siltstone
Pennsylvanian	400 feet	Battle Formation	Chert-pebble conglomerate, sandstone and minor shale
ROBERTS MOUNTAIN ALLOCTHON			
Devonian	2,000 feet	Scott Canyon Formation	Chert, argillite and greenstone
Ordovician	3,000 to 8,000 feet	Valmy Formation	Interbedded quartzite, shale, argillite, chert, pillow metabasalt, and minor sandstone
Cambrian	3,000 feet	Harmony Formation	Olive gray-green feldspathic sandstone

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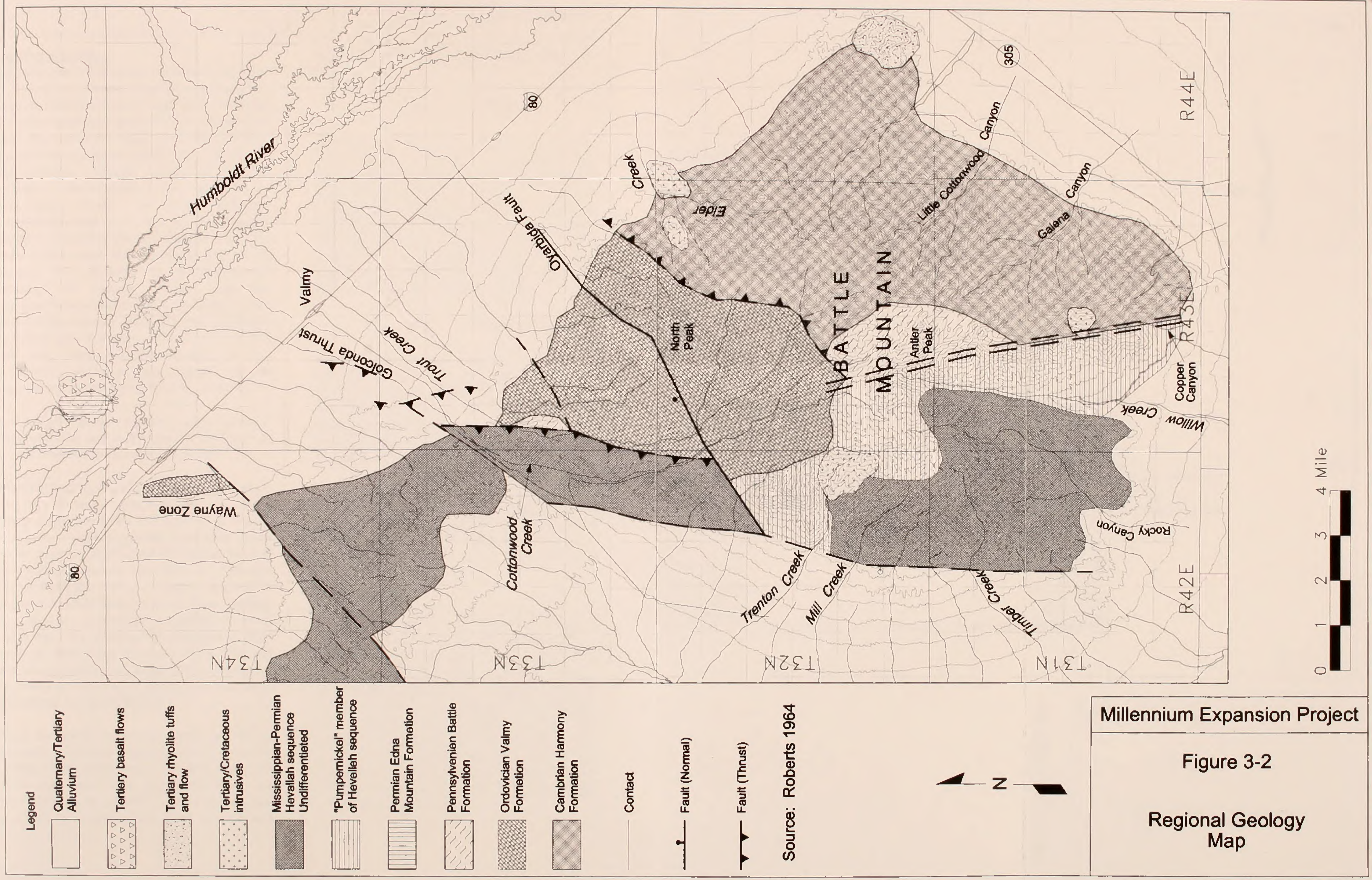


Millennium Expansion Project

Figure 3-2

Regional Geology Map

Golconda Allochthon

The rocks that comprise the Golconda allochthon, known as the Havallah sequence (Mississippian-Permian), were emplaced over the Valmy Formation and Antler sequence during the Sonoma orogeny, along the Golconda thrust fault. The Havallah sequence was previously thought to be made up of two formations (Roberts 1964): the Havallah Formation, Mississippian and Permian – conglomerate, shale, sandstone, limestone, metavolcanics, and chert, and the Pumpernickel Formation, Pennsylvanian and Permian chert and siltstone. More recent work by Stewart et al. (1986) disproves the existence of a 'Pumpernickel Formation' and suggests assigning these two 'formations' to the Havallah sequence, on the basis of widely varying ages for rocks originally assigned to the Pumpernickel Formation. In Figures 3-2 and 3-3, rocks that were originally assigned to the Pumpernickel Formation are mapped as the 'Pumpernickel' member of the Havallah sequence.

The Havallah sequence is a major regional tectono-stratigraphic unit and is the principal unit used to define the extent of the Golconda thrust fault.

During the Late Cretaceous to early Tertiary periods (60 - 100 Ma), many areas of western and central Nevada experienced the intrusion of plutons of granodiorite to quartz monzonite composition. These granitic magmas altered and mineralized the wall rocks in place. However, most, if not all, of the gold deposits of the Battle Mountain area are believed to have formed during late Eocene-early Oligocene time, about 38-41 Ma., in relation to a regional extensional regime and the emplacement of additional felsic stocks (McGibbon and Theodore 2002). This has been well documented at both Battle Mountain and at the nearby McCoy – Cove deposits, as well as in other districts in northern Nevada.

During the Tertiary period, the Basin and Range underwent extensive faulting and volcanism. Additional felsic stocks were developed during this period, and felsic tuffs and basalt flows are interbedded with the alluvial fan sediments that were developing as a result of uplift. Battle Mountain was formed during the middle to late Tertiary uplift (10 - 25 Ma).

3.2.2.3 Structure

The major structural features of the Battle Mountain area are shown on Figure 3-2. The main structural features are thrust faults and north-trending normal faults. The thrust faults are related to the Antler Orogeny (the Roberts Mountains thrust fault is believed to be present but very deeply buried) and the Sonoma Orogeny. The Sonoma Orogeny resulted in development of the Golconda thrust fault. The normal faults are related to Basin and Range faulting during the middle to late Tertiary (Roberts 1964).

3.2.2.4 Mineralization

In the area near Marigold, only the Marigold Mine and the Lone Tree Mine have been continuously active. The Trenton Canyon deposit to the south is mined out. Intermittent mining at the Buffalo Valley Mine, further south, ended in the late 1980s – early 1990s and the Valmy deposit (Trenton Canyon Project) to the east is currently being mined.

Figure 3-3 presents a simplification of the geology at the Glamis Marigold Mine. Representative cross sections of the Terry Zone, Mackay, Target No. 1, Target No. 2, Basalt, and Antler pits are shown in Figures 3-4, 3-5, 3-6, 3-7, 3-8, and 3-9, respectively.

Terry Zone Pit

The development of the Terry Zone Pit would involve expanding the Top Zone and Red Rock pits to mine a deeper, structurally controlled, ore zone referred to as the Terry Zone Pit. Mineralization of the Terry Zone Pit is found in the Valmy Formation, primarily comprised of quartzite and to a lesser extent argillite or shale with minor sandstone and chert. Quartzite and argillite form the bulk of this rock unit. The quartzite is light to dark gray, with interbeds of white to green argillite. Zones have been sheared and boudined to form pods of isoclinally folded forms in outcrops. This rock unit is very low in sulfides, with iron staining along fractures.

Minor amounts of the Antler sequence (Edna Mountain sandstone) would be mined along the western margins of the pit. The Havallah Formation and the Edna Mountain Formation locally overlie the Antler Peak Limestone in the mine area (Figure 3-4).

Mackay Pit
This shallow and small pit would be developed south of the East Hill South Pit, in oxidized Valmy Formation as described above (Figure 3-5).

Target No. 1 Pit
Among the first areas to be mined would be the Target No. 1 Pit located in the east ½ of Section 30. This shallow pit would be developed in shallow alluvium and oxidized Valmy Formation as described above (Figure 3-6).

Target No. 2 Pit
The Target No. 2 Pit would be mined concurrently with the Target No. 1 Pit. The Target No. 2 Pit is located in the south ½ of Section 30 and the north ½ of Section 31. Waste rock mined from the Target No. 2 Pit would be backfilled into the Target No. 1 Pit and thus would form the base of the main South Waste Rock Storage Area. This pit would be developed in unconsolidated Quaternary alluvium, weakly consolidated Tertiary alluvium and minor volcanic tuff and intrusives, Antler Peak Limestone, Edna Mountain siltstone and sedimentary breccia, and Valmy quartzite and shale (Figure 3-7). Rock units are oxidized with almost no sulfide content.

Basalt Pit
After development of the Target No. 2 Pit is well advanced, the Basalt Pit, located in the southeast ¼ of Section 31 would be developed. Waste rock from the Basalt Pit would continue the development of the main waste rock storage area, but upon completion of mining in the Target No. 2 Pit, waste rock from the Basalt Pit would be dumped into the Target No. 2 Pit to reduce the footprint of the main Millennium waste rock storage area. The Basalt Pit would predominantly be comprised of Valmy Formation, with up to 200 feet of Tertiary alluvium and volcanic tuff covering the bedrock (Figure 3-8). Valmy lithologies to be mined include quartzite, shale, argillite, metabasalt, and chert. These rocks are oxidized within the pit and demonstrate iron-oxide staining. Locally along the west margin of the pit, a minor amount of Antler sequence would be mined.

Antler Pit
Development of the Antler Pit, located in the southwest ¼ of Section 31, would occur later in the production plan. Mineralization occurs in Antler sequence rocks, including limestone, siltstone and sedimentary breccia overlain by a thick cap of Tertiary or younger alluvium and tuff (Figure 3-9). The Antler sequence rocks are strongly oxidized with almost no sulfide present.

3.2.2.5 Oil, Gas and Geothermal Resources

Oil and gas exploration has occurred sporadically throughout northern Nevada. In 1993 mineral exploration near Kyle Hot Springs, approximately 45 miles southwest of the property, located oil-containing hot water and a low volume production well was installed. Oil and gas resources have not been identified at any other location administrated by the Winnemucca Field Office.

Geothermal resources are hot water systems created by deep groundwater contacting a deep-seated heat source, such as magma. These heated waters form underground geothermal reservoirs that, when connected to the land surface, can result in hot springs, hot pools, fumaroles, geysers, and boiling mud pots. The BLM recently published a Geothermal Resources Leasing Programmatic Environmental Assessment (2002) to respond to the May 2001 National Energy Policy. This policy is a direct response to increasing energy needs and the plan to expedite processing of energy development on public lands.

Public lands administrated by the Winnemucca Field Office have been divided into eight geothermal assessment areas, with the Marigold Mine located within the Humboldt River Basin area. The area around Battle Mountain is a known geothermal high and hot springs are known in the Humboldt River

Basin area; however, none are known at or within the immediate area of the Millennium Expansion Project. The nearest known hot springs, Brooks Springs and Sulfur Springs, are located approximately seven and ten miles northeast of the property, respectively. Blossom Hot Springs (Hot Pots), are located approximately fourteen miles northeast of the Millennium Expansion Project.

Accordingly, there are presently no known oil, gas or geothermal resources identified with the Marigold Mine Property or the Millennium Expansion Project.

3.2.2.6 Seismicity

The Project Area is not located in an area of known seismicity. The nearest zone of seismic activity is the Nevada Seismic Belt located about ten to 15 miles to the west. This belt runs northeast through eastern Pershing County and encompasses the Humboldt River Valley in Pershing County as well as Buena Vista Valley and Grass Valley. The belt runs west of the Lone Tree Mine and up toward the Twin Creeks Mine (Figure 3-10).

The largest recorded earthquake near the Glamis Marigold Mine was a Richter Magnitude 7.8 located about 25 miles southwest of the mine along the Nevada Seismic Belt (Figure 3-11). Two post-1970 seismic events with a magnitude in the vicinity of 4.0 to 5.0 on the Richter Scale were recorded within approximately 20 miles northwest of the mine site. The maximum credible earthquake for the northern part of the Nevada Seismic Belt would produce an acceleration about 0.48 times the acceleration of gravity (Siddharthan et al. 1993). The largest recorded earthquake within 100 miles of the site produced a ground acceleration of 0.09 times the acceleration of gravity (BLM 1996a).

3.2.3 Environmental Consequences & Mitigation Measures

3.2.3.1 Assessment Methodology

Impacts of the Proposed Action and alternatives were assessed based on review of the EIS, review of the PoO for the project (GMMC 2002) and review of the Proposed Action and alternatives.

3.2.3.2 Proposed Action

The Proposed Action would extract and displace geologic materials from their original setting. Approximately 244 million tons of waste rock and 80 million tons of spent ore would be accommodated in waste rock storage facilities and existing and new leach pads. Approximately 1.5 million ounces of gold would be extracted from the new pits and pit expansions. Other direct impacts to mineral resources include burying, through pit backfilling, economically unfeasible resources which may become economic in the future from backfilling operation.

Stability analysis conducted for the various mine facilities indicate that the pits (Vector Engineering 1987), and heap leach pad design (Chilton Engineering 1988, Harding Lawson Associates 1992, Davis 1993, Vector Engineering 2000), area designed to withstand anticipated seismic events. Therefore, no impact is anticipated from structural damage or failure of a facility caused by seismic loading by earthquakes

The Proposed Action would also result in an incremental increase in the irreversible and irretrievable impacts to geology and minerals because of the further removal and loss of mineral resources.

3.2.3.3 Alternative 1 – Trout Creek Diversion Realignment

Under this alternative, the Trout Creek Diversion would be realigned. Alluvial and bedrock material would be excavated to accommodate the realignment. Impacts to geological and mineral resources from the Trout Creek Diversion Realignment are generally the same as those described for the Proposed Action, with the exception of bedrock excavation for a portion of the diversion channel. The additional 12 acres of disturbance associated with this alternative does not measurably change the overall impact to geologic resources.

3.2.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to geological and mineral resources from the expanded stabilization of the Red Rock Pit are generally the same as those described for the Proposed Action. Partial backfilling of the Red Rock Pit would bury resources that are currently not economical to extract, but which may become economic in the future. The pit high wall would be stabilized.

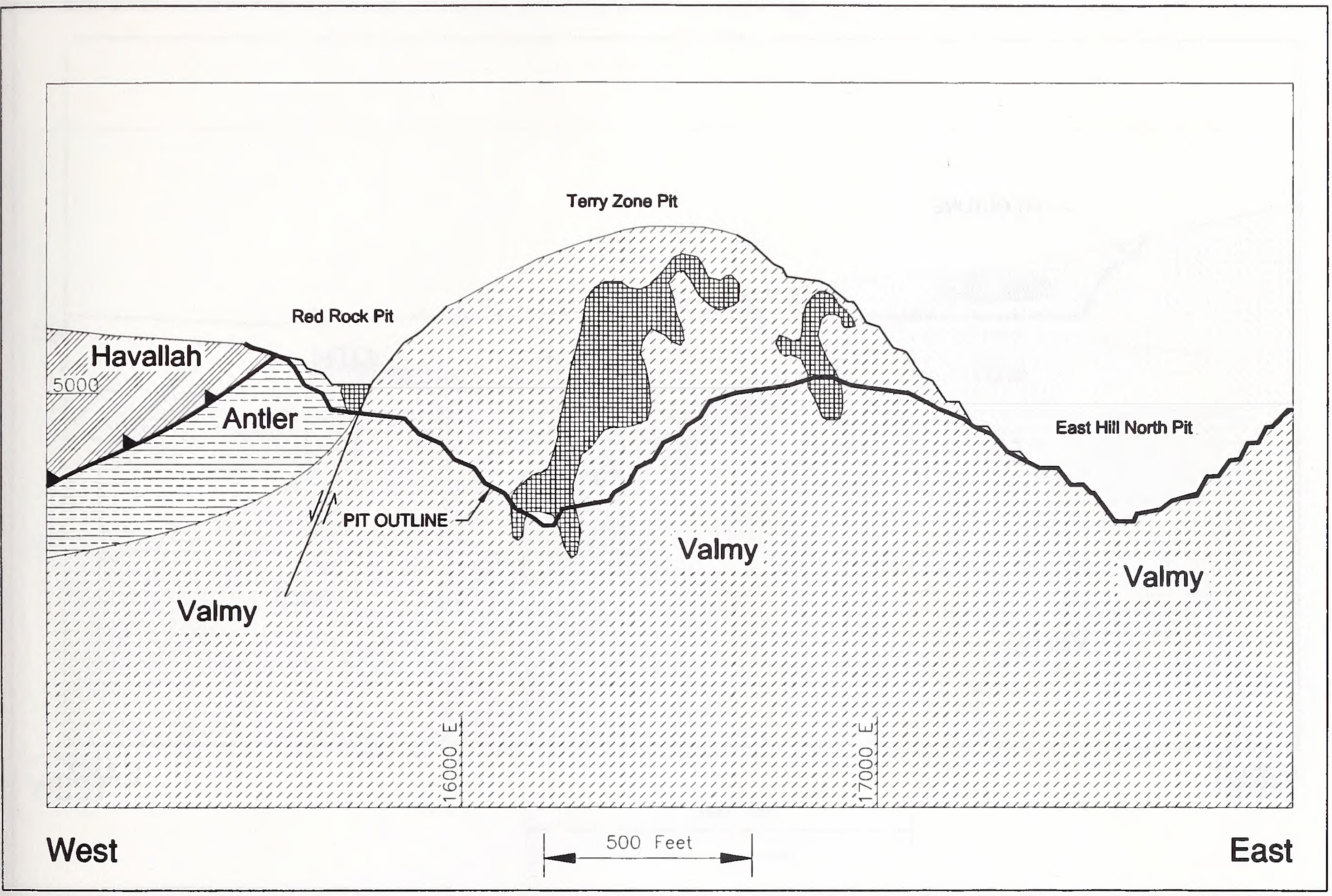
3.2.3.5 Alternative 3 – No Action Alternative

No impacts to geologic and mineral resources would occur under the No Action Alternative beyond what is presently occurring under existing and approved operations.

Millennium Expansion Project

Figure 3-3

Site Geology Map



LEGEND

Quaternary/Tertiary

QTal — Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

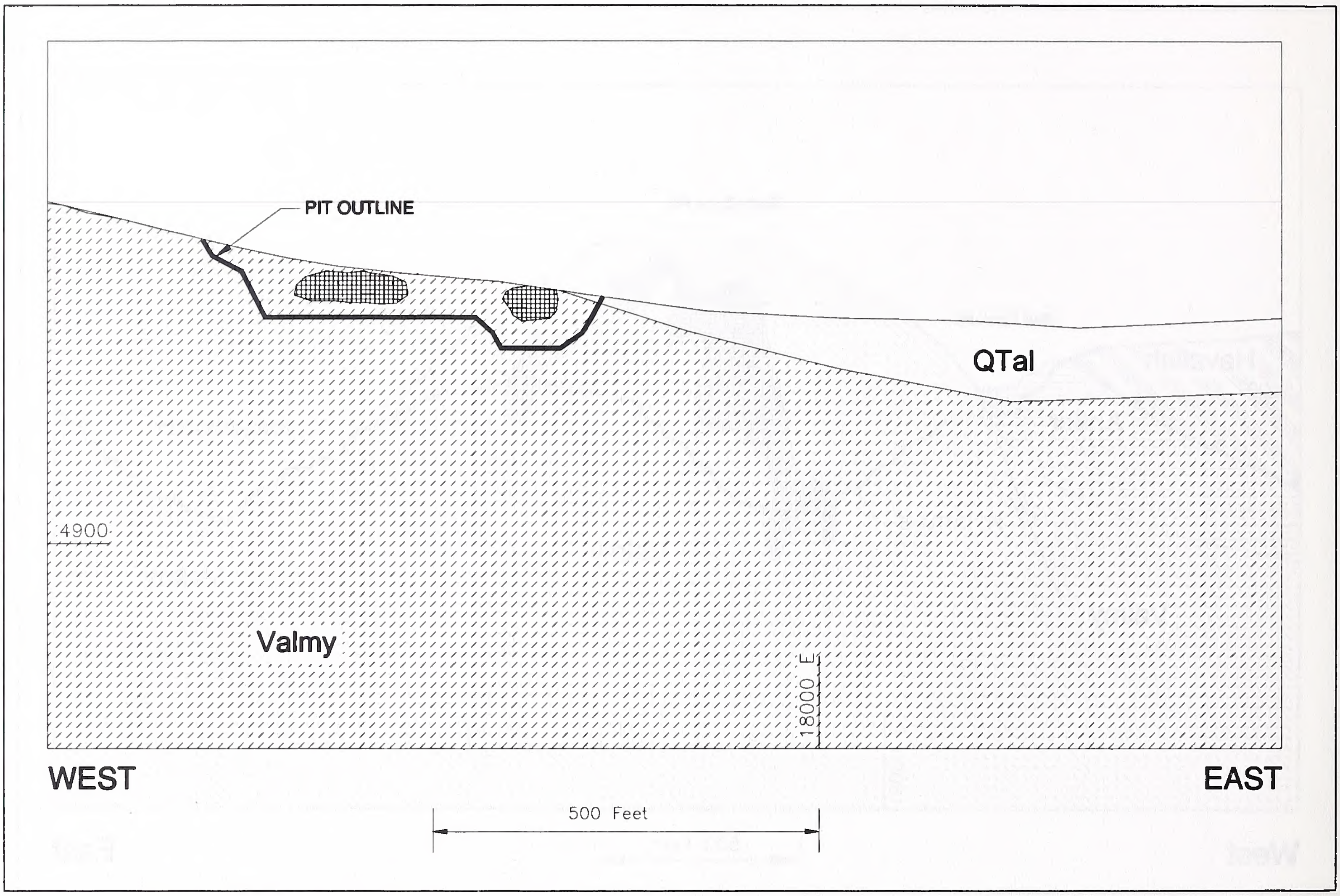
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-4

Geologic Cross-Section for Terry Zone



LEGEND

Quaternary/Tertiary

QTal Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

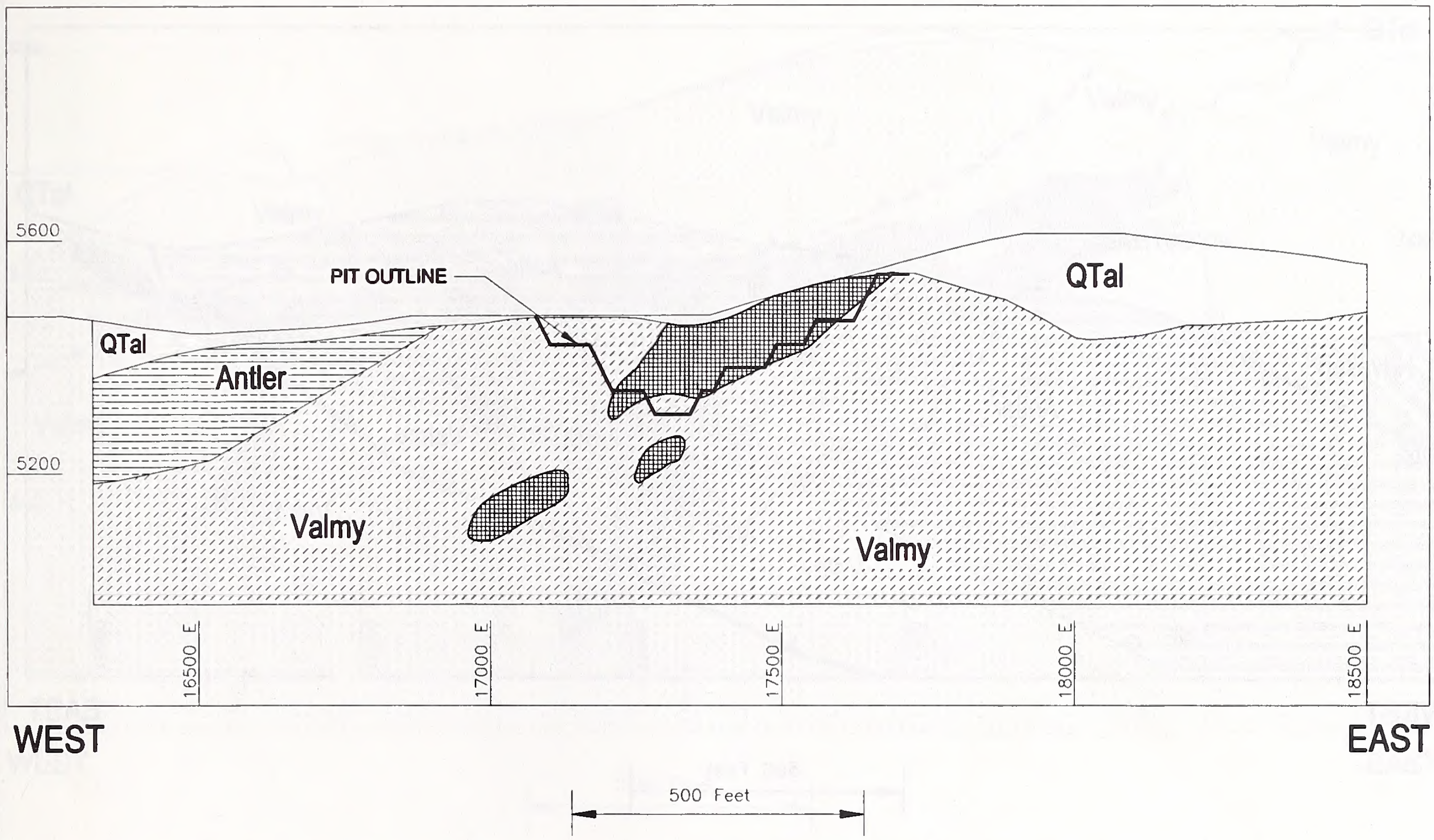
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-5

Geologic Cross-Section for Mackay Pit



LEGEND

Quaternary/Tertiary

QTal — Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

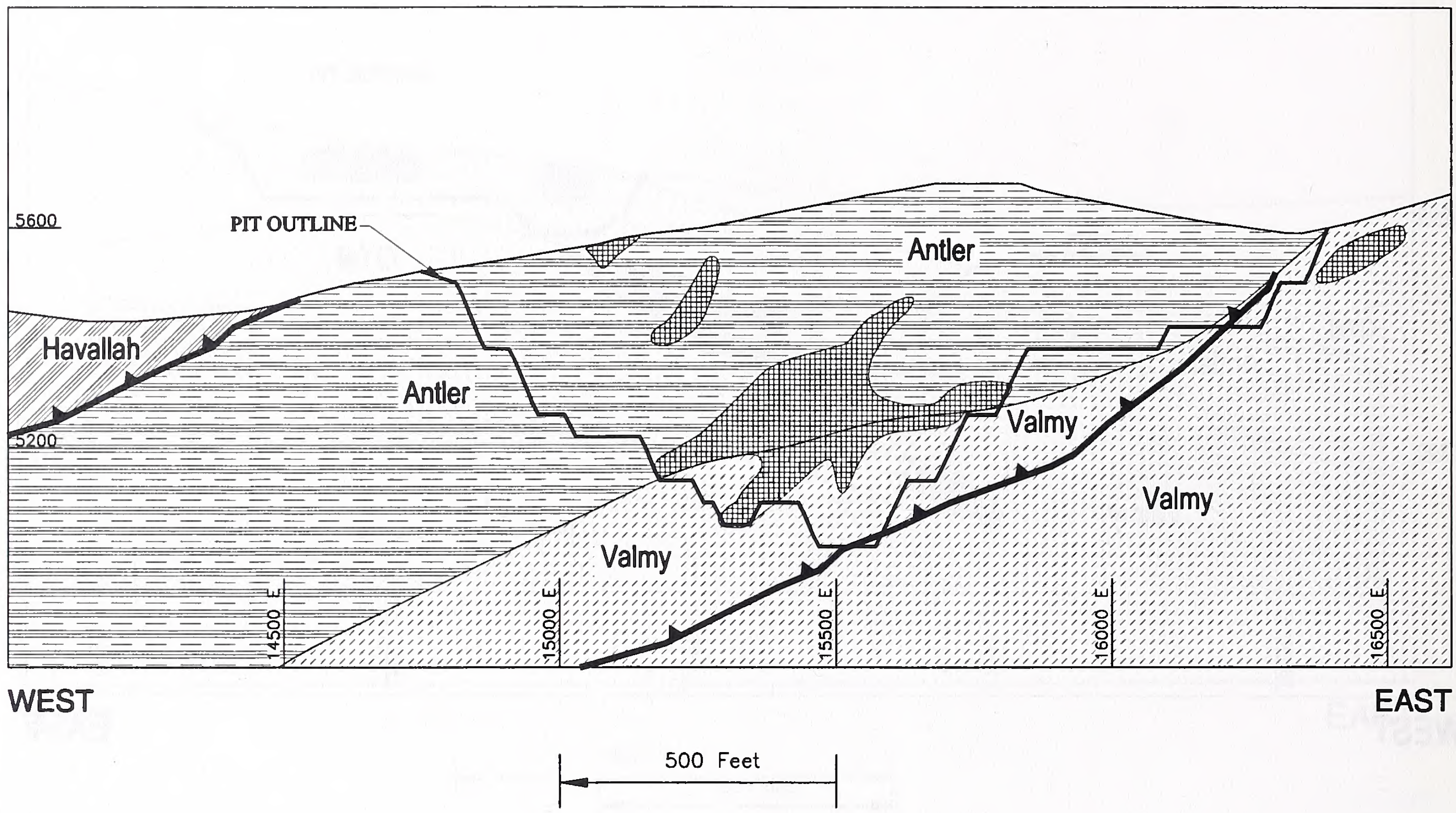
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-6

Geologic Cross-Section for Target No.1 Pit



LEGEND

Quaternary/Tertiary

QTal — Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation

Gold Zone or Significant Gold Anomaly

Geologic contact

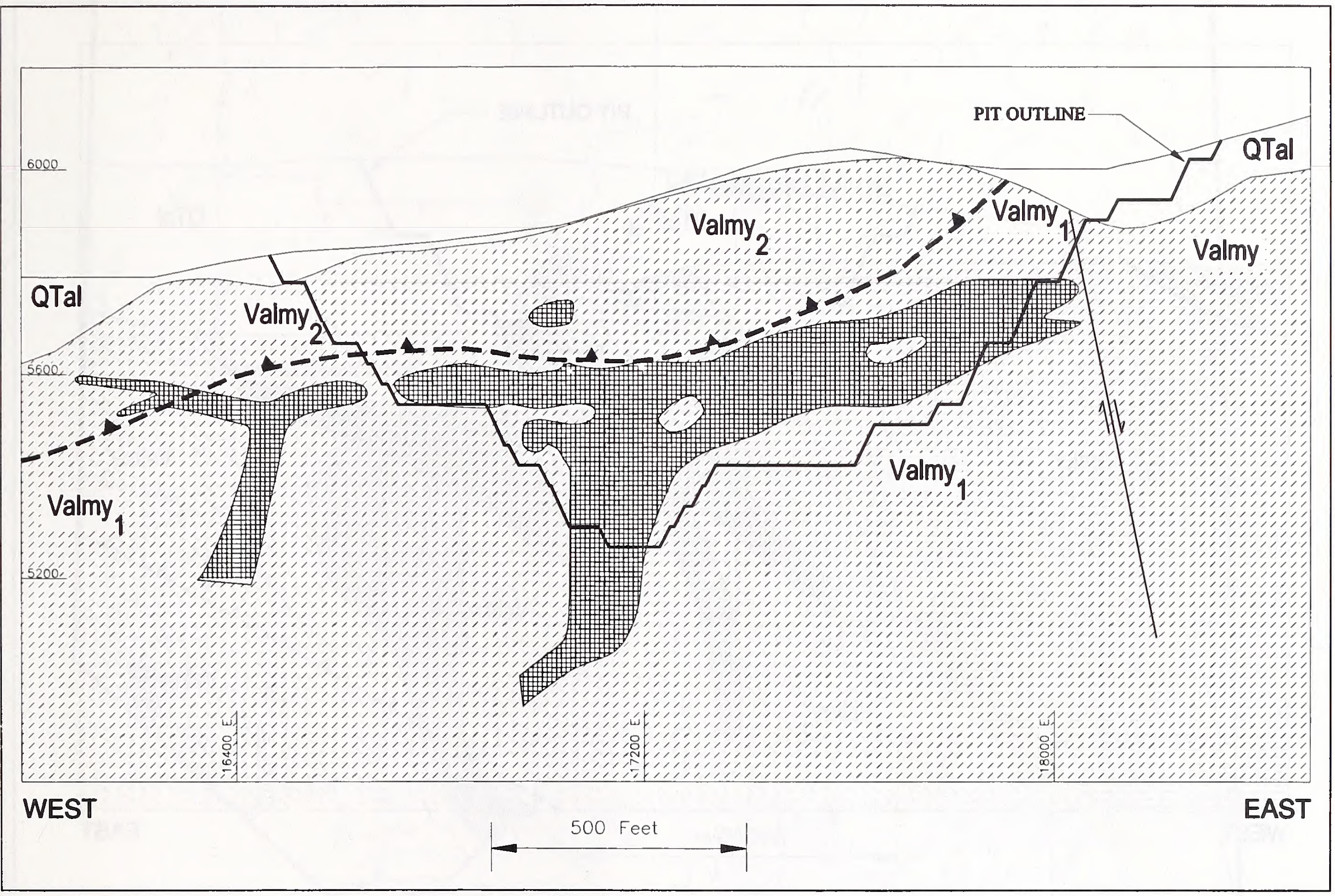
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-7

Geologic Cross-Section for Target No. 2 Pit



LEGEND

Quaternary/Tertiary

QTal	Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation 1 = "Lower" Quartzite
2 = Chert Metabasalt-argilite

Gold Zone or Significant Gold Anomaly

Geologic contact

Minor Thrust Fault

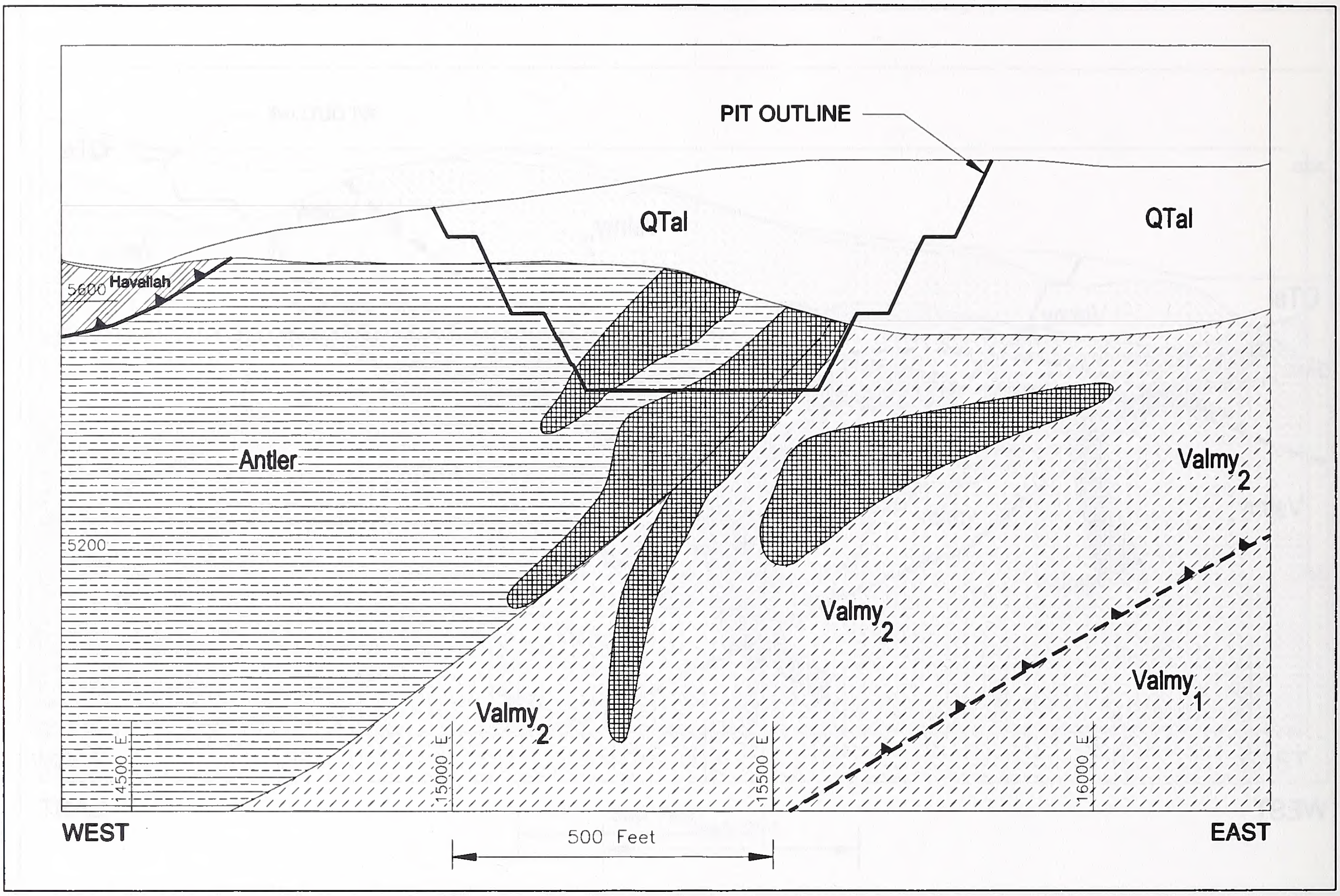
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-8

Geologic Cross-Section for Basalt Pit



LEGEND

Quaternary/Tertiary

QTal — Alluvium

Permian

Edna Mountain Formation

Mississippian-Permian

Havallah sequence

Golconda Thrust Fault

Antler sequence

Pennsylvanian

Battle Formation

Ordovician

Valmy Formation — 1 = "Lower" Quartzite; 2 = Chert Metabasalt-argilite

Gold Zone or Significant Gold Anomaly

Geologic contact

Minor Thrust Fault

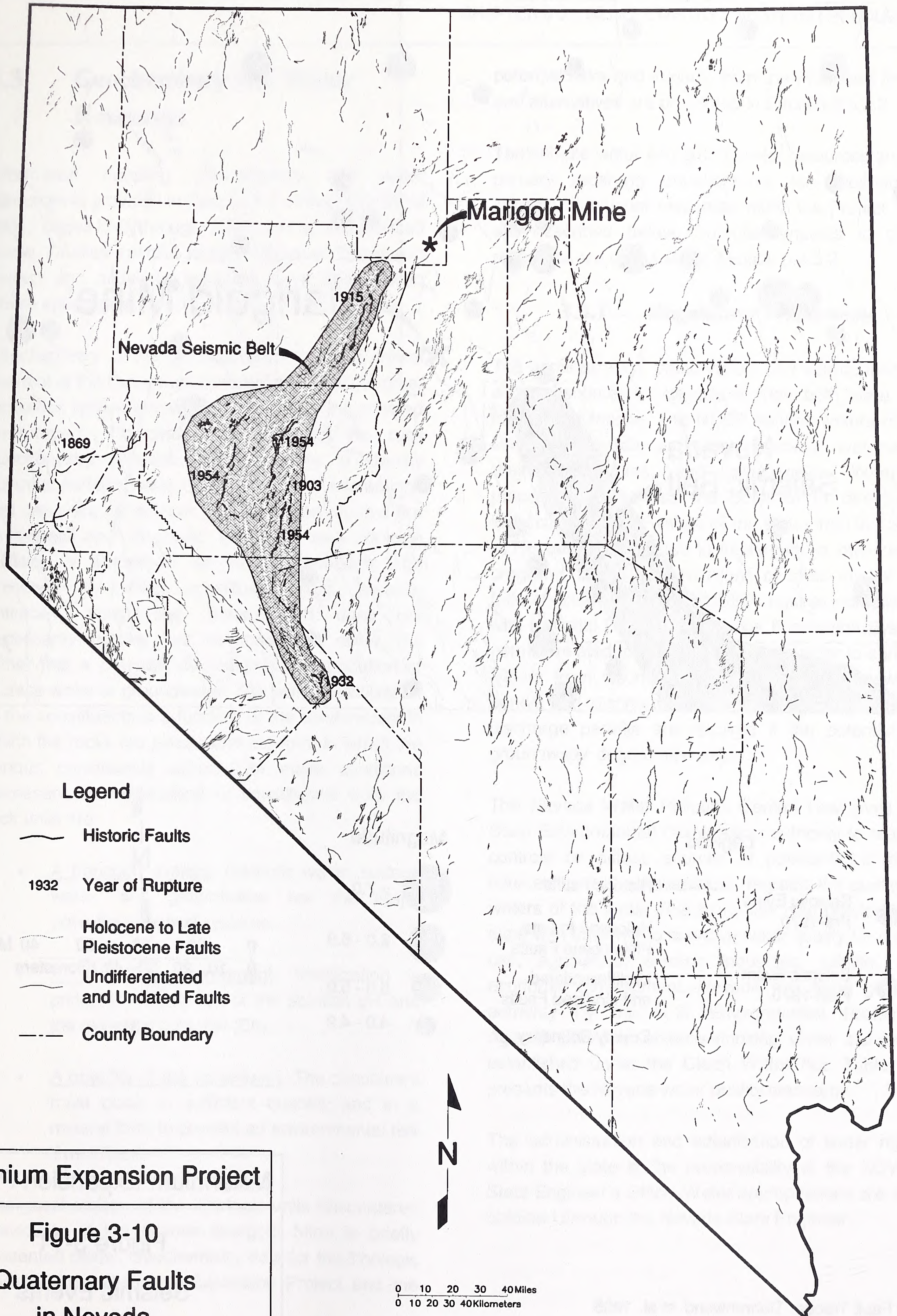
Fault

Source: Marigold Mine

Millennium Expansion Project

Figure 3-9

Geologic Cross-Section for Antler Pit

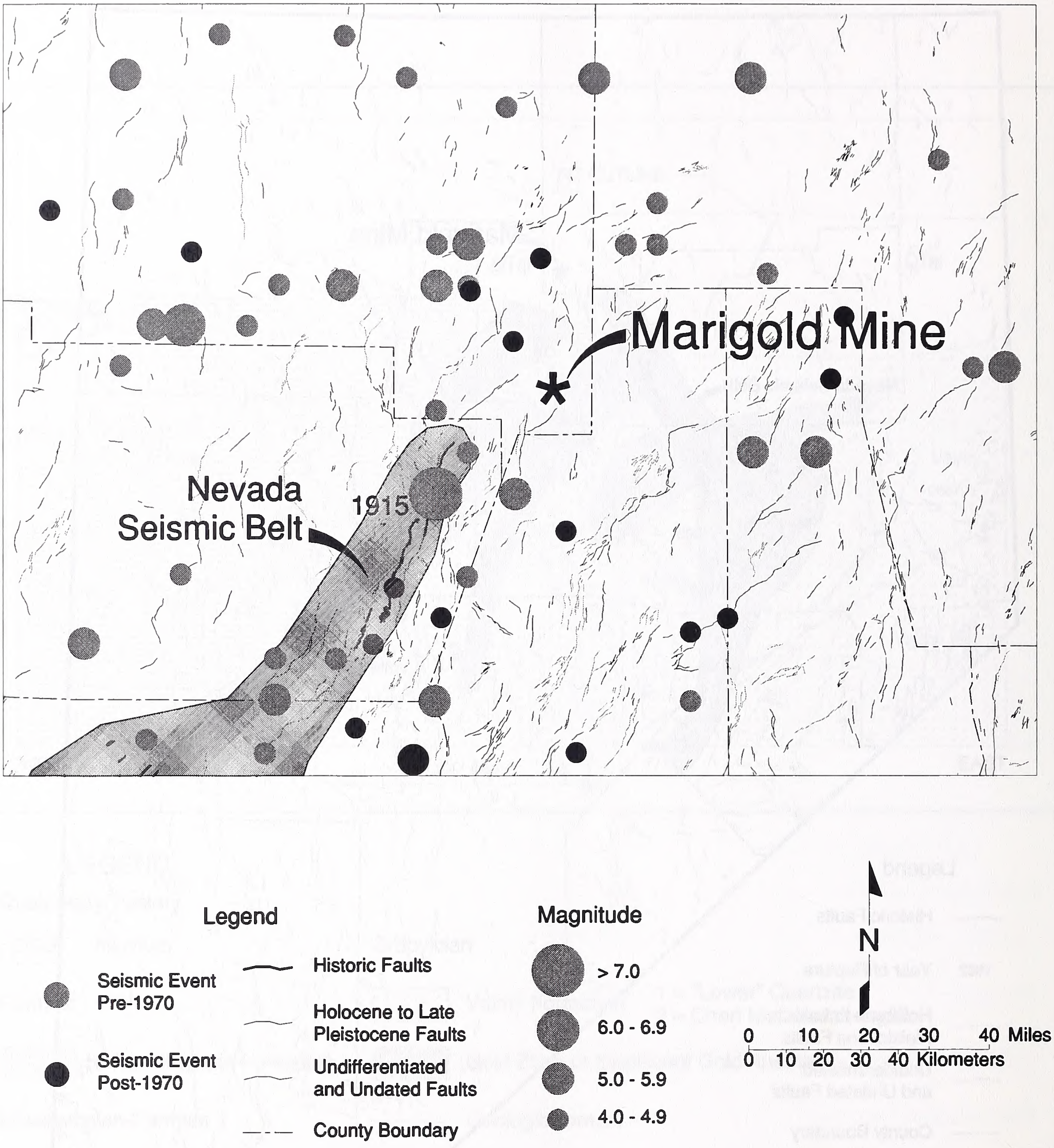


Millennium Expansion Project

Figure 3-10

Quaternary Faults in Nevada

Source: Dohrenwend et al. 1995



Source for Fault Traces: Dohrenwend et al. 1995
Source for Seismic Events: National Earthquake Information Center Data Base

Millennium Expansion Project

Figure 3-11

Seismic Events

3.3 Geochemistry and Water Resources

Information detailing geochemistry and water resources is provided in Section 3.1 of the FEIS (BLM 2001, pages 3-2 through 3-36) and is summarized below. Studies specific to the Millennium Expansion Project and additional modeling have been added where appropriate.

Geochemistry of the geologic units is not a critical element of the human environment or one of the other resources typically considered as part of the affected environment. However, knowledge of the rock geochemistry provides an opportunity to identify potential surface water and groundwater interactions that can occur when rock units previously buried are excavated and disposed in waste rock storage facilities or processed for mineral extraction. The presence of various constituents (e.g., arsenic, antimony, manganese, pyrite, etc.) does not necessarily indicate that an impact will occur, but rather that a potential risk exists for degradation of surface water or groundwater. The actual mobilization of the constituents is a function of the environment in which the rocks are placed and the form in which the various constituents occur. The major conditions necessary for mobilization of constituents from the rock units are:

- A transport system. Meteoric water, surface water, and groundwater are the major potential transport systems.
- A favorable environment. Mobilization is primarily the function of the solution pH and the oxidation potential (Eh).
- A quantity of the constituent. The constituent must occur in sufficient quantity and in a mineral form to present an environmental risk if mobilized.

The geochemistry of the lithologic units encountered previously at the Glamis Marigold Mine is briefly presented below. Geochemistry data for the lithologic units of the Millennium Expansion Project and the potential risks and impacts from the Proposed Action and alternatives are presented in Section 3.3.3.2.

The surface water and groundwater resources are the primary receiving environments for geochemical impacts. The water resources within the Project Area are described below. Potential impacts to these resources are discussed in Section 3.3.3.2.

3.3.1 Regulatory Framework

The administration, preservation, and appropriation of water resources in Nevada include both state and federal regulations. The NDEP defines waters of the state of Nevada as water courses, waterways, drainage systems, and groundwater. When a proposed project has the potential to directly or indirectly affect the waters of the state, then the State of Nevada is authorized to implement its own permit programs under the provisions of state law or the federal Clean Water Act. NDEP requires compliance with National Pollution Discharge Elimination System permits related to discharge of wastewater to surface waters from discharge points, such as wastewater ponds and discharge of storm water runoff. Zero-discharge permits are required if the potential for groundwater degradation exists.

The Nevada Water Pollution Control Law gives the State Environmental Commission authority to require controls on diffuse sources of pollutants, if these sources have the potential to degrade the quality of waters of the state. This same law also provides the state with authority to maintain water quality for public use, agriculture, existing industries, wildlife, and economic development. Nevada has been granted authority by the U.S. Environmental Protection Agency (EPA) to enforce drinking water standards established under the Clean Water Act. Table 3-2 presents the Nevada water quality standards.

The administration and adjudication of water rights within the state is the responsibility of the NDWR, State Engineer's Office. Water appropriations are also obtained through the Nevada State Engineer.

Table 3-2: Nevada Water Quality Standards

Parameter	Nevada Drinking Water Standards (mg/l)[1]
Aluminum	.05 to 0.2
Antimony	0.146
Arsenic	0.05
Barium	2.0
Beryllium	0.004
Boron	-
Cadmium	0.005
Chloride	250 - 400
Chromium	0.1
Copper	1.3
Cyanide (WAD)[2]	0.2
Fluoride	2.0 - 4.0
Iron	0.3 - 0.6
Lead	0.015
Magnesium	125 - 150
Manganese	0.05 - 0.10
Mercury	0.002
Molybdenum	-
Nickel	0.1
Nitrate (as N)	10
pH (SU)	6.5 - 8.5
Selenium	0.05
Silver	0.1
Sulfate	250 - 500
TDS	500 - 1,000
Thallium	0.002
Zinc	5.0

[1] Units are mg/l unless noted. SU = Standard Units; TDS = Total Dissolved Solids.
[2] WAD – Weak Acid Dissociable
Source: NDEP Form 0090, Quarterly Monitoring Report; NAC 445A1.44

3.3.2 Affected Environment

3.3.2.1 Geochemistry

Mineralization in the Project Area is hosted in two principal stratigraphic units: the Valmy Formation and the Antler sequence. Waste rock consists of three principal stratigraphic units: the Valmy Formation, Antler sequence, and Havallah Formation (see Section 3.2.2 for a complete description of these units). In addition, unconsolidated to weakly consolidated alluvium is removed and stockpiled as waste rock and/or growth medium as the existing pits are developed. The mineralized rock contains disseminated and vein siliceous gold ore along with veins of barite and occasionally jarosite, pharmacosiderite and scorodite. Clay alteration accompanied by iron oxides (hematite, goethite, limonite) is common in the ore zones and the waste rock (non-mineralized but altered rock) that accompanies the ore. Each of the existing and proposed pits has a different proportion of lithologic types and alteration types. Section 3.1 of the FEIS (BLM 2001, pages 3-2 through 3-8) describes the rock characteristics for the pits mined to date and the pits approved for future mining. Section 3.2.2 of this document presents a discussion of the geology of the proposed Millennium Expansion Project.

The historic test work is summarized in the FEIS (BLM 2001) and includes quarterly waste rock samples from spent ore and waste rock storage areas analyzed for ABA tests that compare acid neutralizing potential (ANP) and the acid generating potential (AGP), and MWMP analyses. Additional quarterly MWMP analyses were included for years 1998, 1999, and 2000 following preparation of the FEIS. Column tests were conducted on samples from the Havallah Formation and Edna Mountain Formation.

The sulfur content of the Millennium Project rocks is very low, which is consistent with the rock descriptions summarized in the FEIS (BLM 2001). The material is described as low sulfide-bearing and oxidized. The concentration of sulfide and total sulfur in the Valmy Formation, Battle Formation, and Antler Peak Limestone are near or below the detection limits (0.01 weight percent) and slightly higher in the Havallah Formation and Edna Mountain Formation.

All of the samples contain measurable neutralization capacity. The measured ANP in the Valmy Formation is low, near the detection limits (0.5 T $CaCO_3$/kT), but consistently higher than the AGP. The ANP in the majority of Antler Peak Limestone and Battle Formation rocks is high (above 100 T $CaCO_3$/KT), and moderately high in the majority of Havallah Formation and Edna Mountain Formation (greater than 10.0 T $CaCO_3$/KT). The ANP and AGP data suggests that rocks have measurable acid neutralizing capacity, particularly the Antler Peak Limestone and Battle Formation rocks, and on average, low acid-generating potential.

Although the water to rock ratio used in the MWMP is not representative of field conditions, the MWMP data provide qualitative information about trace metal concentrations in pore water or discharge. The leachate from MWMP tests of geologic units previously mined at the Glamis Marigold Mine have had exceedences of the Nevada drinking water criteria in one or more analyses for aluminum, antimony, arsenic, chloride, fluoride, lead, mercury, selenium, sulfate, nitrate, and total dissolved solids (TDS). The low sulfur content and the abundant acid-neutralizing capacity of these geologic units suggest that the material is not likely to generate acid in response to meteoric events. The pH of the MWMP test leachate of these units is generally above 7.0.

Historic MWMP data for the active and authorized mining at the Glamis Marigold Mine are tabulated in Appendix B of the FEIS (BLM 2001). Test results indicate that generally arsenic is the chief constituent that is liberated during the MWMP tests, especially in the Valmy Formation quartzite. The results of MWMP tests on the lithologic units from the proposed Millennium Expansion Project pits are provided in Appendix C.

3.3.2.2 Surface Water Resources

Hydrologic Setting

The Project Area lies within the Clovers Area (Nevada Hydrographic Basin 64), which includes a reach of the Humboldt River and tributaries. Tributary streams drain generally northward from canyons on Battle Mountain onto relatively flat alluvial fans. Flows disperse and infiltrate into the fans.

Average annual precipitation in the area ranges from six to eight inches along the valley floors and foothills, with greater amounts (up to 15 inches) occurring at higher elevations on Battle Mountain (Nevada Department of Conservation and Natural Resources 1964). Mean annual precipitation at the town of Battle Mountain is approximately eight inches (Hydro-Engineering, LLC 2002a). Most of the precipitation occurs as winter snow and is stored in the soil (approximately 90 percent), or becomes runoff or recharge for the groundwater system (approximately ten percent), nearly all of which is eventually lost from the basin by evapotranspiration (Eakin and Lamke 1966). Plants transpire water from the soil, removing the winter moisture stored in the surface soil during periods of low evaporation. In addition, the average annual evaporation from surface water (lakes, streams, etc.) in the locale is approximately 55 inches, with approximately 48 inches evaporating between May and October (Hydro-Engineering, LLC 2002a). This represents the potential for water loss to the atmosphere from surface water.

Surface Water Quantity

Flows in the Humboldt River vary widely from year to year as a result of changes in precipitation, agricultural water use, transpiration by native vegetation, and flow gains or losses from aquifers. The average annual flow in the river at Battle Mountain is approximately 400 cubic feet per second (cfs). The high flow months are typically May or June, which have long-term average flows of approximately 1,000 cfs. Low flow months extend from September through February, with September typically having the lowest average flow rates. The river often goes dry for several days or weeks during the low flow months (U.S. Geological Survey 1999).

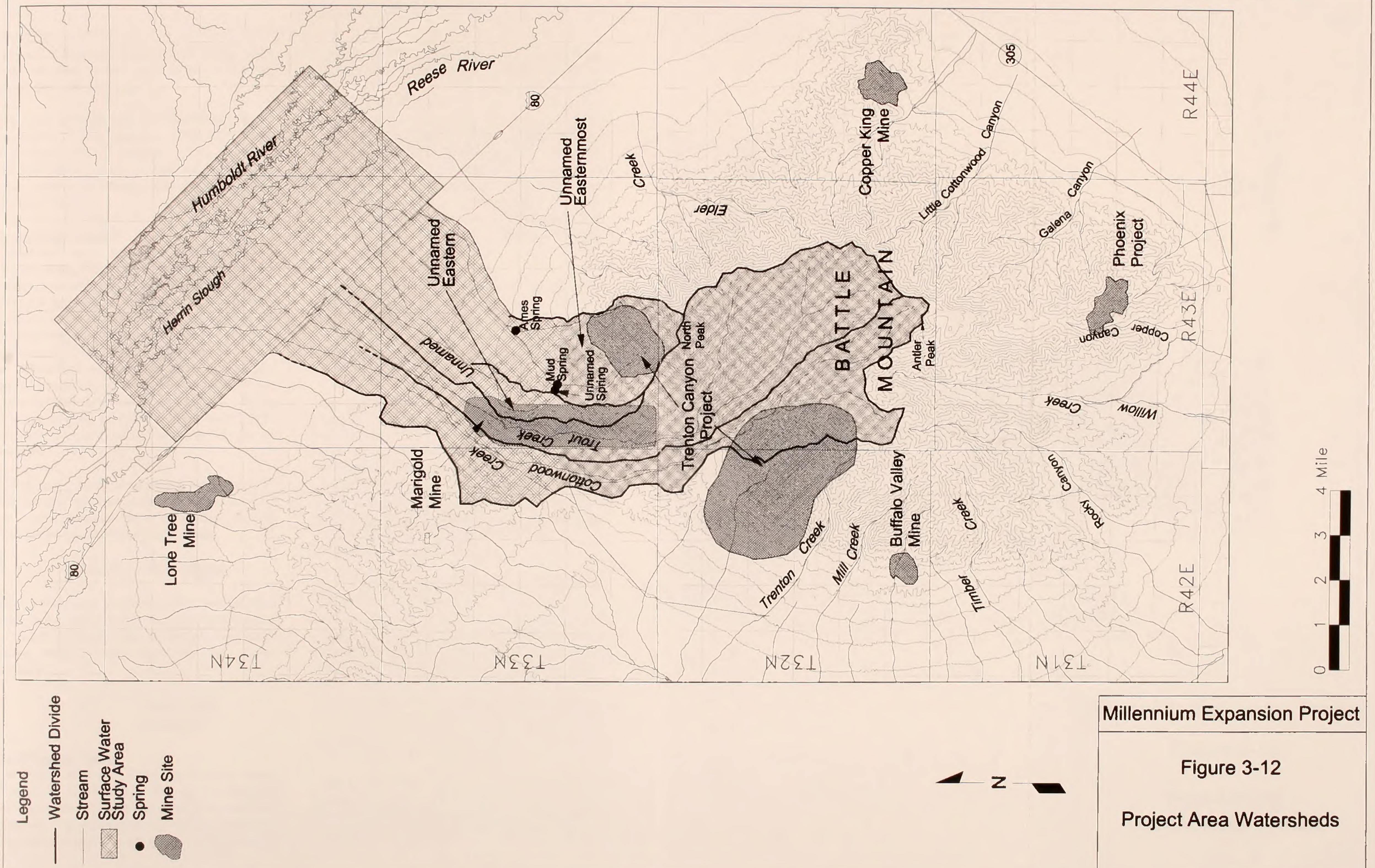
Two named and two unnamed drainages are located within the Project Area (see Figure 3-12). The westernmost drainage is Cottonwood Creek, which has a watershed area of approximately 14 square miles. The Cottonwood Creek channel trends generally northward from higher elevations on Battle Mountain and passes through the western part of the Project Area. Upon leaving the foothills and reaching the major alluvial fan system, it turns northeastward past the existing mining facilities toward the river. No measurements are available regarding the duration or magnitude of flows in Cottonwood Creek within the Project Area. Based on observed conditions, flows in Cottonwood Creek are intermittent and flow seasonally in response to snowmelt or as a result of infrequent precipitation events.

Trout Creek generally parallels Cottonwood Creek approximately one-half to one-eighth of a mile to the east. Trout Creek is perennial in its upper reaches on Battle Mountain upstream of the Project Area boundary. Downgradient reaches are intermittent, because of seepage from the channel into the deeper alluvium (JBR 1998). The watershed is approximately 15 square miles up gradient of the alluvium. Trout Creek flows through the existing mine facilities and is diverted through the operations along approximately 1,700 feet of its length. The existing diversion system was approved under earlier agency permits.

The unnamed eastern drainage (lying immediately to the east of Trout Creek) (Figure 3-12) is ephemeral. The watershed area occupies approximately four square miles, but much of this area has been disturbed by mining and includes pit areas that no longer contribute to surface runoff. The drainage path has been diverted to the east past the tailings facility in Section 9, T33N, R43E. No stream discharge or water quantity data are available for this drainage (JBR 1998).

The unnamed easternmost drainage in the Marigold Mine vicinity (Figure 3-12) has a watershed area of approximately eight square miles, with headwaters in the North Peak area of Battle Mountain. As it opens onto the alluvial fan system, this ephemeral system disperses into a network of numerous small drainages with no distinct streambed evident over most of the fan surface in the Project Area. In the extreme eastern part of Section 16, T33N, R43E, and diagonally across Section 10, T33N, R43E, a small channel system does occur (JBR 1998). No disturbance is planned to occur within this easternmost watershed.

Three springs are located within the unnamed easternmost drainage area. Mud Spring and an unnamed spring approximately 800 feet to its northwest lie within the project boundary in Section 20, T33N, R43E. Ames Spring lies outside of the Project Area in the southwest quarter of the southeast quarter, Section 16 T33N, R43E. As shallow bedrock groundwater flowing perpendicular to the Mud Springs Fault encounters the low permeability fault zone an upward vertical gradient is created. The clay rich layers within the alluvium act as barriers to the vertical flow resulting in the low discharge rates and the dispersed discharge areas observed in both the Mud and unnamed springs (WMCI 2002). A similar mechanism may be responsible for the seepage



Millennium Expansion Project

Figure 3-12

Project Area Watersheds

observed at the Ames Spring location. There are no other identified surface water features within the project boundary or nearby.

The Corps of Army Engineers determined that no connectivity existed between Cottonwood Creek, Trout Creek, and the unnamed drainages with the Humboldt River. Based on that determination, no waters of the U.S. occur within the Project Area (Gebhart 2002).

Surface Water Quality

Nevada water quality standards are shown in Table 3-2. Water quality data for samples retrieved from Trout Creek in the spring and summer of 1998 are shown in Table 3-3. Sampling results indicate that water quality upstream and downstream of the site is generally within Nevada drinking water standards. Manganese and iron, which have drinking water standards based on discoloration and taste as opposed to health criteria, exceed the drinking water standards both upstream and downstream of the site. These constituents show increase in concentration from upstream to downstream. The cause of this is unknown.

Surface water quality monitoring was conducted at Cottonwood Creek approximately two miles south of the Glamis Marigold Mine in Section 25. No exceedences were identified (BLM 1998a).

3.3.2.3 Water Rights

Table 3-4 indicates the water rights, sources, and usage in the project vicinity. A number of the rights, particularly the oldest certificated rights for irrigation or mining, occur several miles from the project boundary.

3.3.2.4 Groundwater Resources

Hydrogeologic Setting

The Project Area lies within the Humboldt River drainage in north-central Nevada. Groundwater recharge in the vicinity of the project is derived from infiltration of precipitation in the bedrock highlands, infiltration of stream flow during periods of high flow in the late spring and during storms, from the Humboldt River, and from deep interbasin flow along faults and in carbonate bedrock. The Humboldt River loses approximately eight cfs as it flows from the town of Battle Mountain northwestward to Valmy (BLM 1995). Discharge of groundwater is more difficult to estimate in the Project Area. Groundwater can come to the surface as springs and the abundance of springs in the highland areas and along the base of the highland areas suggest that this is an important source of groundwater discharge. Domestic, agricultural, and industrial use of groundwater is high in the region (BLM 2001).

In general, precipitation increases with elevation within the range. Precipitation at higher elevations runs off to the valley margins and recharges the upper-most aquifer system within alluvial fan deposits with minimal bedrock recharge occurring at the higher elevations.

The existing Marigold Mine pits and the proposed Terry Zone pit are located on a small bedrock outcrop that is topographically isolated from the main range front. Recharge to the bedrock in the area of the mine is comprised of infiltration to near-surface joints and fractures. Given that the bedrock high where the mine is located is topographically isolated from the range front, it is unlikely that the deeper groundwater system would receive substantial subsurface recharge from upgradient areas (WMCI 2002).

The complex structural setting at the site appears to result in compartmentalization of groundwater flow within the bedrock system. This compartmentalization results in variable groundwater elevations between structurally controlled hydrogeologic blocks. Given the low primary permeability of the bedrock, most of the water within the system occurs within fractures. During exploration drilling, water is often encountered in fracture zones or near lithologic contacts that are generally isolated or perched above the deeper circulating flow system (WMCI 2002).

The alluvial valley system represents the primary groundwater flow system in the vicinity of the site. The bedrock flow system contains less water and is subject to flow compartmentalization and perched or isolated water within the rock. In addition, groundwater typically occurs in major fault zones in this area of Nevada. However, the occurrence of such water was not confirmed at the site before the effects of the Lone Tree dewatering reached the Marigold Mine area so the natural flow direction of such groundwater is unknown (BLM 2001).

Lone Tree Mine Dewatering and Water Level Declines at the Marigold Mine

Water levels in the Marigold production wells and the monitoring wells to the north of the tailings impoundment have been declining since about 1992. Over the period 1994 through 1999, water levels at Glamis Marigold Mine dropped an estimated 35.0 to 37.5 feet. WMCI (1994) completed a study of the water level declines from 1992 through 1994. This study was based on actual water level changes in the production water wells and the tailings monitor wells at the Glamis Marigold Mine. The study concluded that dewatering at the Lone Tree Mine was the cause of the water level declines. The study showed that water levels had been dropping at a rate of about 7.0 to 7.5 feet/year in the Glamis Marigold Mine production wells (WW wells) and the tailings impoundment monitor wells (TDOH wells). The study concluded that when the Lone Tree Mine increased its dewatering rate, the rate of decline also would increase. The Glamis Marigold Mine was pumping 425 gpm from its three production wells and maintained that pumping rate over the five-year period 1994-1999 (BLM 2001). Pumping rates ranged from 274 gpm to 316 gpm between 1999 and 2002.

The initial groundwater model prepared by HCI (1994) for the Lone Tree Mine indicated that the ten-foot drawdown contour associated with pit dewatering at the Lone Tree Mine would not reach the Glamis Marigold Mine until the year 2036. According to the HCI model, no impacts to the Glamis Marigold Mine from Lone Tree Mine dewatering should currently be occurring. HCI's 1994 modeling effort was based on the best available data at the time. The modeling effort was conducted primarily to develop pump rates to accommodate mine development, not necessarily to accurately predict drawdown at distance from the mine. Therefore, the HCI study relied on empirical data from the local pit geology and assumptions for the geology at distance from the mine. Since that time, additional monitoring data, which includes information from the Glamis Marigold Mine, have been collected and have been incorporated into a revised groundwater model (HCI 2000).

Table 3-5 identifies monitor wells in the Glamis Marigold Mine area. Those with established water level decline rates indicate that the water levels in the mine area have been dropping at an average rate of 7.4 feet per year since 1992. The Lone Tree Mine began dewatering in 1991 and has been increasing its dewatering rate in steps as the pit deepens. The average dewatering rate for the Lone Tree Mine in 1999 was 36,000 gpm, up from 23,000 gpm in 1994. The pumping rate as of June 2002 was approximately 28,600 gpm. To reconstruct the pre-mining water table in the Glamis Marigold Mine area, the water level decline rate in each monitor well has been used to estimate the water level in 1991. This presents a conservative estimate of the maximum pre-mining water level because the effect of Lone Tree dewatering on the Glamis Marigold Mine area probably did not begin until around 1992 (WMCI 1994). As shown in Table 3-5, water levels in bedrock may have declined as much as about 100 feet since 1991-1993. When the Lone Tree Mine ceases operations around the year 2006, the water table in the Glamis Marigold Mine area should recover. Conservatively, the water table in the Glamis Marigold Mine area could recover to pre-1992 water levels in about 30 years following cessation of dewatering at the Lone Tree Mine. However, development of the Lone Tree Mine may cause some changes in the local flow system (e.g. the evaporative sink caused by the pit lake that is expected to form in the Lone Tree Pit). Therefore it is possible that the groundwater system in the area may not recover to 100 percent of the estimated pre-mining water level (WMCI 2002). Figure 3-13 presents the estimated post-mining groundwater levels.

Table 3-3: Trout Creek Water Quality [1]

Analysis (mg/L unless otherwise specified)	March 1998 Upstream[2]	March 1998 Downstream[3]	May 1998 Upstream	May 1998 Downstream	July 1998 Upstream	July 1998 Downstream	May 1999 Upstream	May 1999 Downstream	April 2000 Upstream	April 2000 Downstream	May 2000 Upstream	May 2000 Downstream	May 2002[4]
pH	8.06	8.06	8.01	8.10	8.48	8.24	8.03	8.05	8.22	8.20	8.17	8.10	8.40
TDS	161	160	155	155	186	196	165	172	240	212	205	208	266
Alkalinity as $CaCO_3$	98.6	98.8	82.8	83.2	135	144	96	96	-	-	107	110	-
Bicarbonate	98.6	98.8	82.8	83.2	129	144	96	96	-	-	107	110	-
Carbonate	<1.0	<1.0	<1.0	<1.0	6.7	<1.0	-	-	-	-	-	-	-
Hydroxide													
Total Cl	13.6	13.9	10.2	9.8	18.0	20.2	13.1	13.1	17.8	18.2	14.9	15.3	18.8
Total F	0.4	0.3	0.2	0.2	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.3	0.4
NO_2+NO_3-N	0.15	0.16	0.10	0.09	<0.02	<0.02	0.05	0.04	<0.02	<0.02	<0.02	<0.02	<0.02
Total Sulfate	31.3	31.2	19.8	19.8	34.7	37.7	29	29	46	47	40	41	61
Total As	0.005	0.008	0.004	0.011	0.005	0.005	0.006	0.008	-	-	0.005	0.009	
Dissolved As	0.003	0.003	0.002	0.002	0.006	0.006	0.004	0.004	0.006	0.004	0.004	0.005	<0.010
Total Ba	0.086	0.116	0.081	0.124	0.066	0.151	0.10	0.17	-	-	0.06	0.08	-
Dissolved Ba	0.041	0.045	0.044	0.045	0.071	0.113	0.04	0.06	0.05	0.05	0.04	0.05	0.06
Total Cd	<0.002	<0.002	0.005	0.003	<0.002	<0.002	0.0025	<0.0024	-	<0.0024	<0.0024	<0.002	<0.0020
Dissolved Cd	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0020
Total Ca[5]	25.9	28.7	19.3	20.1	31.7	33.2	25.2	26.4	-	-	28.0	29.5	-
Dissolved Ca	27.9	26.7	20.9	20.5	35.5	36.4	25.4	25.1	36.7	31.5	28.1	29.7	39.9
Total Cr	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	0.006	0.009	-	-	<0.005	<0.005	-
Dissolved Cr	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.006
Total Cu	0.004	0.013	0.012	0.013	<0.004	<0.004	0.006	0.010	-	-	0.009	0.007	-
Dissolved Cu	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.003	0.004	0.004	0.007	<0.003	<0.003	<0.003

Analysis (mg/L unless otherwise specified)	March 1998 Upstream[2]	March 1998 Downstream[3]	May 1998 Upstream	May 1998 Downstream	July 1998 Upstream	July 1998 Downstream	May 1999 Upstream	May 1999 Downstream	April 2000 Upstream	April 2000 Downstream	May 2000 Upstream	May 2000 Downstream	May 2002[4]
Total Fe	2.49	4.32	1.95	2.92	0.048	0.763	2.6	5.9	-	-	0.9	1.6	-
Dissolved Fe	0.066	0.078	<0.019	0.024	<0.019	<0.019	0.1	0.2	0.0	0.1	0.1	0.1	0.0
Total Pb	0.008	0.006	0.004	0.004	0.003	0.003	0.003	0.004	-	-	0.002	0.001	-
Dissolved Pb	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005
Total Mg[5]	9.34	10.0	6.31	6.65	10.8	11.4	8.69	9.53	-	-	9.77	10.40	-
Dissolved Mg	9.72	9.28	6.55	6.38	12.3	12.5	8.59	8.31	13.00	10.80	9.69	10.20	13.40
Total Mn	0.093	0.132	0.071	0.089	<0.001	0.019	0.114	0.161	-	-	0.044	0.045	-
Dissolved Mn	0.004	0.004	0.002	0.003	0.002	0.004	0.007	0.018	0.004	0.007	0.003	0.006	<0.002

[1]Data shown in bold italics meet or exceed water quality standards shown in Table 3-1.
[2]Upstream = opposite Red Rock Pit.
[3]Downstream = mine access road near 8-South Waste Rock Storage Area.
[4] Sample location not specified
[5]The total concentration will generally exceed the dissolved (filtered) concentration; however, the dissolved concentration may exceed the total concentration as a result of the greater analytical precision possible with a dissolved sample. Unfiltered (i.e., total) samples often contain colloidal particles that interfere with the analysis, resulting in a bias in the reported number.

Sources: Marigold Mining Company 1998, WMCI 2002

Table 3-4: Water Rights in the Project Vicinity

Owner	Application	Point of Diversion (Legal Description)	Filing Status	Source	Diversion Rate (cfs)[1]	Use	Annual Duty (af[2]; Mg[3])
F. Marker	2216	T32N, R43E	Certificated	Trout Creek	0.1661	Irrigation	61.84 af
C.Marker	2324	T33N, R43E, Sec. 30	Certificated	Trout Creek	0.1496	Irrigation	65.04 af
A. Marker	2513	T33N, R43E, Sec. 16	Certificated	Desert Spring	0.10	Irrigation	40 af
Buffalo Valley Mines, Inc.	2621	T32N, R42E, Sec. 26	Certificated	Mill Canyon Spring	0.16	Mine	0
F. Marker	3282	T32N, R42E, Sec. 12	Certificated	Cottonwood Creek	0.3273	Irrigation	160 af
F. Marker	01898	T32N, R42E, Sec. 12	Vested	Cottonwood Creek	---	Irrigation	132 af
G.C. Partee, Trust	10701	T33N, R43E, Sec. 31	Certificated	Trout Creek	0.05	Mine	0
Venturacci Ranch	V03744	T33N, R43E, Sec. 32	Vested	Willow Creek	1.00	Stock	0
Venturacci Ranch	V04636	T33N, R42E, Sec. 20	Vested	Ames Spring Mud Spring	0.50	Stock	0
Marigold Mining Co.	58020	T33N, R43E, Sec. 4	Permitted	Underground		Mine	8 well rights
Marigold Mining Co.	58021	T33N, R43E, Secs. 4/8	Permitted	Underground		Mine	commingled:
Marigold Mining Co.	58022	T33N, R43E, Sec. 8	Permitted	Underground		Mine	not to exceed
Marigold Mining Co.	58023	T34N, R43E, Sec. 28	Permitted	Underground		Mine	828.64 Mg/yr
Marigold Mining Co.	58024	T34N, R43E, Sec. 33	Permitted	Underground		Mine	combined duty.
Marigold Mining Co.	51463	T34N, R43E, Sec. 28	Permitted	Underground		Mine	
Marigold Mining Co.	51884	T34N, R43E, Sec. 33	Permitted	Underground		Mine	
Marigold Mining Co.	51886	T33N, R43E, Sec. 4	Permitted	Underground		Mine	
Santa Fe Pacific Gold Corp.	60606	T32N, R43E, Sec. 7	Permitted	Underground	0.11	Other	60 af
Newmont Mining Co.	62320		Permitted	Underground			

[1]cfs = cubic feet/second.
[2]af = acre feet.
[3]Mg = million gallons.

Source: Nevada Division of Water Resources 1998.

Table 3-5: Marigold Mine Monitor Well Water Levels

Well Name	Date Installed	Hydrologic Unit Screened	First Water Level		Second Water Level		Average Annual Decline Since 1992 (feet/year)	Est. Pre-1992 Water Level (feet amsl)	Comments
			Date	Level (ft amsl)	Date	Level (ft amsl)			
WW-1	3/10/88	Alluvium/ Bedrock	3/10/88	4,431.2	NA[1]	NA	6.5	4,431	WW-1 is a water supply well; Initial water level precedes Lone Tree dewatering; rate of decline as estimated by WMCI (2002)
WW-2/ WW-2B	1/30/89	Bedrock	1/30/89	4,435.5	NA	NA	6.5	4,435	WW-2B is a water supply well; Initial water level precedes Lone Tree dewatering; rate of decline as estimated by WMCI (2002)
WW-3	3/21/89	Alluvium/ Bedrock	3/21/89	4,438.0	NA	NA	7.7	4,438	WW-3 is a water supply well; Initial water level precedes Lone Tree dewatering; rate of decline as estimated by WMCI (2002)
MPS-18-1	12/16/97	Bedrock	4/16/98	4,406.2	8/25/02	4,335.3	16.2	4,508	Pre-dewatering water level est. by extrapolating first water level observed decline backward for 6.3 years at 16.2 ft/year
MPS-20-1	2/25/98	Bedrock	4/16/98	4,667.6	11/10/98	4664.2	NA	NA	Boring went dry shortly after installation; insufficient data to reliably estimate rate of decline
MR-527	4/7/93	Bedrock	4/7/93	4,487.5	NA	NA	16.2	4,508	Only one water level reported for this well; pre-dewatering level extrapolated back 1.3 years based on rate of decline observed in MPS-18-1
MR-1571	6/10/99	Bedrock	6/21/99	4,558.8	9/7/99	4558.2	6.8	NA	Water levels in exploration boring; insufficient data for extrapolation; WMCI (2002) concluded that water is perched and not representative of bedrock water levels
MR-1572	6/10/99	Bedrock	6/10/99	4,592.5	NA	NA	NA	NA	One water level from exploration boring; Marigold contractors conclude that water is perched and levels is not representative of bedrock water levels
MR-1572R	11/08/01	Bedrock	11/23/01	4,342.2	8/25/02	4330.2	15.9	4,500	New monitoring well to replace collapsed MR-1572. Pre-dewatering elevation estimated by extrapolating first water level backward for 9.9 years at 15.9 ft/year
MIL2001-1	11/17/01	Valmy	12/6/01	5,051.9	8/25/02	5,049.9	2.7	5,079	Pre-dewatering water level est. by extrapolating first water level back 10.3 years at 2.7 ft/year
MIL2001-2	11/20/01	Valmy	12/3/01	5,047.9	8/25/02	5045.9	2.7	5,075	Pre-dewatering water level est. by

Well Name	Date Installed	Hydrologic Unit Screened	First Water Level		Second Water Level		Average Annual Decline Since 1992 (feet/year)	Est. Pre-1992 Water Level (feet amsl)	Comments
			Date	Level (ft amsl)	Date	Level (ft amsl)			
									extrapolating first water level backward 10.3 years at 2.7 ft/year
MII2001-3	2/10/02	Valmy	2/10/02	<4,784.5	8/25/02	<4,784.0	NA	NA	All reported depths to water greater than reported well depth
MPS-32-1	2/21/98	Alluvial	4/16/98	4375.0	8/25/02	4326.1	11.2	4,446	Pre-dewatering water level est. by extrapolating first water level backwards 6.3 years at 11.2 ft/year
TDOH-6	12/14/92	Alluvial		4,433.2	Dec-95	4,421.9	6.7	4,440	Pre-dewatering water level est. by extrapolating observed decline back 1 year from 1992
TDOH-12L	8/12/93	Alluvial		4,428.5	6/10/98	4,391.5	7.6	4,444	Pre-dewatering water level est. by extrapolating observed decline back 2 years from 1993
TDOH-12U	9/14/93	Alluvial		4,428.2	Nov-96	4,404.7	7.4	4,443	Pre-dewatering water level est. by extrapolating observed decline back 2 years from 1993
TDOH-14	9/14/93	Alluvial		4,428.4			15.4	NA	Well went dry shortly after installation
TDOH-15	9/14/93	Alluvial		4,428	Jun-98	4,404.7	4.9	4,438	Pre-dewatering water level est. by extrapolating observed decline back 2 years from 1993
TDOH-16	9/14/93	Alluvial		4,428	Jun-98	4,398.2	6.3	4,441	Pre-dewatering water level est. by extrapolating observed decline back 2 years from 1993
TDOH-17	9/14/93	Alluvial		4,425.1	Jun-98	4,394.4	6.5	4,438	Pre-dewatering water level est. by extrapolating observed decline back 2 years from 1993
TDOH-18L	5/5/97	Alluvial		4,395.8	Jun-98	4,385.6	9.4	4,452	Pre-dewatering water level est. by extrapolating observed decline back 7 years
TDOH-19L	5/5/97	Alluvial		4,395.2	Jun-98	4,384.7	9.7	4,453	Pre-dewatering water level est. by extrapolating observed decline back 7 years
TDOH-20L	5/6/97	Alluvial		4,396.4	Jun-98	4,393.5	8.3	4,446	Pre-dewatering water level est. by extrapolating observed decline back 7 years

[1]NA = Not applicable

Source: WMCI 1999, 2002

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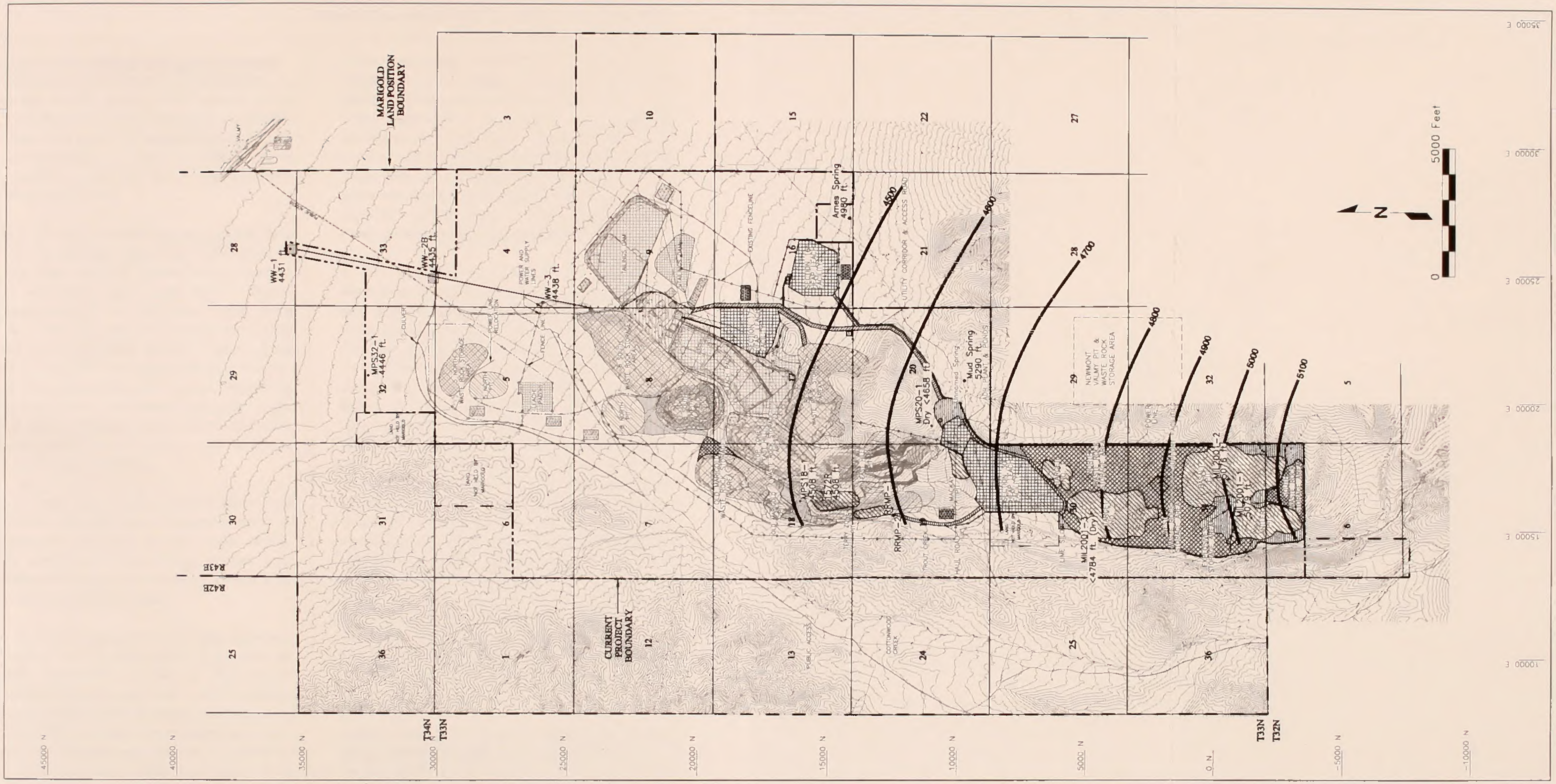


LEGEND

- WASTE ROCK STORAGE AREA
- MINE PIT
- GROWTH MEDIA STOCKPILE
- PROCESS FACILITY
- FACILITY, HAUL ROAD, "INFILL" AREA, ETC.
- SURFACE WATER DIVERSION
- PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY
- EXISTING PERMIT BOUNDARY
- MIL2001-2 ● 5045.9 MONITORING WELL ESTIMATED PRE-MINING GROUNDWATER ELEVATION
- GROUNDWATER ELEVATION (100' CONTOUR INTERVAL)

NOTE: 1) Springs are perched features above regional groundwater system and are not used to define position of contours.

2) 4500' Groundwater contour based on average between MR-1572R and MSP-18-1

Millennium Expansion Project

Figure 3-13

Post-Mining Groundwater Levels

Terry Zone Pit Conceptual Hydrogeologic Model

The existing Top Zone Pit and Red Rock Pit would be incorporated into the proposed development of the Terry Zone Pit. The previous evaluation of available water level data was re-examined with respect to additional monitoring and drilling to assess if any of the proposed pits would intercept the pre-dewatering water table (WMCI 2002).

Two types of data were utilized to evaluate the Terry Zone Pit hydrogeology: data from water-supply or monitoring wells and data collected during drilling of geologic exploration holes. Water levels collected from water supply and monitoring wells more accurately reflect groundwater elevations than those collected during exploration drilling. However, there are few data available from the period prior to water level declines associated with regional dewatering (i.e. pre-1992). It is understood that water levels collected during exploration drilling may be indicative of average conditions but do show a high degree of spatial variability (WMCI 2002).

Interpreted water levels presented in this assessment used monitor well information wherever practical in determining the estimated pre-1992 water levels. However, water-level measurements of each type were reviewed in detail and compared to data from more recent drilling (WMCI 2002).

A number of water supply and monitoring wells have been installed at the mine during the course of operations. Table 3-5 provides an overview of available water level data at the site. After evaluation of water level hydrographs, the water level data were used to estimate pre-1992 groundwater elevations. For wells with sufficient data, the rate of water table decline was estimated using two water level measurements as shown in Table 3-5. It should be noted that the first water level used in the calculations was the first water level after stabilization and not necessarily the first water level observed in a well. As shown in Table 3-5, the water table has been declining at virtually all wells in which water levels have been routinely measured. A comparison between the pre-1992 water levels as estimated in Table 3-5 and the proposed depths of the open pits is provided in Table 3-6.

Three water-supply wells (WW-1, 2[1], and 3) were installed near the margin of the valley within the alluvial and bedrock hydrogeologic units. The water levels measured in these wells are considered representative of the alluvial aquifer system. These wells are shown on Figure 3-14. Static water levels in these wells were measured during 1988 and 1989 when the wells were completed, and provide an accurate representation of pre-dewatering water levels within the alluvial system (WMCI 2002).

In the Terry Zone Pit area, the average pre-1992 water level is estimated to be approximately 4,501 feet amsl and is estimated to range from 4,494 and 4,508 feet amsl based on information gathered from MPS18-1 and MR-1572R. This assessment is based on the assumption that the groundwater system would fully recover to pre-dewatering elevations. Based on information published in the Lone Tree Mine Expansion DEIS (BLM 1995), the estimated time for the groundwater system in the vicinity of the Lone Tree Mine to recover to 90 percent of pre-mining levels is approximately 23 years. Continued drawdown would occur as the cone of depression continues to expand away from the mine for approximately 30 years after the dewatering system is shut down. In addition, development of the Lone Tree Mine may cause some changes in the local flow system (e.g. the evaporative sink caused by the pit lake that is expected to form in the Lone Tree Pit). Therefore it is possible that the groundwater system in the area of the Terry Zone Pit would not recover to 100 percent of the estimated pre-mining water level (WMCI 2002).

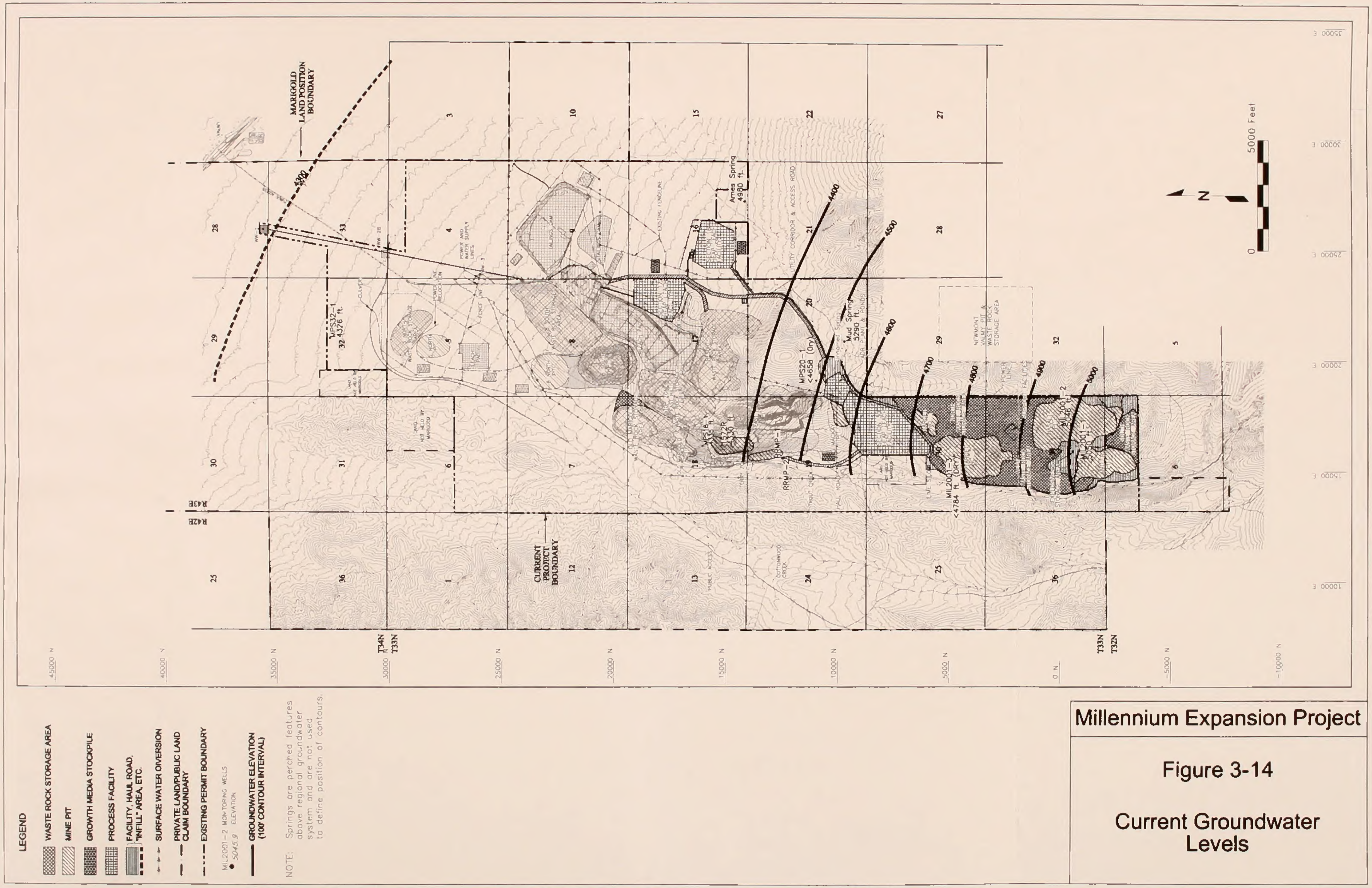
Antler, Basalt, Target No. 1, Target No. 2, and Mackay Pits Conceptual Hydrogeologic Model

An evaluation of water level data was completed for three additional monitoring points (MIL2001-1, MIL2001-2, and MIL2001-3). These monitoring points provide general information regarding groundwater

[1] Well WW-2 was replaced by WW-2B following impacts from the Lone Tree Mine dewatering. The two wells are adjacent to each other, but WW-2B is deeper and is the currently used well at this location.

Table 3-6: Millennium Project Expansion Current Water Levels Versus Planned Pit Floor Elevations

Pit Designation	Mine Coordinate Range for Pit	Proposed Pit bottom (ft amsl)	August 2002 Water Level (ft amsl)	Estimated pre-1992 Water Level (ft amsl)	Comment
Terry Zone Pit	12,000 – 18,000 N 15,000 – 18,000 E	4,480	4,391	4,508	Pre-1992 water level estimate based on drawdown trends observed in MPS-18-1 (see Table 3.5)
Mackay Pit	9,500 - 10,500 N 15,000 - 16,000 E	5,100	4,501	4,667	August water level estimated from current water table map (see Figure 3-14); pre 1992 water level estimated from post-mining water table map (see Figure 3-13)
Target No. 1 Pit	6,000 - 7,000 N 15,500 - 16,500 E	5,300	<4,784	4,814	August water level estimated based on recent water levels observed in MIL2001-3 and drawdowns observed at MIL 2001-1 and MIL 2001-2; pre-1992 water level estimated from post-mining water table map (see Figure 3-13)
Target No. 2 Pit	2,500 - 5,000 N 14,800 - 16,000 E	5,020	<4,784	4,814	August water level estimated based on recent water levels observed in MIL2001-3 and drawdowns observed at MIL 2001-1 and MIL 2001-2; pre-1992 water level estimated from post-mining water table map (see Figure 3-13)
Basalt Pit	-3,000 - 1,000 N 16,000 - 18,000 E	5,220	5,046	5076	Pre-1992 water level based on drawdown trends observed in MIL2001-2 (see Table 3.5)
Antler Pit	-3,500 - 0000 N 14,750 - 16,000 E	5,180	5,050	5,079	Pre-1992 water level based on drawdown trends observed in MIL2001-1 (see Table 3.5)



Millennium Expansion Project

Figure 3-14

Current Groundwater Levels

occurrence in the vicinity of the proposed Antler, Basalt, Target No. 1, Target No. 2, and Mackay pits. Data from the Terry Zone pit was used as well as the data collected during drilling of geologic exploration holes (WMCI 2002).

The proposed Mackay, Target No. 1, Target No. 2, Basalt, and Antler pits are located to the south of the existing Marigold facilities on a bedrock outcrop that is structurally isolated from the main range front by the Oyarbide Fault (Figure 3-2). The Marigold Mine, the Terry Zone Pit, and the Mackay Pit are separated from the other proposed pits by the Mud Springs Fault (WMCI 2002).

As mentioned previously, the fractured and faulted nature of the bedrock at the site appears to create groundwater compartmentalization within the bedrock aquifer. Groundwater elevations within the bedrock can be variable over relatively short distances due to the strong structural control. Flow across faults appears to be limited. Given the low primary transmissivity of the bedrock, most of the water within the system occurs within the fractures. Groundwater removal at Lone Tree drains the fractures, changing the hydraulic head between the compartmentalized bedrock and the fractured zone. Consequently, the compartments also experience drawdown; however the differential transmissivity of the bedrock units accounts for the varied rate of drawdown observed at the monitoring sites within the Project Area.

Based on the above conceptual model, the alluvial valley system further to the north represents the primary groundwater flow system at the site. The bedrock flow system probably contains far less water and is subject to flow compartmentalization and perched or isolated water within the rock.

The alluvial valley system in the area of the proposed Antler, Basalt, Target No. 1, Target No. 2, and Mackay pits is comprised of alluvial fan deposits and alluvium present in the Trout Creek drainage. Recharge to the alluvial valley system is derived from infiltration of runoff and snowmelt at the lower elevations of the alluvial fans and along the Trout Creek drainage (WMCI 2002).

No groundwater elevation data are available from the bedrock prior to Lone Tree Mine dewatering in the areas of the pits listed in Table 3-5. Monitoring wells MIL2001-1, MIL2001-2, MIL2001-3, and MR-1572R were installed in the last quarter of 2001 and start of 2002. Water levels were measured in these wells on a daily basis for two weeks after completion and are currently being monitored monthly. Based on the most recent groundwater elevation data, the hydraulic gradient is from the south toward the proposed Terry Zone Pit and Humboldt River Valley. MIL2001-1, MIL2001-2, and MIL2001-3 may be affected by regional dewatering. Groundwater elevations from last quarter 2001 through April 2002 remained relatively constant at which time water levels began to decrease. Based on the available data, WMCI (2002) estimated that the rate of water level declines in these wells ranged from 2.7 to 2.8 ft/yr.

<u>**Groundwater Quality**</u>

Monitor wells installed north of the existing tailings impoundment are the main source of groundwater quality data for the alluvial aquifer. The three production water wells are the main source of groundwater quality data for the bedrock aquifer. These wells are screened in both the alluvial aquifer and bedrock aquifer and the water quality data represent a mixture of these aquifers. These water quality data are summarized in Table B-6 of the FEIS (BLM 2001, Appendix B). Wells installed for the North Valmy Power Station provide water quality data for the deep alluvial aquifer south of the Humboldt River (BLM 2001).

Groundwater in the deep alluvial aquifer south of the Humboldt River is distinct in that it is primarily sodium bicarbonate-dominated water with elevated sulfate and chloride levels. Sodium ranges from approximately 40 to 630 mg/l. Calcium is below 40 mg/l. Sulfate ranges from 35 to 400 mg/l and chloride from 15 to 200 mg/l. Studies showed that the water quality becomes more saline with depth (Guyton 1977a, 1977b, 1977c). TDS range from 200 to 1,700 mg/l. The temperature of the water is generally between 60 to 75°F, but some wells intercepted groundwater with temperatures ranging from approximately 80 to 115°F (BLM 2001).

The water quality in the Glamis Marigold Mine production wells and in the monitor wells to the north of the tailings impoundment is similar. These waters are calcium bicarbonate-dominated with a TDS in the range of approximately 200 to 450 mg/l. Sulfate ranges from as low as eight mg/l to a maximum around 380 mg/l. Chloride is generally below 100 mg/l. The pH is between 6.2 and 7.84. In the production water wells, arsenic was elevated with values in the range of 0.03 to 0.07 mg/l. The similarity in water quality between the bedrock aquifer in the production wells and the alluvial aquifer to the north of the tailings impoundment suggests that these two aquifers probably communicate in the Project Area (BLM 2001).

3.3.3 Environmental Consequences & Mitigation Measures

3.3.3.1 Assessment Methodology

The acid-base geochemistry of waste rock is important in assessing the potential for the rock to produce acidic seepage elevated in heavy metals and non-metals due to infiltration of precipitation. Similarly, the reaction of waste rock to meteoric water is important in determining if infiltration of rain water or snow melt can mobilize metals without the generation of acidic seepage. The geochemical tests used to assess waste rock and spent ore are summarized below.

- **Paste pH Test** is a simple field test to quickly estimate the potential pH that could be generated as a result of weathering of rock.
- **Static Acid-Base Accounting (ABA Test)** estimates the AGP of the rock from the amount of reactive sulfur in the rock. Pyrite is the most reactive sulfide found in both metal mines and coal mines, but other sulfides can generate acidic effluent in the presence of pyrite. Commonly, however, the acid-generating potential of a rock is based on the pyrite content and expressed as T/kT of equivalent calcium carbonate. The ANP of a rock is based on the ability of the rock to neutralize acid in the laboratory. The ANP of the rock also is expressed as T/kT of calcium carbonate equivalent. The net neutralizing potential (NNP) of the rock is simply: NNP = ANP – AGP.
- **Nevada MWMP** is a test to estimate the level of metals that can be mobilized from crushed waste rock using simulated rainwater with a pH of 5.5. The resultant leachate is then analyzed for constituents of concern. For Nevada, this list of constituents is contained in the Nevada Profile II elements. If one or more constituents exceed the water quality standards, then the placement of the waste rock and the reclamation of the waste rock storage area are evaluated with respect to the potential of infiltrating meteoric water to degrade waters of the state if seepage should occur from the waste rock storage area.
- **Kinetic Column Leach Test Procedure** leaches rock material over time using simulated groundwater or meteoric water (rainwater) in the laboratory by placing run of mine material in a column and allowing water to percolate through the column for a designated period of time (generally 20 weeks or more). Samples are analyzed for Nevada Profile I metals. The weekly sample analyses document not only the initial flush of constituents (i.e., similar to the MWMP), but also any progressive changes in water quality of the leachate due to the progressive removal of the metals and sulfate from the surfaces of the waste rock. Column leach tests are generally conducted when the MWMP procedure indicates that there is potential for impacts to waters of the state, such as when constituents of the rock may be mobilized in substantial quantities or that the waste rock material may come in contact with groundwater (i.e., when used as backfill below the groundwater level).

- **Attenuation Studies** rely on column leaching using heap process solution as a lixiviant. This feed is conservative for this work and can be considered as an upper end or maximum for leachate on site. This solution is percolated through columns charged with the different rock units and alluvium material. The leachate is collected at the base of the column and analyzed for chemical constituents in the Nevada profile II suite. The mass balance difference between lixiviant and leachate concentration reflects the potential for attenuation of constituents within different rock materials and simulates the various scenarios that may occur with leachate release. The procedure is repeated with several pore volumes of lixiviant passed through the column.

The assessment of potential geochemical impacts to surface water and groundwater was based on whether or not the conditions necessary for acid generation and mobilization of constituents would be created by the Proposed Action and alternatives. The conditions necessary for geochemical impacts include: the occurrence of acid generating potential and/or constituents in sufficient quantity to pose a risk; a favorable environment for acid generation and/or constituent mobilization; and the presence of a transport system (e.g., contact with water).

3.3.3.2 Proposed Action

3.3.3.2.1 Geochemistry

The primary geochemistry and water resource issue for the proposed project is potential for groundwater impacts from: 1) infiltration of meteoric water through proposed waste rock storage areas; 2) formation of pit lakes in the proposed pits with resulting water quality impacts; 3) infiltration through the floors of the five proposed open pits; and 4) long-term draindown solutions from the heap leach pads.

GMMC analyzed 112 samples of waste and wall rocks from the proposed pits for pyritic sulfur. Half of the samples had concentrations below detection (less than 0.01 weight percent); only six samples exceeded 0.1 weight percent with the highest concentration of pyritic sulfur recorded being 0.18 weight percent. Such low concentrations of pyritic sulfur with associated high potential for neutralization due to widespread presence of calcite, would indicate that acid generation is unlikely in any of the waste rock or wallrocks. Twenty waste rock composite samples were analyzed using the MWMP test. Of the 20 samples tested, 18 samples exceeded state drinking water standards for aluminum, 11 samples exceeded the standard for arsenic, six samples exceeded the standard for iron, five samples had elevated pH levels, one sample exceeded the fluoride standard, and one sample exceeded the standard for manganese. The leachates were generally of good quality. Long-term column leach tests failed to show exceedences for these constituents indicating that long term leaching is likely to be at a much lower level than indicated by the more aggressive MWMP. The majority of exceedences were associated with the Valmy Formation samples.

Geochemical characterization of the waste rock from each proposed pit and the heap leach solids is presented below.

Proposed Terry Zone Pit

The proposed Terry Zone Pit would involve mining Valmy Formation quartzite and shale or argillite, with minor sandstone and chert and minor amounts of the Antler sequence (Edna Mountain Formation). The Havallah Formation, on the extreme west side of the proposed pit, and the Edna Mountain Formation overlie the Antler Peak Limestone in the mine area.

ABA testing indicated values typical of the Valmy quartzite, a rock of low reactivity (low AGP and low ANP values) with low sulfides and basic paste pH values (Table 3-7). The Valmy Formation samples all had less than 0.17 percent pyrite and had paste pH values greater than 7.80 (i.e., basic). The ANP/AGP ratios were generally low (0.03 to 193) due to the non-reactive nature of the quartzite (GMMC 2002). Samples of material from the Edna Mountain Formation indicate low total sulfur (≤0.1 percent) and low pyrite (<0.06 percent) values and strongly acid neutralizing characteristics with ANP/AGP ranging from 8.8 to 383 and paste pH values above ratios 8.0 (GMMC 2002).

Composite samples of two major lithologic units that would be encountered during the deepening of the Top Zone and Red Rock pits to reach the Terry Zone ore, were sent for the MWMP. MWMP tests of the deeper units of the Valmy quartzite indicate that the effluent would exceed the state drinking water standards for aluminum and arsenic, as has been seen in rock previously mined from these pits. MWMP effluent from the Edna Mountain Formation showed all constituents are below the state drinking water standards.

Table 3-7: Summary of Current Geochemical Test Results

Pit	Total sulfur (Wt %)	Pyritic sulfur (Wt %)	AGP (T $CaCO_3$/KT)	ANP (T $CaCO_3$/KT)	ANP/AGP Ratio (range of values)
Terry Zone Pit (n = 7)	<0.01-0.27	<0.01-0.17	<0.3-5.4	<0.3-652	0.03-383.5
Target No. 1 (n = 1)	0.04	0.01	0.5	7.2	14.4
Target No. 2 (n = 26)	<0.01-0.07	<0.01-0.05	<0.3-1	<0.3-192	1-192
Basalt Pit (n = 62)	<0.01-0.42	<0.01-0.18	<0.3-5.6	<0.3-271	0.2-1,360.0
Antler Pit (n = 18)	<0.01-0.06	<0.01-0.05	<0.3-1.6	3.1-244	6.8-1,626

The backfill material for the Terry Zone Pit would consist of approximately 422,000 tons of Havallah Formation and Edna Mountain Formation material which would be placed as backfill up to the 4,520-foot level (i.e., 12 feet above the predicted post-Lone Tree Mine dewatering level). Alluvium and Valmy Formation material would be used to backfill above the 4,520-foot level. The source of the backfill material for below the predicted water level would be the 8-North Pit; material from this pit has been previously authorized for use as backfill material by the BLM (BLM 2001).

Column leach tests were conducted on samples of Havallah Formation and Edna Mountain Formation (BLM 2001, Appendix B, Table B-7). Neither sample generated an acidic effluent after the 20-week test period. The pH of the Edna Mountain Formation sample ranged between 7.6 and 8.3 standard units during the testing period. Results from the tests indicated that metal levels did not exceed Nevada drinking water standards.

The pH of the Havallah Formation sample varied between 7.7 and 8.4 during the testing period. The maximum aluminum level was 0.268 mg/l at week seven, which is higher than the seven, which is higher than the Nevada drinking water standard of 0.05 to 0.2 mg/l. No other metal levels exceeded the Nevada drinking water standards. The maximum arsenic release in the Havallah Formation was 0.035 mg/l in week 19 and the maximum antimony release from the same column was 0.004 mg/l in week 18. In the Edna Mountain Formation column the maximum arsenic release was 0.044 mg/l in week four and the maximum antimony release from the same column was 0.004 mg/l in week 13.

The column testing results indicated that the exceedences observed form MWMP tests of the same samples were conservative, and that considerable time was required to achieve results similar to the MWMP tests. After 140 days of leaching, neither arsenic nor antimony was observed in the same order of magnitude as in the MWMP test.

By comparison, aluminum leaching was similar in both, indicating either a soluble mineral control such as ettringite ($Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$) or through release of aluminum hydroxide colloids (particles that are smaller than the 0.45 µm filter size used in analysis). The alluvium and Valmy Formation material have shown exceedences for arsenic from some samples in MWMP tests. However, as noted above, the MWMP tests tend to overestimate the amount of constituents that would be mobilized, and it is unlikely that the waste materials would show the same level of leaching in the field. Under the Proposed Action, any use of alluvium or Valmy Formation material as pit backfill would be subject to MWMP testing prior to use. Mineralogical analysis indicated that the main source of arsenic in these materials is adsorbed arsenate associated with clays and iron oxyhydroxides. Under the predicted pH-Eh regime in the backfill, this form of arsenic should be stable and would be unlikely to show appreciable leaching. In the Valmy Formation material the majority of arsenic would be present as discrete arsenic minerals, pharmacosiderite ($KFe_4(AsO_4)_3(OH)6 \cdot 6\text{-}7H_2O$) and scorodite ($FeAsO4 \cdot 2H2O$). Both these forms are relatively insoluble; therefore arsenic leaching is predicted to be low. Further reduction of arsenic leaching from the pit backfill and waste rock would occur from the use of an ET cover to reduce infiltration.

Proposed Mackay Pit

The Mackay Pit would be developed in oxidized Valmy quartzite similar to the material mined from the nearby East Hill South Pit.

No new samples from the Mackay Pit area have been analyzed, but ABA results from Valmy quartzite from the nearby East Hill South Pit indicated pyritic sulfur content of 0.04 percent and total sulfur content of 0.09 percent, with an ANP/AGP ratio of 14.0 (BLM 2001, Appendix B).

MWMP tests of the Valmy quartzite from the East Hill South Pit indicated that leachate would exceed the state drinking water standard for arsenic.

Proposed Target No. 1 Pit and Target No. 2 Pit

The Target No. 1 Pit would be developed in shallow alluvium and oxidized Valmy quartzite as described above for the Terry Zone Pit. The Target No. 2 Pit would be developed in unconsolidated Quaternary alluvium, weakly consolidated Tertiary alluvium and minor volcanic tuff and intrusives, Antler Peak Limestone, Edna Mountain Formation siltstone and sedimentary breccia, and Valmy Formation quartzite and shale.

ABA results indicated the Target No. 1 Pit rock has low reactivity typical of the Valmy Formation (Table 3-7), and low total and pyritic sulfur (<0.04 percent and <0.01 percent respectively) and an ANP/AGP ratio of 14.4 (GMMC 2002).

ABA results indicated the Target No. 2 Pit rocks have low total sulfur (<0.07 percent) and low pyritic sulfur ($\leq$0.05 percent) (Table 3-7). The alluvial units have low sulfur content and ANP/AGP ratios of 1.7 to 15, with paste pH values of 7.97 or higher, indicating low potential for acid generation. The Antler sequence rocks are strongly neutralizing with ANP/AGP ratios from 2.9 to 193, and paste pH values greater than 7.7. Valmy quartzite units had low reactivity, with AGP potential of 0.3 or less, and pyritic sulfur values of 0.01 percent or less (GMMC 2002).

Composite samples of Tertiary alluvium, Antler Peak Limestone, Edna Mountain siltstone, Valmy quartzite, and Valmy shale that would be encountered during mining in the Target pits were analyzed by the MWMP test. Alluvial material may be direct hauled for use as growth media.

The Tertiary alluvium also showed that arsenic and aluminum slightly exceeded the state drinking water standards. The alluvium also showed higher than standard levels of iron and fluoride. Levels of arsenic and aluminum in the Valmy quartzite sample and the sample of Valmy quartzite and shale showed values above the state drinking water standards, and both samples were above the standard for iron. The Antler sequence siltstone sample also showed values slightly higher than drinking water standard for arsenic and antimony, but the Antler Peak limestone showed no exceedences. All units tested showed pH effluent values above 8.0 indicating no potential for acid rock drainage (GMMC 2002).

Proposed Basalt Pit

Waste rock from the Basalt Pit would consist primarily of Valmy Formation quartzite, shale, argillite, metabasalt, and chert. In addition, a minor amount of Antler sequence, consisting mostly of Edna Mountain Formation siltstone, sandstone, and sedimentary breccia from the west side of the pit, and Tertiary alluvium and volcanic tuff overlying the Valmy Formation would be removed as waste rock.

ABA results indicated that the geologic units to be exposed in the Basalt Pit have generally low total sulfur content and low pyritic sulfur content. Small zones do contain visible sulfides, but no sample exceeded 0.5 percent total sulfur (highest 0.42 percent), and no sample exceeded 0.18 percent pyritic sulfur (Table 3-7). Paste pH values were generally above 7.50. The Tertiary alluvium had ANP/AGP values from 1.3 to 18 and the Tertiary tuff had ANP/AGP values from 0.2 (with only 0.05 percent pyritic sulfur) to 45, indicating generally strong neutralizing potential or very low AGP. The Antler sequence rocks were strongly neutralizing with ANP/AGP values from 0.7 (with a 7.85 paste pH) to 1,360. The dominant rock would be from the Valmy Formation, which was weakly reactive with generally very low pyritic sulfur and paste pH values above 7.5. The interbedded metabasalt unit was strongly neutralizing with ANP/AGP values from 12 to 865, even in samples with visible sulfides (GMMC 2002).

Composite samples of Tertiary alluvium, Tertiary tuff, Valmy Formation quartzite, argillite, shale, metabasalt, chert, that would be encountered during mining in the Basalt Pit were sent for MWMP testing. Alluvial material, representing 6.7 percent of the volume of the pit, may be used as growth media (WMCI 2002).

All rock units tested showed exceedence of the Nevada drinking water standard for aluminum. The levels of arsenic and antimony in the three Valmy quartzite samples and samples of the Valmy argillite, shale, and chert showed values very close to the drinking water standard. The sample of the metabasalt unit showed exceedence in arsenic and iron. All units tested showed pH effluent values above 8.0 indicating no potential for acid rock drainage.

Proposed Antler Pit

The Antler Pit would be developed in Antler sequence units overlain by a thick cap of Tertiary or younger alluvium. The Battle Formation conglomerate, Antler Peak Limestone, and Edna Mountain Formation siltstone and sedimentary breccia are the major units of the Antler sequence at this site.

ABA results indicated the Anlter Pit rocks have strong neutralizing potential with ANP/AGP values from 6.6 to 1,626 (Table 3-7). The highest pyritic sulfur tested was 0.05 percent with a paste pH of 8.22 (GMMC 2002).

Composite samples of four lithologic units that would be encountered during mining in the Antler Pit, were sent for the MWMP procedures. Alluvial material may be direct hauled for use as growth media during concurrent reclamation.

All lithologic units tested showed exceedences of the Nevada drinking water standard for aluminum. All rock units tested showed exceedences of the state drinking water standard for arsenic. All other constituents were within the range of the drinking water standards (GMMC 2002).

Geochemical Summary

To date, the waste characterization data for the Millennium Expansion Project have demonstrated very little potential for acid generation, due to the oxidized character of the material being mined, the minimal amount of sulfide material contained in the rock being mined, and the abundance of limestone and calcareous waste rock with excess acid neutralizing potential. Mining occurs at shallow depths, and generally above the water table. The concentration of sulfides in these rocks is very low, as confirmed by the acid-base test work. If sulfidic material is encountered, it is likely to occur in isolated pods and in small quantities. Marigold has an approved *Sulfide Waste Management Plan* (BLM 2001, Appendix B), which calls for the detection, handling, and storage of any sulfide material encountered during the mining process. Any material determined to have potential to create acid rock drainage would be placed in an active, above ground disposal facility and would be encapsulated with at least 20 feet of oxide material. Final grading to achieve positive drainage away from this material would be conducted.

The geochemical characterization results from waste materials from the proposed pits are very similar to the historic data. All of the total sulfur concentrations, pyritic sulfur concentrations, and AGP are generally low and near the detection limit of 0.01 (weight percent). The ANP values show a broad range owing to the abundance of both clastic and carbonate rocks in each pit.

The results of the MWMP test work for the Millennium Expansion Project deposits showed a consistent pattern found in nearly all gold deposits at the Marigold Mine as described in the FEIS (BLM 2001), Section 3. Leachate from the MWMP of the waste rock at Millennium Expansion Project was consistent with the prior testing; levels are elevated above the state drinking water standards for arsenic and aluminum. Concentrations, however, were significantly lower than previous test work on actual waste rock samples from the Marigold Mine.

Heap Leach Solids

Heap leach solids are the spent ore found in the existing leach pads. The pyrite content of the existing spent ore is less than one percent (Table C-6, Appendix C). The pyritic NNP and the ANP/AGP ratio are variable due to the low neutralizing potential of these solids. Also, the total sulfur NNP and ANP/AGP ratio are variable due to both the high percentage of unidentified sulfur relative to the total sulfur content and the low neutralizing potential. However, the low pyrite content and the paste pH values, which are greater than 7.0, suggest that these solids are not acid-generating. Ore from the Millennium Expansion Project pits that would be placed on the proposed pads would have a similar geochemistry (BLM 2001, WMCI 2002, GMMC 2002).

MWMP results from the heap leach solids show exceedences of drinking water standards for aluminum, antimony, lead, mercury, nickel, thallium, sulfate, and TDS (C-7, Appendix C). Other metals are within Nevada water quality standards. These constituents would remain in containment within the heap leach pad or through the constructed and lined wetland and/or ET basin; therefore, degradation of groundwater is not anticipated.

3.3.3.2.2 Waste Rock Storage Area, Heap Leach, and Pit Backfill Closure

Prior to reclamation, the waste rock storage areas and spent ore on the heap leach pads would be recontoured, regraded to overall slope angles of 3H:1V, and crowned to prevent water from ponding. At least six inches of growth media would be applied to the sideslopes as well as the top surfaces of the waste rock storage areas and pit backfill areas. GMMC proposes to reduce infiltration through the spent ore on the existing and proposed heap leach pads by constructing a minimum one-foot thick ET cover system over the spent heaps to reduce the amount of meteoric water infiltrating through the heap leach materials.

The Leaching Estimation and Chemistry Model (LEACHM) (Wagenet and Hutson 1989) and the Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al. 1994) were used to predict the infiltration through the cover for the heap leach pads, waste rock storage areas, and the pit backfill. Results are presented in *Infiltration Modeling of the Leach Pad, Mine Waste Rock, and Pit Backfill Cover Systems for the Marigold Mine* (Hydro-Engineering, LLC 2002a). The simulations indicated that the quantity of infiltrate from the waste rock disposal areas, heaps, and pit backfill would be extremely low. The consumption of water by vegetation and evaporation limits the quantity of water which can infiltrate beyond the root zone and eventually report to the groundwater or liner system. The use of a minimum of six inches and 12 inches of fine-grained cover material on the waste rock storage facilities/pit backfill and heap leach pad surfaces, respectively, would be sufficient to limit infiltration. Assuming sparse vegetation, the predicted quantity of infiltrate from each of the areas modeled would be less than two gpm from 305 acres ($1.5X10^{-7}$ gpm/square-foot) (Hydro-Engineering, LLC 2002a).

Long-term drainage rates predicted for the 12-inch cover are provided in Table C-4, Appendix C. A sensitivity analysis using various thicknesses of cover and varying cover material properties indicated that the infiltration rate would be nominally reduced with increased cover thickness. The analysis was conducted utilizing average precipitation conditions with an artificially inserted significant storm event. However, the results of infiltration modeling of the same growth media cover for the existing tailings facility did include varying precipitation events and the model indicated virtually no change in the infiltration rates under higher than average precipitation conditions (Hydro-Engineering, LLC 2002b). Although the LEACHM model predicts limited infiltration, continued modeling of the ET cover is being performed.

GMMC would utilize sloping and drainage controls, in addition to the ET covers to limit meteoric water from coming in contact with waste materials from the pits. In addition, three of the pits would be backfilled or partially backfilled to eliminate seasonal accumulation of water.

3.3.3.2.3 Pit Lake Formation

Three monitoring wells were installed to determine groundwater conditions in the Millennium Project Area. A comparison between the proposed depths of the open pits at the mine with the current water levels as well as estimated pre-dewatering water levels is provided in Table 3-6. Water levels within the alluvial and bedrock groundwater systems have been measured utilizing on site water supply and monitoring wells. The pre-dewatering groundwater elevation in the Terry Zone Pit area has been estimated to be 4,508 feet, through extrapolation of the water level trends measured for MPS18-1 and MR-1572R. Based on the estimated pre-1992 groundwater elevation, the deepest portion of the proposed pit floor would be below the bedrock water table assuming that the groundwater system fully recovers after dewatering is stopped. The lowest planned pit floor elevation is 4,480 feet; therefore, formation of a pit lake in this area is possible, if water levels recover to pre-dewatering levels when pumping at the Lone Tree Mine ceases. To mitigate potential adverse impacts due to formation of a pit lake, the pit would be backfilled to an elevation of about 4,520 feet, or about 12 feet above the estimated pre-1992 water table. The source of the backfill material for below the predicted water level would be the 8-North Pit; Havallah and Edna Mountain formation material from this pit has been previously authorized for use as backfill material by the BLM (BLM 2001).

Based on recent water level measurements collected in the vicinity of the Terry Zone Pit, the water table is currently below the lowest expected pit elevation. As dewatering at the Lone Tree Mine is anticipated to continue throughout the active development of the Terry Zone Pit, inflows to the pit would be limited to water from perched zones that may exist. However, additional dewatering of the regional groundwater system would not be required to mine the Terry Zone Pit.

As shown in Table 3-6, none of the proposed Antler, Basalt, Target No. 1, Target No. 2, and Mackay pits extends below the pre-dewatering water table. As such, pit lakes are not expected to form.

The expansion of the Red Rock Pit and Top Zone Pit into the Terry Zone Pit creates additional potential for pit highwall failure near Trout Creek. Partial backfill of the Red Rock Pit has been previously authorized; however, additional area of highwall would be created as a result of the Proposed Action. Failure of the highwall would result in flow from Trout Creek entering the pit, resulting in the formation of a seasonal lake.

3.3.3.2.4 Surface Water

The primary issues related to surface water resources include: the potential for degradation of the quality of waters of the state of Nevada; accelerated erosion, sedimentation, and resulting channel or watershed instability; reduction in surface flows as a result of groundwater pumping or drainage modification; impacts to riparian areas or wetlands; and impacts to water rights.

Best management practices and available control technologies would be specified and reviewed for the proposed project components as their design proceeds. At minimum, best management practices would include good housekeeping at the heap leach facilities, ADRs, and storage facilities, preventative maintenance, periodic visual inspections of project components, material handling practices that minimize the exposure of pollutants to storm water, organized spill prevention and response procedures, sediment and erosion controls, and storm water controls. Each of these practices would be adapted to the facilities, processes, and personnel on the Project Area and carried out under a managed program of pollution prevention in accordance with state regulations and permits. Available control technologies include such features as double-lined process ponds, lined ditches and process facilities, containment walls or berms at the ADR plants and at other process or storage facilities, leak detection systems, water monitoring programs, and process facilities (including ponds, ditches, and impoundments) designed to retain or withstand severe storm runoff events. These practices would prevent or minimize potential degradation of surface water resources.

Monitoring data along Trout Creek to date suggest that the existing operations have had minor effects on surface water quality, and the impacts that have occurred (increased iron and manganese) are related mostly to aesthetic standards as opposed to health-derived standards. The causes of the increases in these constituent concentrations in a downstream direction are not known. Water monitoring and reporting programs are ongoing for the project, as is compliance with permit stipulations for storm water control, spill control, and process fluid containment. The PoO for the proposed mine expansion discusses erosion control for slopes and other disturbed areas, road drainage, and diversions around pits and process components that would prevent or minimize disturbed area runoff and mitigate related potential impacts to surface water resources.

The Lone Tree Mine is presently supplying water for operations use at the Glamis Marigold Mine and would continue to supply water for the proposed expansion. GMMC requires approximately 600 gpm for operational use and for the proposed expansion. GMMC currently uses the supply wells to make up the difference between water supplied by Lone Tree Mine and the daily operational needs of the mine. The continued pumping by GMMC of a maximum of 600 gpm of groundwater for production water uses would not be expected to produce any adverse impacts to flow in nearby springs and seeps. The production wells are down-gradient of the recharge zone for the springs in the vicinity of the Millennium Expansion Project.

Riparian areas and wetlands associated with the springs and drainages would be avoided by surface disturbance associated with the Proposed Action. Therefore, no impacts to these resources are anticipated.

The Proposed Action would not create any impacts to water rights, either directly through reduction in water availability or indirectly through access to existing water rights.

3.3.3.2.5 Groundwater

The primary issues related to groundwater resources include: potential for impacts to groundwater levels and potential impacts to groundwater from waste rock seepage; heap leach effluent; and infiltration through pit floors; inflow of Trout Creek to the Terry Zone Pit due to highwall failure.

The Lone Tree Mine is presently supplying water for operations use at the Glamis Marigold Mine and would continue to supply water for the proposed expansion. The continued pumping by GMMC of a maximum of 600 gpm of groundwater for production water uses would not be expected to produce any adverse impacts to groundwater flow. The production water wells draw water from both the alluvium and the bedrock groundwater systems, and have had minimal impact on nearby groundwater resources.

The infiltration modeling indicates that the quantity of infiltrate from the waste rock disposal areas, heaps, and pit backfill and would be extremely small. A store and release ET cover of at least six inches of cover material on the reclaimed surfaces would be sufficient to limit infiltration from each of the areas modeled to less than two gpm over 305 acres ($1.5X10^{-7}$ gpm/square-foot) (Hydro-Engineering, LLC 2002a). GMMC has proposed a 12-inch ET cover on the heap leach pads.

The waste rock storage areas, spent heap leach ore, and pit backfill constitute partially saturated flow systems, which are more complex than saturated flow systems. In these systems, the water moves as a film around soil particles; the film thickness varies with moisture content and pore geometry, so that the cross-sectional area of flow can change considerably. In most partially saturated flow situations, the moisture content is not constant and cycles with the precipitation inputs. The movement of water in the near surface zone can be described as a series of pulses corresponding to precipitation events. With increasing depth, the pulses tend to smooth out, but there are still changes in moisture content and velocity of flow. Simplistic modeling and extrapolation indicated that infiltration would take close to 100 years to move 100 feet through the cover and placed rock and spent ore.

Based on the results of the geochemical characterization, the waste rock placed at the surface would have a negligible potential for acid generation. Total sulfur and sulfur specie values are generally low, and most of the rocks have significant neutralizing potential. The paste pH data indicated the rocks have readily available buffering capacity with values ranging from 7.4 to 8.8. MWMP tests conducted on waste rock from existing pits and waste rock from the proposed pits indicate that seepage from the waste rock would be consistently elevated in arsenic and aluminum. Based on this information, water infiltrating waste rock storage areas has the potential to generate seepage from the base of the storage areas that may be elevated in these constituents relative to Nevada drinking water standards. However, the MWMP is an aggressive test that is likely to show exceedences for constituents when longer term column leach tests demonstrate that long-term leaching is likely to be at a much lower level. Therefore, the minimal amount of seepage that may occur would have water quality similar or better than that predicted by the MWMP tests.

Minimal seepage from waste rock storage areas is expected to leave the waste rock storage areas and enter the alluvium and bedrock where pits have been backfilled. A review of infiltration modeling (WMCI 2002, Hydro-Engineering, LLC 2002a) suggests that there would be limited percolation below the active evaporative zone within the profile of the waste rock storage areas. Less than $1.5X10^{-7}$ gpm/square-foot would move through the waste rock. Because of the low net infiltration, the potential to mobilize weathering products out of the waste rock storage areas would be insignificant. Therefore, even if the waste rock has constituents with potential for mobilization, the climatic conditions are not sufficient to mobilize the weathering products to the receiving environment. Seepage would not be expected to reach groundwater because of the depth of groundwater below the alluvial cover at the mine site and the various presence of a clay layer in the alluvium about 80 feet below the surface that would inhibit downward seepage of effluent from the waste rock storage area where this layer exists. Seepage would not be expected to reach surface water because the seepage rate would be low and the arid climate would act to evaporate any seepage that reaches the surface.

The low sulfide content of the waste rock at the proposed Millennium Expansion Project pits and the abundance of carbonate alkalinity suggest that the pore water within the backfill would be neutral to alkaline. The MWMP data suggests that, while some constituents may slightly exceed the Nevada drinking water standards, overall the trace-metal concentrations were expected to be low or below detection. Given the limited infiltration through the backfill (less than $1.5\ X10^{-7}$ gpm/square-foot would move through the waste rock) and the inert geochemical nature of the materials, the potential for impacts to groundwater quality are negligible.

Minor infiltration through the pit floors may result from seasonal accumulation of water, but the potential to degrade local groundwater quality is low, even if sufficient infiltration occurs to reach the groundwater. It would be expected that infiltration through the pit floors would be similar in composition to the water that comes into contact with the backfill. The rocks exposed in the pit floors would be similar in nature to the waste rock and are expected to have the same geochemical characteristics. The minimal infiltration would initially be expected to have a near neutral or slightly basic pH, low metals except for arsenic and aluminum, and low total dissolved solids. Therefore, based on the available information there low potential for impacts to groundwater from pit floor infiltration.

The potential for pit lake formation from highwall failure and inflow of Trout Creek to the Terry Zone Pit and subsequent infiltration of the surface water through the pit floor exists. The impact to water quality would be similar to meteoric water infiltration through the pit floor and pit backfill discussed above. Over time evapoconcentration would control chemistry of pit lake, up to the point of saturation.

The proposed leach pads would have liner systems similar to the existing systems, as required by the NDEP, with the capacity to contain all process fluids and meteoric waters generated by 25-year, 24-hour storm events. Thus, seepage from the proposed leach pads is not expected during operation and closure activity.

At closure, both existing and proposed heap leach pads would be covered with a minimum of one foot of growth media material to form a store and release ET cover that would reduce infiltration. The purpose of the ET cover is to store moisture and allow vegetation and evaporation at the near surface to eliminate or substantially reduce infiltration of meteoric water into these reclaimed facilities. Infiltration modeling for normal precipitation patterns and above normal precipitation patterns indicates that following cover placement and draindown, the infiltration rates through the heap would be low (less than $1.5X10^{-7}$ gpm/square-foot).

Leach material from the proposed expansion would come from sources similar to those currently producing leach solids. Geochemical data from Cell 8 on the Marigold Heap after an extended period of inactivity (Table C-5, Appendix C) indicate that without rinsing, the heap drainage chemistry should meet all of the Nevada drinking water standards except TDS, chloride, nitrate, sulfate and arsenic. Although somewhat conservative, MWMP results also indicate that heap solids have the potential to leach antimony, aluminum and mercury.

The long-term drainage rate would be dependent primarily on the effectiveness of the cover. Cover infiltration modeling indicates that placing more than 12 inches of cover has a negligible effect on reducing infiltration through the heap (Hydro-Engineering, LLC 2002b). The model results for a 12-inch cover provide a conservative estimate of the long-term drainage rates from the heap under average conditions. GMMC would place a minimum of 12 inches of suitable growth media on the heaps as a cover to provide maximum evapotranspiration and sufficient rooting depth for plants. In addition, reclamation measures include the sloping of the facilities to 3H:1V and grading to minimize ponding.

The long-term drainage from each heap would be managed in passive water management facilities consisting of either wetland-woodland facilities and/or attenuation/evapotranspiration basins. The constituents of the long-term drainage would be contained within the passive water management facilities. In exceptional events, solutions may be discharged into a leach field system located near the process ponds in each heap leach area. The leach field represents a contingency or back up system and is not part of the long-term drainage management. Alluvial sediments in the Great Basin typically exhibit substantial attenuation capacity for metals and metalloids, but do not generally attenuate other constituents. However, the rare occurrence of exceptional events and depth to groundwater should minimize the potential for impacts to groundwater. Design of these facilities would be included in a permanent closure plan for the heap leach facility to be submitted to NDEP two years prior to closure. Long-term characterization (volume and constituents) of the heap leach draindown has not been analyzed. Closure activities would require separate permit approval by NDEP prior to closure.

In summary, the geochemistry data indicate that the lithologic units have some constituents of concern present in sufficient quantity to pose a risk to the receiving environment. However, the environment necessary for substantial mobilization of the constituents (i.e., acidic conditions and oxidation potential) would not be present. In addition, the transport system (meteoric water) would be largely eliminated through the use of the ET cover. In the case of the heap leach pads, the long-term effluent would be managed to prevent groundwater degradation.

3.3.3.2.6 Monitoring

The initial modeling indicated that the store and release ET cover is feasible as a closure technique. Confirmation of modeling results would be conducted by utilizing additional empirical data from existing reclaimed facilities (i.e., the reclaimed 8-South Waste Rock Storage Facility), concurrent reclamation of facilities currently active (i.e., cells of the current heap leach pad), and continued modeling efforts. GMMC would also conduct attenuation studies of heap leach solids to determine the potential for arsenic mobilization.

GMMC would continue the waste characterization sampling at all pits to ensure that the waste material placement conforms to the GMMC *Sulfide Waste Management Plan* (GMMC 2000).

GMMC would also conduct column tests of material scheduled for use as pit backfill to ensure that degradation of groundwater would not occur.

Monitoring wells would be installed downgradient of the Antler and Basalt pits to monitor groundwater quality during mining and mine closure. These monitoring wells would be installed within 200 feet of each pit and would be monitored on a quarterly basis, with results sent to NDEP and BLM for review. Following mine closure, these monitoring wells would continue to be monitored by GMMC as required for BLM and NDEP.

3.3.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to water resources from the Trout Creek Diversion realignment option of this alternative are generally the same as those described for the Proposed Action. The differences between the Proposed Action and Alternative 2 that relate to impacts to water resources are the decreased potential for pit lake formation due to highwall failure that would allow surface flow from Trout Creek to enter the pit, and 12 additional acres of disturbance that would be associated with the construction of the new channel diversion. As such, the potential for erosional losses of soils would increase; however, erosion would be kept at a minimum by utilizing BMPs. The remaining impacts to water resources are the same as those described for the Proposed Action.

3.3.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

The Red Rock Pit stabilization expansion would consist of placing backfill in the pit, and a berm of backfill material would be placed at the edge of the pit to prevent the potential highwall failure and the formation of a pit lake as a result of surface flow from Trout Creek entering the Red Rock Pit. If this Alternative is implemented, the impacts to water resources would be the same as those described for the Proposed Action. Limited infiltration through the backfill and the geochemical nature of the materials make the potential for impacts to groundwater quality negligible. No additional impacts to water are anticipated under this alternative.

Implementation of this alternative would greatly reduce the potential for any pit lake formation or infiltration of the backfill material.

3.3.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, disturbance and activities associated with the Proposed Action would not occur. Impacts to water resources under the No Action Alternative would be the same as those described and analyzed in the FEIS (BLM 2001; pages 3-26 through 3-33).

3.4 Air Quality

3.4.1 Regulatory Framework

The following federal and state laws, regulations, guidelines, and/or procedures pertaining to ambient air quality and the emissions of air pollutants are applicable to management of air resources potentially affected by the Project:

- National Ambient Air Quality Standards (NAAQS);
- State Ambient Air Quality Standards (SAAQS);
- Prevention of Significant Deterioration (PSD);
- New Source Performance Standards (NSPS);
- Federal Operating Permit Program (Title V); and
- State of Nevada standards for permits to operate.

3.4.2 Affected Environment

3.4.2.1 Climatology and Meteorology

Information detailing the air quality in the area of the Proposed Action is provided in the FEIS (BLM 2001, pages 3-56 to 3-66), and is summarized below.

The Project Area is located near the east-central portion of the Great Basin. The surrounding terrain consists of alternating mountain ranges and shadscale-covered valleys. The mine site is situated in Hydrographic Area 64, which is also the designated air basin. Mountains in the region of the mine site include high peaks reaching elevations over 9,000 feet amsl. Elevations, in the vicinity of the mine, range from approximately 5,500 feet to over 7,500 feet amsl (ERM 2002).

Baseline meteorology, air quality, and dispersion conditions at the Project site are characterized from ambient monitoring data taken at the nearby Lone Tree Mine and Valmy Power Station. The climate in the Project region is classified as semi-arid. Elevations below 5,000 feet receive the least amount of precipitation and are generally described as arid or desert climatic zones. An arid climate is characterized by low rainfall, low humidity, clear skies, and relatively large annual and diurnal temperature ranges. The mountainous areas are significantly wetter receiving 11 to over 15 inches of precipitation annually.

Bright sunny days and clear nights occur frequently because of the typically dry atmosphere. Clear skies allow rapid heating of the ground surface during daylight hours and rapid cooling at night. Since heated air rises and cooled air sinks, winds tend to blow uphill during the daytime and downslope at night.

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, wind (speed and direction), and stability. Mixing height is the height above ground within which rising warm air from the surface will mix by convection and turbulence. The degree to which pollutants are diluted in this mixed layer is determined by local atmospheric conditions, terrain configuration, and source location. Mixing heights vary diurnally, with the passage of weather systems, and with season. For the Project Area, the mean annual morning mixing height is estimated to be approximately 1,000 feet above ground, but during the winter months the mean morning mixing height is approximately 700 feet (Holzworth 1972). The mean annual afternoon mixing height exceeds approximately 7,000 feet above ground.

The Project is located at a latitude that places it within the belt of prevailing westerly winds that circle the earth in the northern hemisphere. However, the mine site is located in complex terrain where the local winds are affected by topographic features.

High quality meteorological data are collected on a routine basis from three sites at the Valmy Power Station located about ten miles north of the mine site.

Winds were measured on a multi-level tower at ten, 50, and 100 meters at Valmy. A wind rose for the calendar year 2001 data from Valmy Station Meteorological Site 1 for the ten-meter level is shown in Figure 3-15. These data show the percentage of time that the wind blows from a particular direction. For this site, the most frequently observed wind direction is from the northwest.

Wind speed has an important effect on area ventilation and the dispersion of pollutant concentrations from individual sources. Light winds, in conjunction with large source emissions, may allow pollutants to accumulate and stagnate or move slowly to downwind areas. During stable conditions, downwind usually means down valley or toward lower elevations. Climatological data from the region (Winnemucca) indicate that the potential for air pollution episodes to last five or more days is nearly zero (Holzworth 1972). A potential air pollution episode is defined as a period of time with wind speeds less than five miles per hour and mixing heights less than 3,500 feet.

Although weather conditions are not monitored at the mine site, average temperatures would be similar to but slightly cooler than those experienced in Battle Mountain, Nevada located about 13 miles southeast of the Glamis Marigold Mine. Battle Mountain is located at approximately 4,540 feet amsl, which is about 1,000 feet lower than the lower portions of the project area. On average, temperatures range from about 15°F in January to 93°F in July. Table 3-8 is a tabulation of the average minimum and average maximum temperatures at Battle Mountain during the period April, 1944 through December 2001.

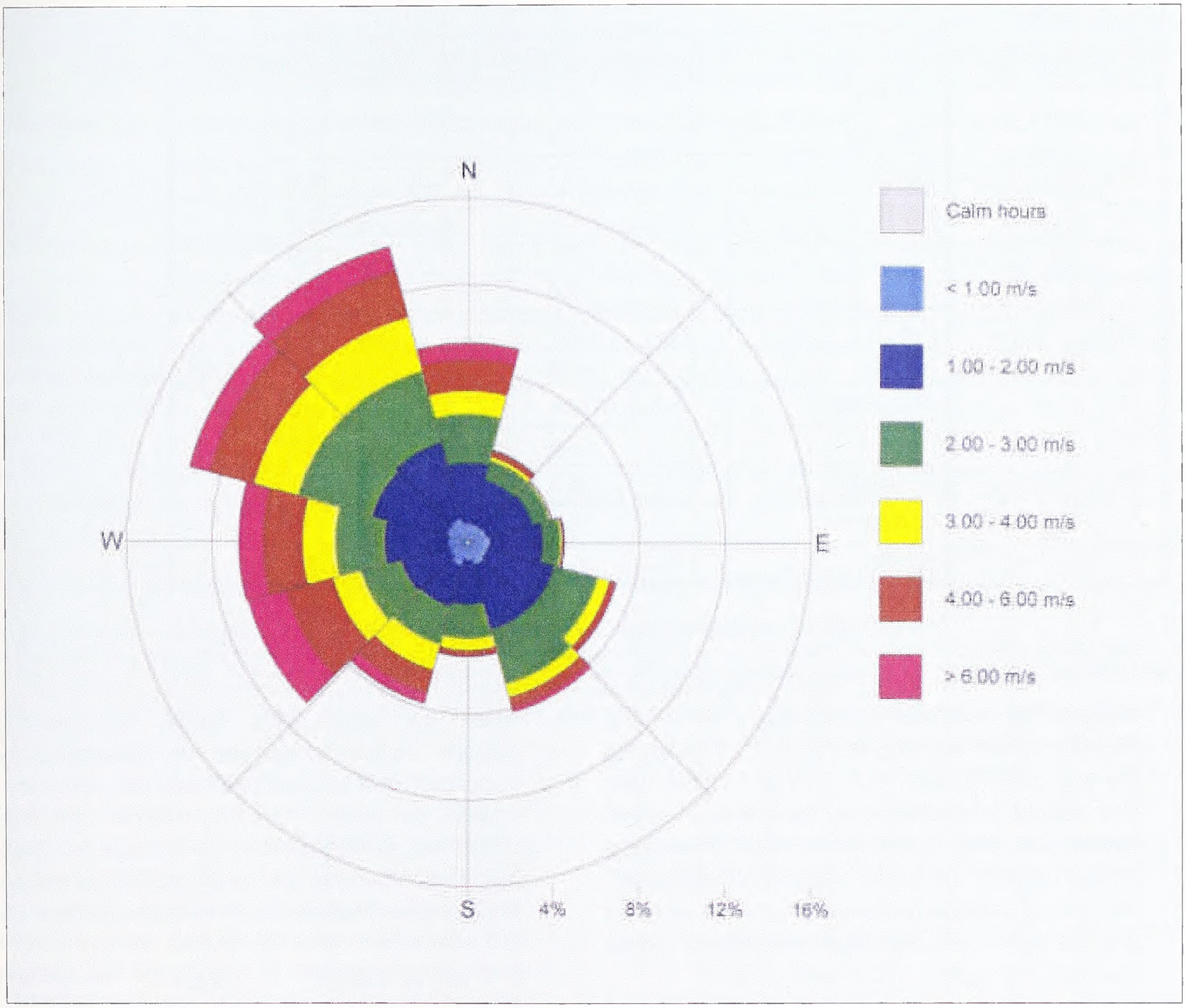
Summers are typically hot and dry except in the higher mountain ranges. Although precipitation is spread throughout the year, most of the annual precipitation falls as snow during the winter months. The precipitation in Battle Mountain averages 8.08 inches over a 56-year period. Monthly data collected at the Marigold Mine during 1998 and 1999 indicate a one-year total of 10.26 inches of precipitation. These on-site data indicate that the mine receives about the same or somewhat higher amounts of precipitation than Battle Mountain due to the increase in elevation. Average relative humidity ranges from a low of 17 percent in the summer during the day to a high of 77 percent in spring during the night (NOAA 1982). Net evaporation exceeds precipitation in the Project Area.

3.4.2.2 Air Quality

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Measurement of pollutants in the atmosphere is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure.

The existing air quality of the Project Area is typical of the largely undeveloped regions of the western United States. For the purposes of statewide regulatory planning, this area (Basin 64) has been designated as unclassified for all pollutants that have an ambient air quality standard.

The Marigold Mine shares Basin 64 with Sierra Pacific Power's Valmy Power Station, which is a major source for U.S. Environmental Protection Agency (USEPA) Prevention of Significant Deterioration (PSD) purposes. A small portion of the Lone Tree Mine falls within this basin as well. The submittal by Sierra Pacific of an application for an air quality operating permit to the USEPA and the NDEP, Bureau of Air Pollution Control (BAPC) triggered the Minor Source Baseline Date in 1978 for particulate matter and sulfur dioxide. As such, new sources within Basin 64 may be further constrained to the amount of particulate matter and sulfur dioxide emissions that can be permitted.



Valmy Power Station Wind Rose for 2001

Millennium Expansion Project
Figure 3-15 Valmy Generating Station Wind Rose

Table 3-8: Summary of Minimum, Maximum, and Average Monthly Mean Temperatures (°F) Battle Mountain, Nevada (4/5/1944 to 12/31/2001)

Month	Average Minimum	Average Maximum
January	15.5	41.1
February	21.5	47.9
March	25.1	54.4
April	30.0	63.3
May	38.2	72.9
June	45.0	82.6
July	50.9	93.3
August	47.8	91.5
September	39.1	81.7
October	29.6	68.5
November	22.3	51.9
December	15.8	41.9
Annual	31.7	65.9

Source: Western Regional Climate Center, wrcc@dri.edu

As part of the Air Quality Permit process, the Marigold Mine conducted ambient monitoring for PM_{10} during the time period October 1991 through October 1992. The highest concentration of PM_{10} was 96 $\mu g/m^3$ recorded on June 11, 1992. This value is below the 24-hour ambient air quality standard of 150 $\mu g/m^3$. The annual average concentration of PM_{10} was less than 30 $\mu g/m^3$, and this value is below the annual standard of 50 $\mu g/m^3$.

3.4.3 Environmental Consequences & Mitigation Measures

3.4.3.1 Assessment Methodology

Air quality standards specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations within the standards are generally not considered to be detrimental to public health and welfare. The relative importance of pollutant concentrations can be determined by comparison with an appropriate national and/or state ambient air quality standard. National and state ambient air quality standards are presented in Table 3-9. An area is designated by the USEPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the NAAQS. An area is not in attainment if violations of NAAQS for that pollutant occur. Areas where insufficient data are available to make an attainment status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

National and state Ambient Air Quality Standards establish levels of common air contaminants that are the lowest concentrations at which adverse human health or ecological effects from exposure to air pollution are known or suspected to occur. The Ambient Air Quality Standards are concentrations set by law designed to protect public health and welfare from the air pollutants listed in Table 3-9. Air quality impacts evaluated in this analysis would be

Table 3-9: Applicable National and State Air Quality Standards

Pollutant	Averaging Time	Nevada Standards[1]	National Standards[2]	
		Concentration	Primary[3]	Secondary[4]
Sulfur Dioxide	Annual Mean	80 $\mu g/m^3$	80 $\mu g/m^3$	---
	24 hours	365 $\mu g/m^3$	365 $\mu g/m^3$	---
	3 hours	1,300 $\mu g/m^3$	---	1,300 $\mu g/m^3$
PM_{10}	Annual Mean	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
	24 hour	150 $\mu g/^m$	150 $\mu g/m^3$	150 $\mu g/m^3$
Ozone	1 hour	235 $\mu g/m^3$	235 $\mu g/m^3$	235 $\mu g/m^3$
Carbon Monoxide (below 5,000 feet MSL)	8 hours	10,000 $\mu g/m^3$	10,000 $\mu g/m^3$	10,000 $\mu g/m^3$
Carbon Monoxide (at or above 5,000 feet MSL)	8 hours	6,670 $\mu g/m^3$	---	---
Carbon Monoxide (at any elevation)	1 hour	40,000 $\mu g/m^3$	40,000 $\mu g/m^3$	40,000 $\mu g/m^3$
Nitrogen Dioxide	Annual Mean	100 $\mu g/m^3$	100 $\mu g/m^3$	100 $\mu g/m^3$

[1]Nevada standards are values that are not to be exceeded where the general public has access.
[2]National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
[3]National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than 3 years after that state's implementation plan is approved by the USEPA.
[4]National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.
Source: ERM 2002

considered notable if impacts from the mining operations cause an increase of regulated pollutants that result in a violation of state or federal regulations.

3.4.3.2 Proposed Action

Air quality in the study area would be affected by both construction and operation of mining facilities. Construction, mining, and ore-processing activities at the proposed Millennium Expansion Project would be a source of both suspended particulates and particulates that have aerodynamic diameters smaller than ten micrometers (PM_{10}). Ore processing operations and gasoline and diesel-powered vehicles and equipment would be primary sources of gaseous pollutants such as sulfur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO), and volatile organic compounds (VOC). Sources of total suspended particulates, PM_{10}, and other pollutants include the following:

- Drilling and blasting
- Loading haul trucks
- Hauling ore/waste rock
- Truck dumps
- Leach pads
- Haul road maintenance
- Support vehicles
- Lime silo storage, loading and unloading
- Cement silo storage, loading and unloading
- Crucible furnace and carbon kiln
- Mercury retort
- Storage tanks
- Wind erosion of active and inactive disturbance areas, overburden, and ore stockpiles

The air quality impact of a fugitive dust source depends on the quantity and drift potential of the dust particles released into the atmosphere. The larger dust particles settle out near the source, while fine particles are dispersed over much greater distances. Theoretical drift distances, as a function of particulate diameter and mean wind speed, have been computed for fugitive dust emissions. For a typical wind speed of ten miles per hour (mph), particles larger than 100 micrometers (µm) are likely to settle out within 20 to 30 feet from the source. (For comparison, a human hair has a thickness of about 100 µm.) Particles 30 to 100 µm, depending on the extent of atmospheric turbulence, are likely to settle within approximately 500 hundred feet. Dust particles smaller than 30 µm are generally recognized as emissions that may remain suspended indefinitely. The fraction of fugitive emissions in the various size categories is derived from the major emission source categories for a typical mining operation and is summarized in Table 3-10.

Construction and reclamation activities associated with the further development and eventual closing of the mine would cause an increase in fugitive and gaseous emissions in the local area during the construction and reclamation phases. Air quality effects from construction would result in temporary impacts due to increases in local fugitive dust levels. Dust generated from these open sources is termed "fugitive" because it is not discharged to the atmosphere in a confined flow stream (e.g., stack, chimney, or vent). The principal sources of fugitive dust would be related to construction activities, including land clearing, earth moving, scraping, hauling, and materials storage and handling; drilling and blasting; truck loading operations; wind erosion from stockpiles; and ore handling operations. In addition, other fugitive emissions impacts would be caused by mud/dirt track-out onto paved surfaces.

During construction and reclamation, vehicle exhaust particulate emissions would be generated but such emissions are minor compared to fugitive emissions from earth moving, hauling and other construction activities and would not have a great effect on regional air quality. Particulate levels from construction and reclamation activities would vary, and impacts would depend on the activity location and the daily wind and weather.

The additional surface loading and vehicle exhaust emissions during construction and reclamation would cause an increase in fugitive emissions from the proposed Project. The FEIS (BLM 2001) estimated that the Glamis Marigold Mine had the potential to emit about 3,715 tons per year of fugitive emissions; this estimate did not account for all potential fugitive emissions. The proposed expansion has the potential to emit about 4,340 tons per year of fugitive emissions, which accounts for fugitive emissions from existing and proposed activities. Fugitive dust would be minimized by implementing the air quality environmental protection measures described in Section 2.2.16.6.

Table 3-10: Project Estimated Particle Size Distribution (percent of total emissions)

Process	<2.5 (µm)	2.5-10.0 (µm)	10.0 - 30.0 (µm)	>30.0 (µm)
Material Handling[1]	11	24	39	26
Unpaved Roads[2]	10	26	44	20
Composite	11	25	42	23

[1]Source USEPA 1998 Source: ERM 2002
[2]Source BLM 2001

Construction and reclamation activities require a surface disturbance permit from BAPC, which would require that appropriate measures be taken to limit fugitive dust emissions. While mitigation measures required by BAPC would reduce the amount of emissions from such activities, some level of fugitive dust emissions would be unavoidable due to the nature of the work. Although some impacts to air quality from vehicle emissions would inevitably occur during construction and reclamation, they would be transitory and temporary, limited in duration, and would end at the completion of that particular phase of the work. Once reclamation was completed, pollutant concentrations would return to background levels.

Air quality impacts due to emissions from mining operations would occur throughout the operational phase of the proposed Project. The primary pollutant would be fugitive dust particulates (TSP and PM_{10}) generated by blasting, loading and dumping, haul roads, and other processes. Other pollutants include gaseous hydrogen cyanide (HCN), NO_x, CO, SO_2 and VOCs from exhaust emissions from the vehicles, and other fuel burning equipment. VOCs are also emitted from fuel storage tanks. HCN gas is a decomposition product of the sodium cyanide solution used during the heap leaching operations.

Air pollutant sources are deemed "major" by the USEPA for PSD purposes if their emissions exceed 250 tons per year (tpy). All criteria pollutant emission rates (exclusive of fugitive dust) are less than 250 tpy (Table 3-11); therefore, the mine is not a "major stationary source" for PSD review. The FEIS (BLM 2001) estimated that emissions of criteria pollutants would be about 38 tons per year, which did not include emissions from mobile sources. As stated above, this estimate did not include all potential fugitive emissions. The combination of the existing operations and the proposed expansion has the potential to emit about 233 tons per year of criteria pollutants from both stationary and mobile sources. The planned mine expansion would result in an increase of gaseous emissions, but each type would still be below the 250 tpy threshold for PSD. Each of the criteria pollutant emissions listed in Table 3-11 from the non-fugitive sources at the mine facilities would be less than 100 tpy; therefore, the mine would not be classified as a major source under Title V of the Clean Air Act.

Mercury is a pollutant that may affect the nervous system of humans and wildlife and bio-accumulates in food chains. Mercury is released into the environment through natural and man- made processes. The metal mining industry began reporting estimates of mercury releases as part of the Toxic Release Inventory to the EPA in 1998. In 2000, the threshold reporting limits for mercury were substantially reduced, which resulted in an increase in the amounts of mercury reported. Mercury emissions from mining operations generally originate from processing the ore. Residual mercury emissions may be generated as a by-product from the mercury retort and through heap leaching. Potential mercury emissions are based on total recoverable mercury from ore and waste material, engineering estimates, and processed ore throughput at the mine for a typical year and are projected to average 0.86 tpy over the proposed six-year project life.

There are no NAAQS for mercury and there is presently insufficient information available as to the distribution of elemental and oxidized mercury from gold mining operations. These emission levels qualify the mine as a minor source of air contaminants.

Hazardous air pollutants (HAPs) emissions would be less than ten tpy for each individual pollutant and less than 25 tpy for all HAPs combined. Total combined HAPs are projected to be 15.1 tpy. The highest individual HAP potential to emit would be hydrogen cyanide; the estimated value is 7.16 tpy. The proposed Project would comply with NAAQS per the #204BAPC Air Quality Permit #AP1041-0158 at these levels of emissions.

The state of Nevada has previously granted air quality permits for the existing mine operations. The Project would comply with all existing air quality standards in Nevada. In October 1999, GMMC applied for and received their five-year air quality permit extension. The mine currently operates under BAPC Air Quality Operating Permit #AP1041-0158.

Table 3-11: Summary of Project Potentials to Emit for Criteria and Hazardous Air Pollutants

Pollutant	Combustion Sources (ton/yr)	Permit Sources (ton/yr)	Fugitive Sources (ton/yr)	Total Release (ton/yr)	Title V /PSD Emissions (ton/yr)
PM	5.0	52.6	3,395.0	3,452.6	76.1
PM10	5.0	35.9	940.0	980.9	46.6
NO_X	148.5	0.7	n/a	149.2	64.7
CO	40.3	10.4	n/a	50.7	34.0
SO_2	21.8	0.00	n/a	21.8	4.9
VOC	10.9	3.4	n/a	14.3	6.9
Acetaldehyde	0.001	n/a	n/a	0.00	0.00
Acrolein	0.0003	n/a	n/a	0.00	0.00
Anthracene	0.00005	n/a	n/a	0.00	0.00
Benzene	0.08	n/a	n/a	0.08	0.08
Benzo(g,h,i)perylene	0.00003	n/a	n/a	0.00	0.00
Biphenyl	0.0008	n/a	n/a	0.00	0.00
1,3-Butadiene	0.00	n/a	n/a	0.00	0.00
Dibutyl phthalate	0.00	n/a	n/a	0.00	0.00
Dichlorobenzene	0.00	n/a	n/a	0.00	0.00
Ethylbenzene	0.03	n/a	n/a	0.03	0.03
Ethylene Glycol	n/a	n/a	n/a	n/a	n/a
Formaldehyde	0.02	n/a	n/a	0.02	0.02
n-Hexane	0.1	n/a	n/a	0.1	0.10
Hydrogen Cyanide	n/a	n/a	7.16	7.16	7.16
Methanol	n/a	0.00	n/a	0.00	0.00
Methyl tert-butyl ether (MTBE)	0.24	n/a	n/a	0.24	0.24
Naphthalene	0.01	n/a	n/a	0.01	0.01
Nitric Acid	n/a	0.00	n/a	0.00	0.00
Phenanthrene	0.002	n/a	n/a	0.00	0.00
Phenol	0.00	n/a	n/a	0.00	0.00
Polycyclic Aromatic Compounds (PACs)	0.0003	n/a	n/a	0.00	0.00
Propylene (Propene)	0.15	n/a	n/a	0.15	0.15
Styrene	0.002	n/a	n/a	0.00	0.00
Toluene	0.16	n/a	n/a	0.16	0.16
1,2,4-Trimethylbenzene	0.05	n/a	n/a	0.05	0.05
Xylene (mixed isomers)	0.06	n/a	n/a	0.06	0.06
Metals					
Antimony	0.00	0.0006	0.12	0.12	0.12
Arsenic	0.00	0.01	2.38	2.39	2.39
Beryllium	0.00	0.00005	0.01	0.01	0.01
Cadmium	0.00	0.00005	0.01	0.01	0.01
Chromium	0.00	0.004	1.14	1.14	1.14
Cobalt	0.00	0.00007	0.07	0.07	0.07
Lead	0.00	0.001	0.2	0.2	0.20
Manganese	0.00	0.003	1.55	1.55	1.55
Mercury	0.00	0.85	0.01	0.86	0.86
Nickel	0.00	0.003	0.43	0.43	0.43
Selenium	0.00	0.001	0.24	0.24	0.24
TOTAL Hazardous Air Pollutants				**15.08**	**15.08**

3.4.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to air resources from the Trout Creek Diversion realignment are generally the same as those described for the Proposed Action. Minor amounts of fugitive dust would be created during construction activities for this alternative; however, this impact would be short-lived. Impacts from the final diversion configuration would not differ from existing conditions. No additional impacts to air quality are anticipated under this alternative.

3.4.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to air resources from expanding the Red Rock Pit stabilization would be generally the same as those described for the Proposed Action. Waste rock that would have been placed in a waste rock storage area would instead be used as backfill for the Red Rock Pit. Haul distances would be similar to those for the Proposed Action. The duration of hauling would not differ from the Proposed Action. No additional impacts to air quality are anticipated under this alternative.

3.4.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, disturbance associated with the proposed project would not occur, and air emission levels would continue at the current levels through 2007. Fugitive emission levels would gradually decrease through the reclamation period.

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3.5 Soils

3.5.1 Regulatory Framework

BLM regulations for surface management of public lands mined under the General Mining Law are provided in 43 CFR 3809. The regulations require the BLM to review proposed operations to ensure that:

- adequate provisions are included to prevent undue and unnecessary degradation of federal lands and to protect non-mineral resources on these lands;
- measures are included to provide for reclamation of disturbed areas; and
- the operations are in compliance with applicable federal, state, and local laws and regulations.

Specifically, 43 CFR 3809.1-3(d) requires mining related activities to minimize impacts to soil resources.

A Storm Water Pollution Prevention Plan (SPPP) is required for Project development and is implemented by NDEP through the Nevada Storm water National Pollution Discharge Elimination System (NPDES) permit program with appropriate erosion control features designed to meet BMPs and Natural Resource Conservation Service (NRCS) performance standards (NRCS 1992).

3.5.2 Affected Environment

Information detailing the soils in the area of the Proposed Action is provided in the FEIS (BLM 2001; pages 3-67 through 3-75), and is summarized below. The information was obtained from several sources, including the NRCS (1998), JBR (1996, 1998, and 1997), Cribley (1996), and the BLM (1988).

In general, soils occurring within the Project Area are coarse textured in the western foothills of the area, and fine textured on the less steep slopes in the north and eastern portion of the property. The soils in the immediate area of the proposed Millennium Expansion Project are formed in alluvial fan deposits or in colluvium and residuum from mixed rocks on hillslopes and crests. Of the 12 soil-mapping units identified in the Marigold EIS, only nine occur in the Millennium Expansion Project Area (Figure 3-16). These include soils from the:

- Linrose-Roca Association (Mapping Unit 1);
- Soughe-Hoot Association (Mapping Unit 2);
- Soughe gravelly clay loam, 15 to 50 percent slopes (Mapping Unit 3);
- Rose Creek sandy loam, two to eight percent slopes (Mapping Unit 4);
- Oxcorel clay loam, two to eight percent slopes (Mapping Unit 5);
- Hoot-Burrita Association (Mapping Unit 6);
- Soughe-Burrita Association (Mapping Unit 7);
- Whirlo very gravelly sandy loam, zero to two percent slopes (Mapping Unit 8); and
- Existing and Approved Disturbance (Mapping Unit EX).

Details of these major soil associations are provided in the FEIS (BLM 2001; pages 3-67 through 3-75).

The FEIS evaluated the physical characteristics and suitability of the soils for reclamation, details which are summarized in Tables 3-12 and 3-13. Threshold values for a soil's suitability as a growth medium for reclamation use were based on the following set of parameters:

- Sodium adsorption ratio – greater than 46 (excess sodium);
- Electrical conductivity – greater than 16 mmhos/cm (excess salinity);

- pH – greater than 8.5 (high alkalinity);
- Soil texture – textures of clay, silty clay, sandy clay, (high clay content) sand, fine sand, very fine sand (high sand content);
- Coarse fragments – greater than 60 percent by weight (high coarse fragment content); and
- Erosion hazard for water or wind – severe.

Surface soils that exceeded these criteria were considered unsuitable for salvage and use during reclamation. Salvage suitability and erosion hazards are indicated on Figure 3-17.

3.5.3 Environmental Consequences & Mitigation Measures

3.5.3.1 Assessment Methodology

The environmental consequences to soils were evaluated using available soil mapping data and project-specific information. Soil baseline conditions as reported in the FEIS (BLM 2001; pages 3-67 through 3-75) are herein incorporated by reference.

3.5.3.2 Proposed Action

The Proposed Action would disturb an additional 1,474 acres of soils over the currently permitted activities. The disturbed soils would be salvaged as growth media for use in future reclamation activities. This salvaged growth media as well as suitable waste rock and alluvium would be placed on the 1,204 acres designated for revegetation.

A detailed breakdown of the proposed disturbance acreage based on soil type is provided in Table 3-13. For the Proposed Action, up to 960,200 cubic yards of soils would be stripped and stockpiled for future use in reclamation activities (Table 3-14).

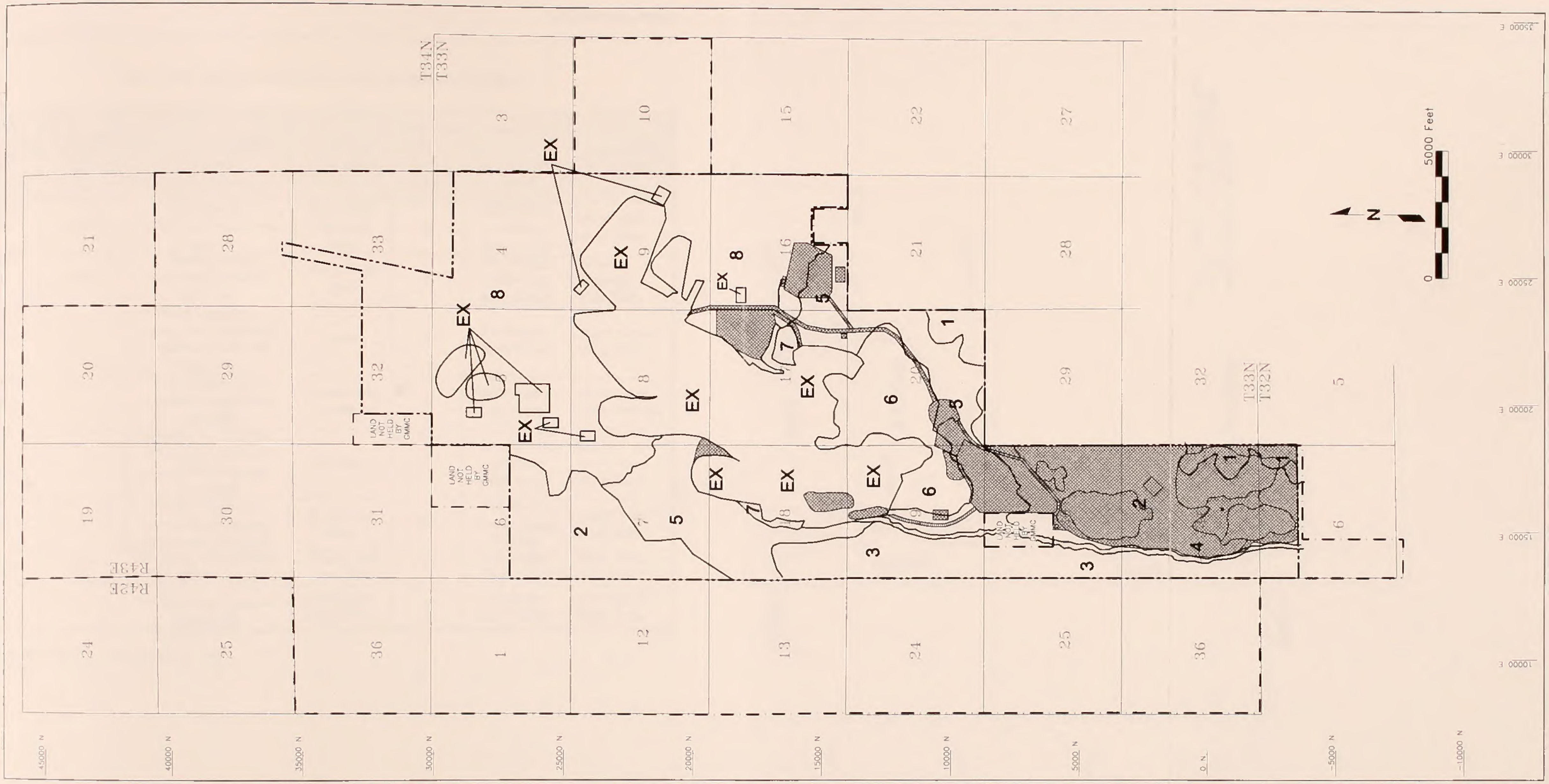
Direct impacts to soils include modification of soil chemical and physical characteristics and decreased soil biological activity resulting in a loss of productivity. Salvaging, stockpiling, and redistribution would result in loss of soil structure, decreased permeability, and decreased water-holding capacity.

Accelerated soil erosion rates may occur during mine development due to the continued removal of vegetation, surface soil disturbance, soil compaction, soil salvaging, and reclamation. Plant cover provided by vegetation in the Project Area would be removed during mining operations, thereby increasing the potential for accelerated erosion rates.

Stockpiled soils would have higher than normal erosion rates until successful interim revegetation occurs. Successful revegetation of the stockpiles is anticipated to occur approximately two to three years after reseeding. At this time, plant cover should be sufficient to control soil erosion. The sediment control structures would collect eroded soil from the stockpiles and eliminate the potential for off-site transportation of soil by water. Soil erosion caused by wind would be limited by the successful reclamation of the stockpiles.

Potential soil erosion rates and off-site sedimentation impacts associated with the Proposed Action would be reduced or avoided with the implementation of BMPs, environmental protection measures included in the Proposed Action, and concurrent reclamation activities. Following the reclamation of disturbed surfaces associated with the Proposed Action, the potential for continued erosion and off-site transportation of sediment from the Project Area would be greatly reduced. No mitigation measures beyond the environmental protection measures included in the Proposed Action are required.

Areas to be reclaimed consist of the waste rock dumps, the new heap leach facilities, the stockpile areas, haul and access roads and other ancillary facilities associated with the Proposed Action. A preliminary soil balance for the Project indicates up to 960,163 cubic yards of material could potentially be salvaged. Soil salvaging activities would include stripping surface and subsurface soils suitable for reclamation activities and the transportation and placement of these soils in stockpiles.



LEGEND

PROPOSED FACILITY

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

SOIL TYPES

1 - Linrose-Roca Association
2 - Soughe-Hoot Association
3 - Soughe gravelly clay loam, 15 to 50 percent slopes
4 - Rose Creek sandy loam, 2 to 8 percent slopes
5 - Oxcorel clay loam, 2 to 8 percent slopes
6 - Hoot-Burrita Association
7 - Soughe-Burrita Association
8 - Whirlo very gravelly sandy loam, 0 to 2 percent slopes
EX - Existing and/or Authorized Disturbance

Source: JBR Environmental Consultants 1997

Millennium Expansion Project

Figure 3-16

Soil Types in the Project Area

Table 3-12: Soil Characteristics and Reclamation Suitabilities

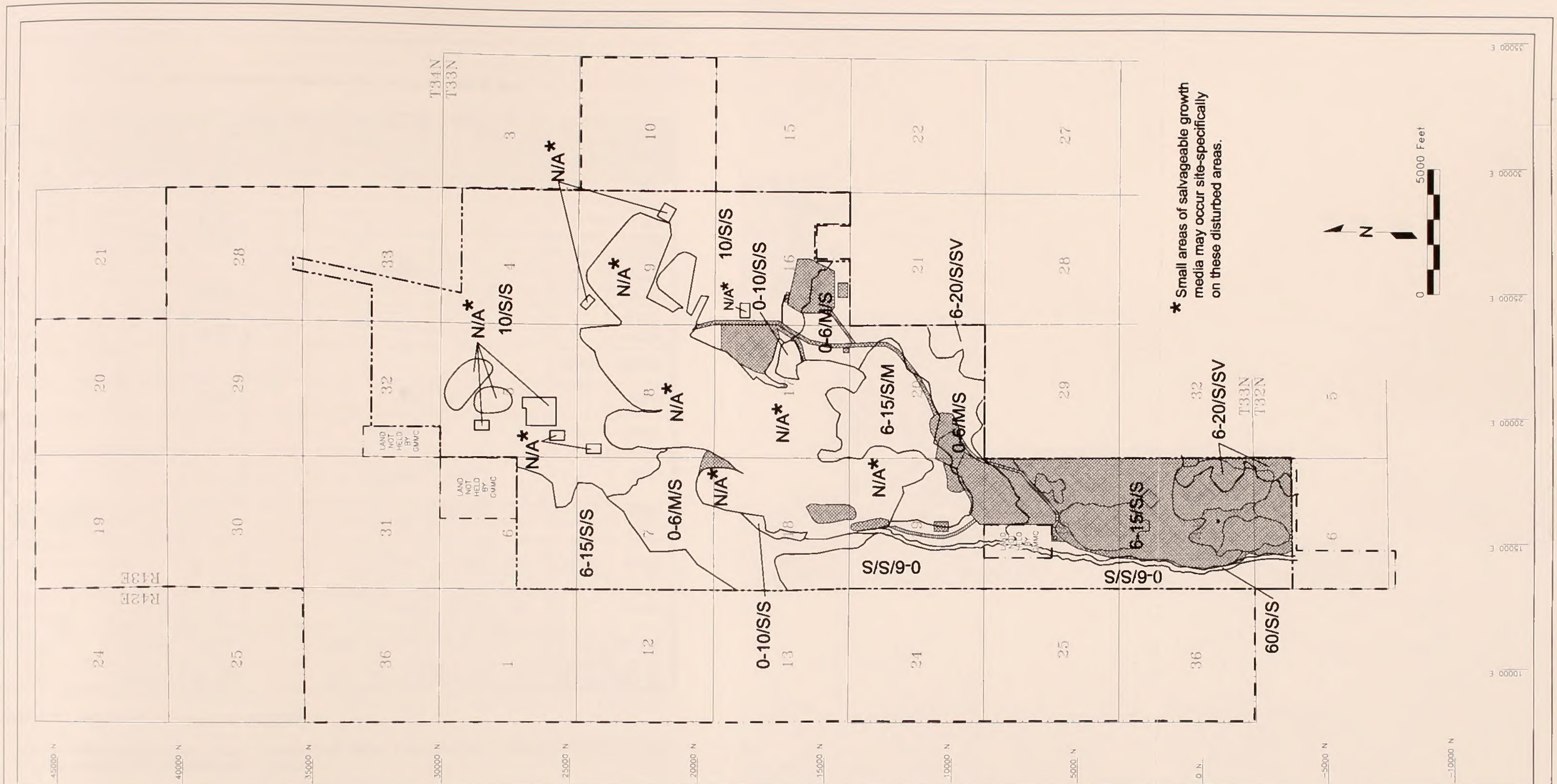
Soil Series / Soil Map Unit Name[1]	Associated Mapping Unit(s)[1]	Dominant Associated Vegetation [1]	Surface Texture [1]	Suitable Soil Depth (in.)	Soil Limitations for Use as Growth Media	Susceptibility to Erosion [1]
Burrita	6, 7	Big sagebrush, rabbitbrush, bottlebrush squirreltail	Very gravelly fine sandy loam	10	Small stones, too clayey, depth to rock	Water: Slight Wind: Slight
Hoot	2, 6	Shadscale, bud sagebrush, bottlebrush squirreltail	Very gravelly loam	6	Too alkaline, small stones, depth to rock	Water: Moderate Wind: Slight
Linrose	1	Black sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass	Loam	30	Small stones, depth to rock	Water: Severe Wind: Slight
Oxcorel	5	Shadscale, bud sagebrush, bottlebrush squirreltail	Gravelly clay loam	6	Excess sodium, too clayey	Water: Slight Wind: Moderate
Roca	1	Wyoming big sagebrush, rabbitbrush, bottlebrush squirreltail, bluebunch wheatgrass	Silt loam	6	Small stones, too clayey, depth to rock	Water: Moderate Wind: Slight
Rose Creek	4	Basin wildrye, big sagebrush, greasewood, rabbitbrush, cheatgrass	Fine sandy loam	60[1]	Possibly too alkaline in upper 10 inches	Water: Slight Wind: Slight
Soughe	2, 3, 7	Shadscale, big sagebrush, bottlebrush squirreltail	Gravelly sandy clay loam	0	Too alkaline, depth to rock	Water: Slight Wind: Slight
Whirlo	8	Shadscale, big sagebrush, cheatgrass	Gravelly fine sandy loam	10	Too alkaline, small stones	Water: Slight Wind: Slight

[1] Source: JBR Environmental Consultants, Inc. 1998.

Table 3-13: Native Soil Occurrence in Proposed Disturbance Areas

Project Component	Soil Mapping Unit Extent (acres)								Total (acres)
	1	2	3	4	5	6	7	8	
Section 30 - Target 1		19							19
Section 30 - Target 2		125							125
Section 31 - Antler Pit		77							77
Section 31 - Basalt Pit	54	120							174
Mackay Pit					13.1	5.9			19
Old Marigold					16				16
North Storage Area		288							288
South Storage Area	8.8	44.2							53
West Storage Area		144							144
Section 17 Heap Leach Facility								80	80
Section 30 Heap Leach Facility		47.9			137.7	9.4			195
Section 16 Heap Leach Facility					37			43	80
New truck shop, warehouse, fuel dispensing					5.7	1.3			7
Section 19 Growth Media						5			5
Section 16 Growth Media					5				5
Millennium Expansion Project Haul and Access Roads					27.2	10.4	0.1	14.3	52
Millennium Expansion Project Water Supply	2.7				12.9	5.3	0.1		21
Millennium Expansion Project In fill Areas	1.8	84.9		1.2	22.0	4.1			114
TOTAL DISTURBANCE	67.3	950	0	1.2	276.6	41.4	0.2	137.3	1,474

[1]Soil Mapping Unit 3 does not occur in areas proposed for disturbance.



LEGEND

PROPOSED FACILITY

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

RANGE OF SALVAGEABLE DEPTH, INCHES, FOR DOMINANT SOILS

WIND EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE

6-20/S/SV

WATER EROSION HAZARD
S = SLIGHT
M = MODERATE
SV = SEVERE

Source: JBR Environmental Consultants 1997

Millennium Expansion Project

Figure 3-17

Salvageable Soil Characteristics

Table 3-14: Available Soil Resources for Use as Growth Media

Project Component	Potential Soil Salvage Volume per Soil Type (bank cubic yards)[1]								Total (yd^3)
	1	2	3	4	5	6	7	8	
Section 30 - Target 1		7,663							7,663
Section 30 - Target 2		50,417							50,417
Section 31 - Antler Pit		31,057							31,057
Section 31 - Basalt Pit	94,380	48,400							142,780
Mackay Pit					10,567	6,346			16,913
Old Marigold					12,907				12,907
North Storage Area		116,160							116,160
South Storage Area	15,381	17,827							33,208
West Storage Area		58,080							58,080
Section 17 Heap Leach Facility								104,867	104,867
Section 30 Heap Leach Facility		19,320			111,078	10,110			140,508
Section 16 Heap Leach Facility					29,847			57,811	87,658
New Truck shop, warehouse, fuel dispensing					4,598	1,398			5,996
Section 19 Growth Media						5,378			5,378
Section 16 Growth Media					4,033				4,033
Millennium Expansion Project Haul and Access Roads					21,941	11,186	67	19,226	52,420
Millennium Expansion Project Water Supply	4,719				10,406	5,700	67		20,892
Millennium Expansion Project In fill Areas	3,146	34,243		9,680	17,747	4,410			69,226
TOTAL	117,626	383,167	0	9,680	223,124	44,528	134	181,904	960,163

[1]Soil Mapping Unit 3 does not occur in areas proposed for disturbance.

Note: Volumes are based on average salvage depths from Table 3-13 and acreage figures from Table 3-14. Additional volume is recoverable from deeper alluvial deposits underlying Mapping Units 4, 5, and 8.

Soil productivity may decrease as a result of mine operations since growth media (i.e. salvageable surface and sub-surface soil) would be mixed during salvaging and stockpiling activities. Surface soils typically have higher organic matter contents and contain higher nutrient levels than subsurface soils. Soil biological activity and nutrient cycling would be reduced or eliminated during stockpiling as a result of anaerobic conditions created in deeper portions of the stockpiles. If growth media were placed over waste rock, the character and texture of the original soils would also be altered. Based on previous successful mine reclamation projects utilizing stockpiled and redistributed growth media, the effectiveness of the soil material to function as growth-media is not likely to be reduced.

Residual adverse impacts would result in the unavoidable loss of minor amounts of soil that cannot be salvaged during facility construction.

3.5.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to soils from the Trout Creek Diversion Realignment are generally the same as those described for the Proposed Action. The differences between the Proposed Action and Alternative 1 that relate to impacts to soil are that 12 additional acres of disturbance of Soughe gravelly clay loam (Mapping Unit 3) would be associated with the construction of the new channel diversion. Soil removed for the construction of the diversion would be used to reclaim the existing diversion. No stockpiling of this material would occur. As such, the potential for erosional losses of soils would be kept at a minimum. The remaining impacts to soils are the same as those described for the Proposed Action.

3.5.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

The expanded stabilization of the Red Rock Pit highwall would not directly impact soil resources. The backfill would be placed in the pit and a berm of backfill material would be placed at the edge of the pit to prevent pit highwall failure and waters of Trout Creek from entering the Red Rock Pit. If Alternative 2 is implemented, the impacts to soils would be the same as those described for the Proposed Action (Section 3.5.3.2). No additional impacts to soils are anticipated under this alternative.

3.5.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, disturbance associated with the Proposed Action would not occur, and existing soil resources would remain unaffected. Impacts to soils under the No Action Alternative would be the same as those described and analyzed in the FEIS (BLM 2001; pages 3-75 through 3-81).

3.6 Vegetation Resources

3.6.1 Regulatory Framework

Public lands under BLM administration are managed for multiple use under the guidance of the *Sonoma-Gerlach MFP* (BLM 1982). In addition, the BLM developed *Standards for Rangeland Health and Guidelines for Grazing Management* (Standards and Guidelines) for BLM-administered lands in Nevada. These Standards and Guidelines set specific conditions to be achieved on BLM lands and the practices that would be applied in order to achieve the Standards.

Executive Order 11990: Protection of Wetlands is an overall wetlands policy for all agencies managing federal lands, sponsoring federal projects, or providing federal funding to state or local projects. Under this order, federal agencies are to use measures of avoidance, mitigation, or preservation with public input before proposing new construction in wetlands.

The BLM Riparian-Wetland Initiative for the 1990s provides a national strategy for management and restoration of riparian-wetland areas on BLM-administered lands. One of the implementation strategies to achieve the goals of the initiative is to "Avoid or mitigate the impact of surface disturbance activities on riparian-wetland areas".

The Carson-Foley Act of 1968 directs the BLM to take any action necessary "to prevent unnecessary and/or undue degradation of the public lands." The Noxious Weed Act of 1974, as amended by Section 15 of the Management of Undesirable Plants on Federal Lands (1990), authorizes the Secretary of Interior to "cooperate with other federal and state agencies and others in carrying out operations or measures to eradicate, suppress, control, prevent, or retard the spread of any noxious weed." The provisions of the act direct the agencies to consider noxious weeds when considering impacts of surface disturbing activities.

Executive Order 13112: Invasive Species (1999) requires each federal agency whose actions may affect the status of invasive species to identify such actions and implement measures to prevent the introduction of invasive species as well as detect and respond rapidly to control populations of invasive species.

U.S. Department of Interior Manual 609 sets forth policy to control undesirable or noxious weeds on the lands, waters, or facilities under its jurisdiction, to the extent economically practicable, and as needed for resource protection and accomplishment of resource management objectives.

BLM Manual 9011 and Handbook H-9011-1 provide policy for conducting chemical pest control programs using an integrated pest management approach. BLM Manual 9014 addresses the planning and implementation of biological control within an integrated pest management program. BLM Manual 9015 requires that all ground-disturbing projects and any projects that alter plant communities are evaluated to determine the risk of introducing or spreading noxious weeds.

The NRS and NAC Chapters 555 provide for the designation and control of noxious weeds and their removal.

3.6.2 Affected Environment

The Project Area is located in the Central Great Basin floristic region of the Intermountain physiographic region. This floristic region is characterized by mountain ranges trending north and south with large, extensive valleys located between the mountain ranges. This region covers about 30,250 square miles in central Nevada.

3.6.2.1 Vegetation

The vegetation resources for the Project Area were described in the FEIS Project (BLM 2001), Section 3.5 (pages 3-83 through 3-84).

Site-specific vegetation studies were conducted in the Project Area during 1997 (JBR 1998). The baseline vegetation studies included the delineation of plant communities based on aerial photograph interpretation and on-site vegetation surveys. Vegetation sampling was completed at representative sites within these plant communities to determine species composition, forage production, and other vegetative parameters.

The Project Area is dominated by two major upland plant communities: the shadscale-cheatgrass community and the Wyoming big sagebrush-spiny hopsage community (Figure 3-18). In addition, lands previously disturbed by mining occur in the Project Area. Small communities of greasewood- Wyoming big sagebrush are found in the Ames Spring area. Limited riparian communities are associated with the spring sites; isolated riparian plant species occur along the southern portion of Trout Creek. No federal jurisdictional wetlands are within the Project Area. Small, scattered populations of Utah juniper occur near the southernmost portion of the Project Area. The distribution of these communities is directly related to subtle differences in landscape position, aspect, soil texture, and soil moisture.

The Wyoming big sagebrush-spiny hopsage community is predominately found in the southern half of the Project Area, which is characterized by foothills and drainages associated with Battle Mountain. Shadscale and green rabbitbrush are subdominant shrubs that are locally abundant. The shadscale-cheatgrass community is predominantly found in the northern half of the Project Area, which is characterized by gently sloping alluvial fans. The community also occurs on some south-facing foothills where green rabbitbrush occurs as a subdominant shrub. Where this community was previously burned, the amount of cheatgrass is more prevalent. Cheatgrass is an annual species that readily invades burned or disturbed areas.

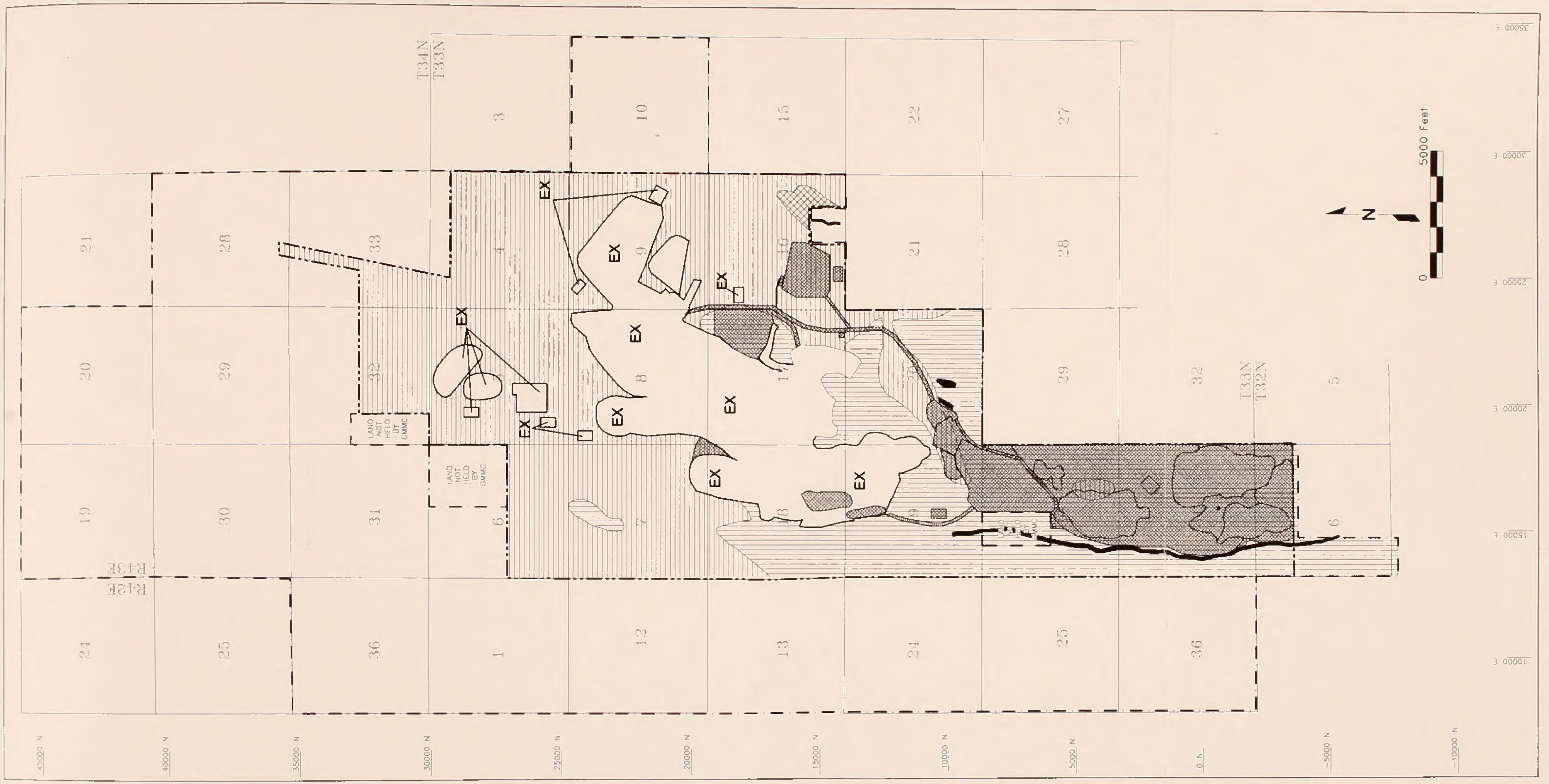
An isolated greasewood-Wyoming big sagebrush community occurs in the vicinity of Ames Spring, which is located in the southeastern portion of the Project Area. Shadscale is the prominent subdominant shrub in this community, with only isolated occurrences of Nevada ephedra and horsebrush. Cheatgrass is the dominant grass species in the community.

Riparian-wetland communities occur in two locations within the project boundary, in association with natural springs (Mud Spring and unnamed spring) that are found in the Section 20. The dominant species in these wetlands include foxtail barley, meadow barley, rabbitfoot grass, wiregrass, monkeyflower, curly dock, yarrow, and buttercup. The lower portions of Trout and Cottonwood Creeks, which intersect the Project Area, are classified as intermittent drainages and support a limited amount of riparian-wetland vegetation.

Disturbed areas support a mixture of native vegetation associated with the shadscale-cheatgrass and Wyoming big sagebrush-spiny hopsage communities and weedy species. Weedy species that are found in the Project Area include cheatgrass, tansy-mustard, tumblemustard, clasping pepperweed, halogeton, prickly lettuce, sumpweed, and fiddleneck.

3.6.2.2 Noxious Weeds

Two species on the state noxious weed list are found on and in the vicinity of the Project Area. Hoary cress, a member of the mustard family, has established within the shadscale-cheatgrass community, primarily in the areas disturbed by wildfire and livestock concentration areas. Small infestations also occur along Trout and Cottonwood creeks. Scotch thistle is also common in the area and is found in the Trout Creek and Cottonwood Creek drainages.



LEGEND

PROPOSED FACILITY

PRIVATE LAND/PUBLIC LAND CLAIM BOUNDARY

EXISTING PERMIT BOUNDARY

VEGETATION TYPES

SHADSCALE/CHEATGRASS

BIG SAGEBRUSH/SPINY HOPSAGE

GREASEWOOD/BIG SAGEBRUSH

RIPARIAN OR WETLAND VEGETATION ASSOCIATED WITH SEEPS AND/OR SPRINGS AND TROUT CREEK

EX EXISTING and/or AUTHORIZED DISTURBANCE

Source: JBR Environmental Consultants 1998

Millennium Expansion Project

Figure 3-18

Plant Communities Within the Project Area

3.6.3 Environmental Consequences & Mitigation Measures

3.6.3.1 Assessment Methodology

Potential impacts to the vegetation resources may be direct or indirect, as well as short-term or long-term. Direct impacts are those which would result in the direct removal of vegetation due to surface disturbing activities. Indirect impacts result when the vegetation remains on the site, but the condition, structure, or composition is modified. Short-term impacts are defined as direct or indirect effects that occur over the life of the Project, while long-term impacts are defined as impacts that would remain beyond the life of the Project. The removal of mature shrubs for a period greater than ten years would be considered a long-term impact.

BLM Manual 9015 *Integrated Weed Management* (BLM 1992c) provides the methodology for assessing ground-disturbing or plant community-altering projects. A risk assessment is based on two risk factors: likelihood of noxious weed species spreading to the Project Area; and the consequences of noxious weed establishment in the Project Area

3.6.3.2 Proposed Action

3.6.3.2.1 Vegetation

Proposed mine development and operation would disturb or remove a maximum of 1,474 acres of vegetation. Of the 1,474 acres of vegetation to be removed or disturbed, approximately 211 acres would be shadscale-cheatgrass vegetation and the remaining approximately 1,263 acres of disturbance would be Wyoming big sagebrush-spiny hopsage vegetation. No removal or disturbance of vegetation would occur within the greasewood-Wyoming big sagebrush community or within the riparian-wetlands community as a result of mine development or operation.

Under the Proposed Action, vegetation would be removed during development or expansion of the waste rock dumps, pit areas, heap leach pads, haul road and access roads, and construction of water diversions, new solution and storm water ponds, and other proposed facilities. Disturbance also would include trampling of vegetation caused by the use of vehicles and heavy machinery within the infill areas.

At the cessation of mining, the pit highwall areas would be the only project components that would not be reclaimed. The stabilized, storm water channels would remain after the completion of mining, with flows reporting to established drainages. Successful revegetation of disturbed land is anticipated to occur approximately three to five years after reclamation. Reclamation activities would consist of the grading of final slopes, ripping of compacted soil, application of growth media and/or soil amendments, and broadcasting of seed. Based on the reclamation completed to date at the Glamis Marigold Mine, the reclaimed plant communities would likely consist of adequate herbaceous plant cover with sufficient diversity to substantially reduce the potential for soil erosion and provide forage for use by livestock and wildlife within three to five years. Shrub species would also establish during this time period and become more prevalent as the plant communities matured.

Vegetation would be reestablished as a result of reclamation on 1,204 acres of the disturbance. Approximately 270 acres of pit area would remain without vegetation.

The removal of 211 acres of shadscale-cheatgrass vegetation and 1,263 acres of Wyoming big sagebrush-spiny hopsage would be a direct impact. Based on reclamation studies that have been conducted for the existing operations, the growth rate of shrubs is very rapid and mature-sized shrubs would likely be established approximately three to five years after reclamation. However, plant species such as sagebrush may take a decade or more to establish. The reclaimed areas would have different plant composition than the existing plant communities and the structural complexity of the reclaimed plant communities is likely to be less complex than the adjacent undisturbed vegetation. These impacts are likely to occur over a period of years or decades, depending on the site. However, the additional plant species and early seral stages created by the reclamation would increase the overall regional plant diversity and community structure.

Approximately 270 acres of previously vegetated land would remain without vegetation for the long-term. All of this acreage represents acreage of Wyoming big sagebrush-spiny hopsage. The pits that are not backfilled would not support appreciable amounts of vegetation for the foreseeable future. This would be a residual, adverse (i.e., long-term) impact.

Root contact with spent ore or waste rock could expose plants to elevated levels of metals or other constituents that could cause adverse effects to plant growth. However, the plant growth on the 8-South Waste Rock Storage Area, where run-of-mine waste rock and alluvium were used for growth media has been robust to date. The waste from the proposed expanded and new pits would be similar in rock characterization. None of the heap leach pads have been reclaimed to date; therefore no data exists for the heap leach pads. Test plots on the tailings dam indicate that direct planting into the tails is successful. Consequently, vegetation establishment does not appear to be limited by constituents in the waste rock or spent ore.

3.6.3.2.2 Noxious Weeds

The risk assessment for noxious weeds resulted in a moderate risk rating. This rating indicates that noxious weeds in the area are likely to increase in distribution and abundance within the Project Area. Disturbed sites, such as berms, waste rock storage areas, infill areas, and truck shop/warehouse facilities, create favorable sites for noxious weed establishment.

GMMC has committed to coordinate with the NDEP and the BLM to minimize the spread of noxious weeds throughout the Project Area (Section 2.2.19, Reclamation). Under GMMC's current Reclamation Plan, noxious and invasive weed controls would be implemented through vegetation establishment to minimize competition from weedy species and maximize the establishment of desirable species.

According to BLM Manual 9015, a moderate risk rating requires that a preventive management measures to reduce the risk of introduction or spread of noxious weeds into the area be developed. Measures would include interim seeding of disturbed sites, control of new or established infestations of noxious weeds, or development and implementation of a noxious weed control plan.

3.6.3.3 Alternative 1 – Realignment of the Trout Creek Diversion

Under Alternative 1 the impacts would be similar to the Proposed Action with the exception that an additional 12 acres of disturbance of Wyoming big sagebrush-spiny hopsage would be associated with the diversion realignment. This acreage would likely reestablish some vegetation over the long-term, but sections of the diversion that would require rip rap would not support extensive vegetation.

3.6.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to vegetation resources from the expanded Red Rock Pit stabilization are generally the same as those described for the Proposed Action.

3.6.3.5 Alternative 3 – No Action Alternative

The additional disturbance of 1,474 acres of native vegetation would not occur under the No Action Alternative. Vegetation impacts would be limited to ongoing, permitted mining and exploration activities. Reclamation activities, weed control, and subsequent revegetation would occur earlier under this Alternative, as compared to the Proposed Action.

3.7 Wildlife and Fisheries Resources

3.7.1 Regulatory Framework

The following laws, regulations, guidelines, and/or procedures are applicable to management of the wildlife and fisheries resources potentially affected by the Project.

- The BLM and NDOW signed a Memorandum of Understanding (MOU) in 1971 regarding how wildlife and fisheries resources, and their habitat, on public lands would be managed cooperatively by the two agencies. The MOU defines BLM's role to manage the habitat for the wildlife and fisheries resources and NDOW's role in managing populations.

- The Migratory Bird Treat Act (16 USC 701-718h) prohibits the taking of any migratory birds without a permit. Any action that contributes to unnatural migratory bird mortality could be considered a violation of the Act.

- The Bald Eagle Protection Act (PL 92-535) provides federal protection to the bald eagle (*Haliaeetus leucocephalus*) and through provisions and amendments to the Act, protection to the golden eagle (*Aquila chrysaetos*) as well. The Act prohibits the direct or indirect taking of an eagle, eagle part or product, or eagle nest.

- Nevada Revised Statutes (NRS 501.181) authorizes the Nevada Division of Wildlife (NDOW) and the Wildlife Commission in the protection, propagation, restoration, transplanting, introduction, and management of wildlife in the state.

- Nevada Administrative Code (NAC 504.520) requires approval of NDOW for any activity that may obstruct, damage, diminish, destroy, change, modify or vary the natural shape and form of a stream system or its banks by any type of construction or other activity that is detrimental to the wildlife habitat. Such activity includes channelization, thermal pollution, and diversion.

- A NDOW Industrial Artificial Pond Permit (NRS 502.390 and NAC 502.460 *et seq.*) is required for any operator of a mining operation which develops or maintains an artificial body of water containing chemicals directly associated with the processing of ore.

3.7.2 Affected Environment

Information detailing the wildlife habitats and populations in the area of the Proposed Action is provided in the FEIS, Section 3.6, (BLM 2001), and is summarized below. Original baseline studies dealing with aquatic biology and terrestrial wildlife include studies/reports by JBR (1998), BLM (1997, 1998a, 1999, and 2001), NDOW (2002), and personal communications with BLM (Crimmins 2002).

3.7.2.1 Aquatic Biology

Surface water in the Project Area is limited to two intermittent creeks (Cottonwood Creek and Trout Creek) and two isolated spring complexes (Mud Spring/unnamed spring and Ames Spring). The spring complexes, located northeast of the site of the Proposed Action, support a number of mesic-habitat plant species (JBR 1998).

In the upper reaches of Cottonwood Creek and Trout Creek, a viable brook trout (*Salvelinus fontinalis*) fishery occurs where perennial flows are present and deep pools with dense willow (*Salix spp.*) cover provide suitable habitat for fish (BLM 1998a). However, little riparian habitat and no fisheries are present in the lower reaches of Cottonwood and Trout creeks within the Project Area (BLM 2001, NDOW, 2002).

3.7.2.2 Terrestrial Wildlife

Wildlife habitat associated with the Project Area is limited to two dominant plant communities: the shadscale-cheatgrass community, which is found on gentle slopes and south-facing foothills at lower elevations; and the Wyoming big sagebrush-spiny hopsage community which occurs in the foothills and drainages at higher elevations. These major habitat types exist in abundance within the Battle Mountain-Buffalo Valley region. Special habitats, such as riparian/wetland and rock outcrops are not as abundant. Overall water availability is the primary limiting factor for wildlife in the project region.

Terrestrial wildlife species occurring in the Project Area include those typically found in lower and mid-elevation Great Basin habitats. Mule deer (*Odocoileus hemionus*) utilize the foothill habitats in the Project Area during the winter season. Other big game species known to occur in the vicinity of Battle Mountain include pronghorn antelope (*Antilocapra americana*), and mountain lion (*Felix concolor*) (BLM 1998a).

Upland game bird species, including the sage grouse (*Centrocercus urophasianus*), chukar (*Alectoris chukar*), Hungarian partridge (*Perdix perdix*), and mourning dove (*Zenaida macroura*), are known to occur in the vicinity of Battle Mountain and may occur in the Project Area. A number of raptor species have been observed using the Project Area. These include golden eagles, red-tailed hawks (*Buteo jamaicensis*), northern harriers (*Circus cyaneus*), American kestrels (*Falco sparverius*), and great-horned owls (*Bubo virginianus*) (JBR 1998).

Nongame birds include a variety of passerine and raptor species, as well as a diversity of neotropical migrants birds that breed in North America and winter in the neotropical region of South America. These bird species are considered integral to natural communities, as they often act as environmental indicators. Nongame mammalian species include several bats that may occur in the Project Area, including Townsend's big-eared bats (*Plecotus townsendii*), pallid bats (*Antrozous pallidus*), long-legged myotis (*Myotis volans*), and Western small-footed myotis (*Myotis ciliolabrum*) (JBR 1998; BLM 1999). Black-tailed jackrabbits (*Lepus californicus*), yellowbelly marmot (*Marmota flaviventris*), and other small mammals are common in the region.

Detailed lists of representative wildlife species in the vicinity of the Proposed Action are provided in Appendix C of the FEIS (BLM 2001).

3.7.3 Environmental Consequences

3.7.3.1 Assessment Methodology

Potential effects on wildlife and fisheries resources are described as direct or indirect, short-term (i.e. during the life of the project) and long-term. Direct impacts are those that would result in the death or injury of an animal. Indirect impacts include the degradation of wildlife or fisheries habitat to the extent that population numbers decline. Short-term impacts are those that could occur during project implementation and until reclamation is complete. Long-term impacts are those occurring after reclamation is complete.

3.7.3.2 Proposed Action

Implementation of the Proposed Action could result in the limited mortality of less mobile species and the displacement of animals from the Project Area into adjacent habitats during initial construction and ground-clearing activities. Displaced animals would have a tendency to increase intra-specific competition in adjacent lands and would be assumed to be lost from the population. Impacts to migratory birds would be minimized by the environmental protection measures included in the Proposed Action. It is anticipated that the Proposed Action would not eliminate any local population of any species known to occur in the region. Creation of a fresh water pond would present a hazard of drowning to wildlife species that cannot negotiate the pond embankment. The fresh water pond would also create a benefit to wildlife as a water source.

The potential exists under the Proposed Action for pit highwall failure of the west side of the Terry Zone Pit (formerly Red Rock Pit). Such a failure would create a small pit lake at the bottom of this pit which may create a potential hazard for wildlife, either from drowning or from potential water quality issues.

Construction and operation of the Millennium Expansion Project would directly affect 1,474 acres wildlife habitat, including mule deer winter range, through removal of vegetation in areas proposed for surface disturbance. The value of the habitat lost would be the same as for the Marigold Mine Expansion Project (low to moderate) due to the proximity of the project to past and present disturbances and activities, and the availability of native habitats in the surrounding region. The total disturbed acreage of either the shadscale-cheatgrass community or the Wyoming big sagebrush-spiny hopsage community is small in relation to the availability of these particular habitat types in the region.

The Proposed Action includes environmental protection measures to limit land clearing activities to the avian non-breeding season. In the event that land clearing activities are necessary, a qualified biologist would survey the area prior to clearing. If active nests are identified, or if other evidence of nesting (mated pairs, territorial defense, carrying nesting material, transporting food) is observed as a result of this survey, then a protective buffer (the size of which would depend on the requirements of the species) would be delineated and the delineated protective buffer avoided to prevent destruction or disturbance to nests until the nests are no longer active or nesting activities are no longer observed. Therefore, no direct impact to migratory bird species is anticipated.

The Proposed Action would result in the loss of up to 270 acres of terrestrial wildlife habitat resulting from surface disturbance in the open pit areas. The non-vegetated acreage would be a residual adverse impact to wildlife species that inhabited the area prior to mining. However, the pit highwalls represent potential nesting habitat for raptors. Approximately 1,204 acres of wildlife habitat would be removed in the short term and then reclaimed as a result of mine development, operation, and closure. The reclaimed land would have more grass and forb forage and less mature shrub forage in the short-term.

Approximately 1,204 acres of disturbed acreage would be reclaimed, replacing some, but not all the pre-mining wildlife habitat values. Post-reclamation wildlife habitat would differ from pre-project habitat in vegetation compositions and age class. A portion of the Project Area would be converted from a shrub-dominated community to a grass/forb-dominated community in the short term. Once reclaimed, the vegetation that becomes established would, through succession, create a more shrub dominant habitat within three to five years, as occurred on the 8-South Waste Rock Storage Area. However, a decade or more may be required to establish mature shrubs. In the short term, only seed-eating and grass/forb-eating species such as rabbits and seed-eating birds would benefit from reclamation efforts. This may increase the overall diversity of the wildlife community due to the presence of additional habitat types and habitat structures not currently available. Populations of the wildlife species of the shadscale-cheatgrass and Wyoming big sagebrush-spiny hopsage communities would decline until the vegetation returns to pre-mining conditions.

Noise disturbance would be continuous during operations implemented under the Proposed Action. Some wildlife would avoid the area while other wildlife would adapt to the noise and continue normal feeding and breeding activities. However, since the resident animals in the area are already familiar with the noises at the existing Marigold Mine, the residents are not expected to abruptly react to mining noises. Some transient wildlife may avoid the Project Area due to the noise factor. Mule deer and a variety of migratory bird species are commonly found within the Project Area and on the reclaimed 8-South Waste Rock Storage Facility. These species have acclimated to the constant and predictable activity at the mine site.

Sodium cyanide is lethal to wildlife at certain concentrations, and recent information provided by the NDOW and U.S. Fish and Wildlife Service (USFWS 2002) indicates that certain bat and avian species exhibit a delayed influence from cyanide poisoning. These study results suggest that an increased number of bats and birds may be affected by cyanide solutions than previously thought, and individuals may be succumbing to cyanide poisoning away from mine areas. As a result, these mortalities would be less likely to be found and reported.

The Proposed Action includes piping cyanide solutions from the heap leach pads to the processing ponds, eliminating the exposure pathway to wildlife receptors and the cyanide solution. Similarly, the solution ponds would be covered by netting (an approved protection measure) to minimize bird or bat exposure to cyanide solutions. The solution ponds would also be enclosed within a chain-link fence to prevent larger terrestrial wildlife from accessing the solutions. Ponding of solutions on the heap leach pads may occur, creating an exposure pathway for wildlife. Exposure via any of these routes could result in both acute (immediate mortality), or chronic (long-term sickness with possible mortality) of wildlife that comes in contact with, or ingests cyanide-laden solutions. However, appropriate mitigation of this potential impact would include regular monitoring of the heap leach pad surfaces for ponding of cyanide solution during the application process. Ponding on the heap leach pad surface would be removed by moving the dripper lines or ripping the surface to promote infiltration. These measures have proven effective in limiting avian exposure to cyanide solution. These measures have been developed in accordance with the BLM's cyanide management policy and the NDOW's Industrial Artificial Pond Permit.

The vegetation established during reclamation has potential, through root contact with the waste rock or spent ore underneath the ET cover system, for uptake of metals or other constituents found at elevated levels in the MWMP analysis. The elevated levels of these constituents are based on drinking water standards, which cannot be directly related to uptake by plants. However, the risk to large herbivores would be considered low due to the amount of their diet, either daily or seasonally, that would be derived from the reclaimed facilities. For less mobile species, such as jackrabbits, all of their diet may be obtained from one facility. The risk was considered low to these species due to the extensive use of herbaceous species with shallower root systems and the variety within their diet of plants with different capability for uptake of these constituents. The alluvial material also has elevated levels of some of the same constituents as the waste rock. The shallow soils at the mine site create a potential for root contact with alluvial material and bedrock; no impacts to wildlife species have been determined from foraging on pre-disturbance vegetation.

3.7.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to wildlife and fisheries resources from the Trout Creek Diversion Realignment (Alternative 1) are generally the same as those described for the Proposed Action. The differences between the Proposed Action and Alternative 1 that relate to impacts on wildlife habitat are that an additional 12 acres of disturbance would be associated with the construction of the new channel diversion. Because Trout Creek is intermittent along this reach, its value as a fisheries resource is negligible. Movement of the diversion channel 100 to 200 feet away from the existing channel would have little to no impact on wildlife utilization of the creek bed and bank area.

Impacts to wildlife habitat from changes in wildlife mortality and/or displacement, general removal of wildlife habitat, structural modification of wildlife habitat, noise, and potential exposure to cyanide solutions are the same as those described for the Proposed Action (Section 3.7.3.2).

Construction and operation of the Millennium Expansion Project, including Alternative 1, would directly affect wildlife habitat through removal of vegetation in areas proposed for surface disturbance. The Proposed Action includes environmental protection measures to limit land clearing activities to the avian non-breeding season. In the event that land clearing activities are necessary, a qualified biologist would survey the area prior to clearing. If active nests are identified, or if other evidence of nesting (mated pairs, territorial defense, carrying nesting material, transporting food) is observed as a result of this survey, then a protective buffer (the size of which would depend on the requirements of the species) shall be delineated and the delineated protective buffer avoided to prevent destruction or disturbance to nests until the nests are no longer active or nesting activities are no longer observed. Therefore, no direct impact to migratory bird species is anticipated.

3.7.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to wildlife and fisheries resources from the expanded stabilization of the Red Rock Pit (Alternative 2) are generally the same as those described for the Proposed Action. Impacts to wildlife habitat from changes in wildlife mortality and/or displacement, general removal of wildlife habitat, structural modification of wildlife habitat, noise, and exposure to cyanide solutions are the same as those described for the Proposed Action (Section 3.7.3.2). Potential impacts to wildlife from drowning in a pit lake as a result of failure of the Red Rock Pit highwall would be greatly reduced by implementing this alternative.

3.7.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, none of the impacts identified for the Proposed Action would occur.

Impacts to wildlife under the No Action Alternative would be the same as those described and analyzed in the FEIS (BLM 2001; pages 3-91 through 3-94).

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3.8 Special Status Species

3.8.1 Regulatory Framework

The Endangered Species Act of 1970, as amended (ESA), is administered by the USFWS, in consultation with other federal and state agencies. The ESA affords protection to species classified as threatened or endangered or candidate species, as well as to habitats which are designated by the Secretary of the Interior to be critical to such species. The ESA prohibits the "taking" (i.e., killing, harming, or harassment) of listed species without special exemptions.

Species of concern (formerly Candidate, Category 2 species) are not afforded the same protection under the ESA as listed species; however, the federal agencies are required to afford them consideration in their planning and decision-making processes. BLM in Nevada incorporated all former USFWS-designated Category 2 candidate species into the Nevada Special Status Species List as Sensitive Species. In addition, there is a Nevada State Protected Animal List (NAC 501.100 – 503.104) that BLM has incorporated, in part, into the BLM's Special Status Species List. Under this designation, BLM policy is to require that actions authorized, funded, or carried out by the agency do not contribute to the listing of any sensitive species or candidate species as threatened or endangered under the ESA.

Nevada revised statute (NRS 527.270-300) prohibits removal or destruction of plant species listed as threatened with extinction except by special permit from the Nevada Division of Forestry.

The general location and status of Nevada's sensitive plants and natural biological communities is compiled in an inventory maintained by the Nevada Natural Heritage Program (NNHP). In addition to federal and state protected species, the NNHP tracks species for which the scientific community in Nevada has concern. The Northern Nevada Native Plant Society (NNNPS) is a non-profit organization that acts in an advisory capacity to state and federal agencies regarding native plant and their distribution. The NNNPS designates plants to one of six categories with respect to the species abundance and distribution in Nevada. The designations do not afford legal status or protection for the species, but the agencies do consider the listings in their planning and decision-making processes.

3.8.2 Affected Environment

The special status species identified by the USFWS (2002) and NNHP (1998, 1999) for the Project Area and cumulative assessment area are listed in Table 3-15. Although a number of sensitive terrestrial and aquatic species occur in northern Nevada, few species have been documented for the immediate Project Area. In support of this document and previous mine expansions, baseline surveys have been conducted in and near the Project Area (BLM 1998a; JBR 1998). Information regarding the special status species identified as having potential to occur within or near the Project Area is provided in Section 3.7 of the *Final Environmental Impact Statement Marigold Mine Expansion* Project (BLM 2001, pages 3-96 through 3-100), and is incorporated by reference.

3.8.2.1 Plants

Two BLM state sensitive species, the Elko rockcress and windloving buckwheat, could potentially occur within or adjacent to the Project Area, based on their habitat associations (Table 3-15). General habitat surveys conducted in 1997 recorded no special status species within the Project Area (JBR 1998). One state-sensitive plant species that has been documented in the vicinity of the project, but not found within the Project Area, is the sand cholla cactus (JBR 1998) (Table 3-15). This cactus is typically associated with big sagebrush and shadscale. It is thought to be widely distributed and uncommon throughout its range (Mozingo and Williams 1980). All cacti and yucca species are protected by NRS 527.060-120.

Eight additional species that were identified by the NNHP were considered but eliminated from the analysis based on the lack of suitable habitat, soil composition, geology, and elevational range of these species. These species included the Ophir rockcress,

Table 3-15: Special Status Wildlife Species Identified for the Proposed Project

Common Name	Scientific Name	Federal Status[1]	Potential Occurrence in the Project Area and Vicinity[2]
PLANTS			
Elko rockcress	*Arabis falcifructa*	BLM	U
Sand cholla cactus	*Opuntia pulchella*	State	R-V
Windloving buckwheat	*Eriogonum anemophilum*	BLM	DNO
BIRDS			
Bald eagle	*Haliaeetus leucocephalus*	FT	W, M
Peregrine falcon	*Falco peregrinus*	BLM	M
Golden eagle	*Aquila chrysaetos*	BLM	R
Swainson's hawk	*Buteo swainsoni*	BLM	R-V
Ferruginous hawk	*Buteo regalis*	BLM	R-V
Northern goshawk	*Accipiter gentillis*	BLM	R-V
Western burrowing owl	*Athene cunicularia hypugea*	BLM	R
Sage grouse	*Centrocerus urophasianus*	BLM	R
Black tern	*Chlidonias niger*	BLM	DNO
Least bittern	*Ixobrychus exilis hesperis*	BLM	DNO
White-faced ibis	*Plegadis chihi*	BLM	DNO
MAMMALS			
Small-footed myotis	*Myotis ciliolabrum*	BLM	R
Long-eared myotis	*Myotis evotis*	BLM	U
Fringed myotis	*Myotis thysanodes*	BLM	U
Long-legged myotis	*Myotis volens*	BLM	R-V
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	BLM	R
Pacific Townsend's big-eared bat	*Corynorhinus townsendii townsendii*	BLM	R
Spotted bat	*Euderma maculatum*	BLM	U
Pygmy rabbit	*Brachylagus idanoensis*	BLM	DNO
INVERTEBRATES			
Nevada viceroy	*Limenitus archippus lahontani*	BLM	DNO

[1]FE = Federally endangered.
FT = Federally threatened.
BLM = BLM state sensitive species.
Currently protected by the BLM in Nevada under the BLM's state guidelines.
State = Protected by Nevada State law (NRS 527.060-120).
[2]R-V = Resident in Vicinity: this species has been documented in the project vicinity, which includes habitats surrounding the Project Area.
R = Resident: this species has been documented in the Project Area.
W = Winters: this species winters in the vicinity of the Project Area.
M = Migrates: this species is known to migrate through the Project Area.
U = Unknown: it is currently unknown whether this species occurs in the study area or vicinity; however, appropriate habitat is present.
DNO = Does not occur within the Project Area.

Goodrich biscuitroot, Nevada willowherb, Lewis buckwheat, Nevada dune beardtongue, Tiehm beardtongue, obscure scorpion plant, and least phacelia.

3.8.2.2 Birds

The USFWS has downlisted the bald eagle to federally threatened from endangered status (USFWS 1995). No bald eagle nesting habitat occurs in or near the Project Area; however, migrating eagles do move through the state, and wintering birds would occur within the appropriate winter habitats (e.g., Humboldt River corridor) from December through March. Eagle presence in the immediate Project Area would be infrequent and limited to occasional foraging in the upland habitats.

The American peregrine falcon was delisted as federally endangered on August 25, 1999. The peregrine falcon continues to be protected under the Migratory Bird Treaty Act and is considered a BLM state sensitive species. No eyries are known to occur in the vicinity of the Project Area. In addition, no primary foraging habitat (e.g., riparian zones) occurs in the Project Area. Peregrine use of the project and cumulative assessment areas would be limited to migrating birds.

The golden eagle is a yearlong resident and is considered to be a common breeder throughout Nevada. Golden eagle nesting has been documented in the Battle Mountain area; however, suitable nesting habitat (e.g., cliff faces, highwalls in inactive pits) in the immediate Project Area is limited. No active eagle nests have been recorded within the Marigold Mine expansion area (BLM 1997).

The Swainson's hawk is a summer resident of Nevada and, like the golden eagle, is most abundant in the northern third of the state (NDOW 1985). Although Swainson's hawks have been observed exhibiting territorial behavior along the Humboldt River (BLM 1995), no occupied territories or active nest sites have been documented within the Project Area.

The ferruginous hawk is a common breeder in many areas of Nevada. This species often nests in trees, on promontory points, rocky outcrops, cut banks, or on the ground (Terres 1991). No breeding activity has been observed in the Project Area.

The northern goshawk is a forest species that is a yearlong resident, breeding in the mountains and wintering in the lower foothills and valleys (Herron et al. 1985). Although potential nesting habitat occurs in the Battle Mountain area, no suitable habitat occurs in the Project Area.

The burrowing owl is known to breed throughout Nevada. The majority of the breeding population is known to migrate from northern Nevada during the winter months. Suitable habitat (i.e., shadscale and sagebrush communities) for this species is present in the Project Area. Burrowing owls, including one family group, were recorded in shadscale/cheatgrass habitat within the Project Area north of Ames Springs in 1997 (JBR 1998).

Sage grouse are native to the Battle Mountain area, occurring in upland shrub communities at the upper elevations. Surveys conducted in 1994 and 1995 recorded sage grouse in upland habitats and riparian areas of Battle Mountain (BLM 1998a). In 1997, the NDOW located five leks on ridges in the upper elevations of Battle Mountain (JBR 1998). Historic lek sites previously identified by the Battle Mountain Band Council of Te-Moak Tribe of Western Shoshone and the Duck Valley Shoshone-Paiute Tribe as occurring within the Project Area were visited by the NDOW to determine activity. However, the NDOW was unable to verify that any of the sites were still active (BLM 1998a).

The Nevada Sage Grouse Conservation Strategy (NDOW 2001) includes local planning groups for sage grouse conservation planning. The Glamis Marigold Mine is within the Battle Mountain Population Management Unit (PMU). This PMU consists of an isolated, small population (< 250 birds). The Battle Mountain PMU has been identified as a priority for management. The local planning group is developing management strategies for this PMU, based on the *Guidelines To Manage Sage Grouse Populations and*

Their Habitats (Connelly et al. 2000) as they pertain to local conditions. The lower elevation habitats are of limited quality based on the abundance and age class of sagebrush and lack of herbaceous understory. These habitats are candidates for restoration measures that could include alteration of the vegetation to favor additional herbaceous species.

The black tern, least bittern, and white-faced ibis are all associated with riparian or wetland habitats. These species may occur in association with the Humboldt River, approximately eight miles north of the mine site, but no habitat exists within close proximity to the Glamis Marigold Mine.

3.8.2.3 Mammals

Several BLM sensitive bat species either occur or may occur in the Project Area. Federal and state agencies identified sensitive bat species, including the small-footed myotis, long-eared myotis, fringed myotis, long-legged myotis, Townsend's big-eared bat, and the spotted bat, as potentially occupying the appropriate habitat types in and near the Project Area.

The habitat preferences of the Pygmy rabbit in Nevada are not well known (Brussard 2001); however, the lack of riparian habitat, deep friable soils, and basin big sagebrush limit the potential for this species to occur. None were observed during the field surveys (JBR 1998).

3.8.2.4 Invertebrates

The Nevada viceroy, a butterfly, is distributed along the Humboldt River. This species is associated with riparian areas, due in large part to their dependence on willow as a larval host species.

The USFWS also expressed concern over the potential for springsnails to occur within the Project Area and to be impacted by the proposed mining activity. BLM examined Ames, Mud and the unnamed springs on September 20, 2002. No springsnails were found and BLM concluded that the condition of the spring was not suitable as habitat for springsnails (M. Varner 2002).

3.8.3 Environmental Consequences & Mitigation Measures

3.8.3.1 Assessment Methodology

Concerns related to special status species were identified through the public scoping process, internal BLM scoping, and review of the issues addressed in the previous NEPA documents prepared for GMMC.

Potential effects to special status species are described as direct or indirect, short-term (i.e. during the life of the Project) and long-term. Direct impacts are those that would result in the death or injury of an animal. Indirect impacts include the degradation of species' habitat to the extent that population numbers decline. Short-term impacts are those that could occur during project implementation and until reclamation is complete. Long-term impacts are those occurring after reclamation is complete.

3.8.3.2 Proposed Action

No sensitive plant populations are known to occur in the project vicinity. Therefore, impacts to sensitive plant species are not anticipated, as a result of mine construction and operation.

The Proposed Action would disturb approximately 1,264 acres of the Wyoming big sagebrush-spiny hopsage community and 211 acres of the shadscale-cheatgrass community. The environmental protection measures included in the Proposed Action would restrict vegetation removal activities to the avian non-breeding season.

The removal of this vegetation represents a short-term and indirect impact of a loss 1,474 acres of hunting habitat for golden eagles, wintering bald eagles, Swainson's hawk, ferruginous hawk, and western burrowing owl. Removal of the 1,264 acres of Wyoming big sagebrush-spiny hopsage vegetation would have potential short-term indirect impacts to sage grouse, if present. The vegetation communities do not represent habitat for the Nevada Viceroy, therefore no impact to this species is anticipated.

Both plant communities are abundant in the vicinity and removal of 1,474 acres of habitat would not create a population impact on any of the raptors. No direct impacts to breeding or nesting sage grouse would be anticipated from the proposed project. This analysis is based on the lack of potentially suitable breeding and nesting habitat within the Project Area and the distances to known lek sites at the upper elevations of Battle Mountain. Indirect impacts due to removal of potential winter habitat may occur, but evidence of sage grouse winter use of the Project Area was not found during the baseline surveys. No mitigation is proposed beyond the reclamation measures included in the Proposed Action.

The removal of 211 acres of the shadscale-cheatgrass community would be considered a short-term, indirect impact by reducing the available nesting habitat for western burrowing owl. This species has been observed nesting in the area, but lower in elevation on the alluvial fan. Direct impacts to western burrowing owls would be avoided by implementing the environmental protection measure to restrict vegetation removal to the avian non-breeding season.

The extension of the mining activity to the south of the existing mining operations would result in increased human activity where activity levels have been historically light. Human activity in the southern portion of the Project Area may result in the direct or indirect impact of nest abandonment or nest disturbance. Ferruginous hawks are susceptible to disturbance during the courtship and incubation periods. However, no ferruginous hawks have been documented as nesting in the area. The environmental protection measure of removing vegetation during the avian non-breeding season would limit the magnitude of this impact. Other species may be impacted by the disturbance.

No riparian or wetland areas would be impacted by the Proposed Action, either directly through surface disturbance or indirectly by impacts to the groundwater system.

The Proposed Action would not impact any existing underground workings that could provide potential bat habitat. No other underground workings are known to occur within the Project Area. No direct impacts to bats are anticipated from the Proposed Action. Removal of vegetation would reduce the amount of available foraging habitat; however, extensive acreage of the various plant communities in the area would remain intact. Foraging by bats at the local springs would not be affected.

No residual adverse impacts would occur to federally listed species identified for this project. Residual effects applicable to BLM state sensitive species would be limited to potential habitat loss for the raptors, burrowing owl, and sage grouse from the unreclaimed acreage of the pits. However, this may provide nesting habitat for some species of raptors, as evidenced by golden eagles, prairie falcons, and great-horned owls nesting in inactive pits located on Battle Mountain (Back 1999).

3.8.3.3 Alternative 1 – Trout Creek Diversion Realignment

Under Alternative 1 an additional 12 acres of the Wyoming big sagebrush-spiny hopsage plant community would be disturbed during the construction of the diversion.

The impact to special status species from the implementation of this Alternative would not substantially add to the impacts identified for the Proposed Action.

3.8.3.4 Alternative 2 - Expanded Red Rock Pit Stabilization

Under Alternative 2 no additional direct or indirect impacts would occur beyond those identified under the Proposed Action.

3.8.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the incremental habitat loss for the raptors, sage grouse, and burrowing owl would not occur.

3.9 Range Resources

3.9.1 Regulatory Framework

The Taylor Grazing Act of 1934, as amended, FLPMA, as amended by the Public Rangelands Improvement Act of 1978, 43 CFR 4100 Grazing Regulations, and Public Land Orders all authorize the Secretary of Interior to administer livestock grazing on public lands.

The Sonoma-Gerlach Rangeland Program Summary and MFP are long-range plans developed by the BLM. The plans were developed in response to Sections 202 and 603 of the FLPMA that require the BLM to prepare land use plans for public lands. The Project Area is located within the North Buffalo grazing allotment. The Copper Canyon grazing allotment is located south of the North Buffalo allotment. Both allotments are administered by the BLM, Battle Mountain Field Office.

In 1997, the BLM in Nevada developed rules to carry out the Fundamentals of Rangeland Health. The rules are called *Standards for Rangeland Health and Guidelines for Grazing Management*. These Standards and Guidelines set specific conditions to be achieved on BLM lands and the practices that would be applied in order to achieve the Standards.

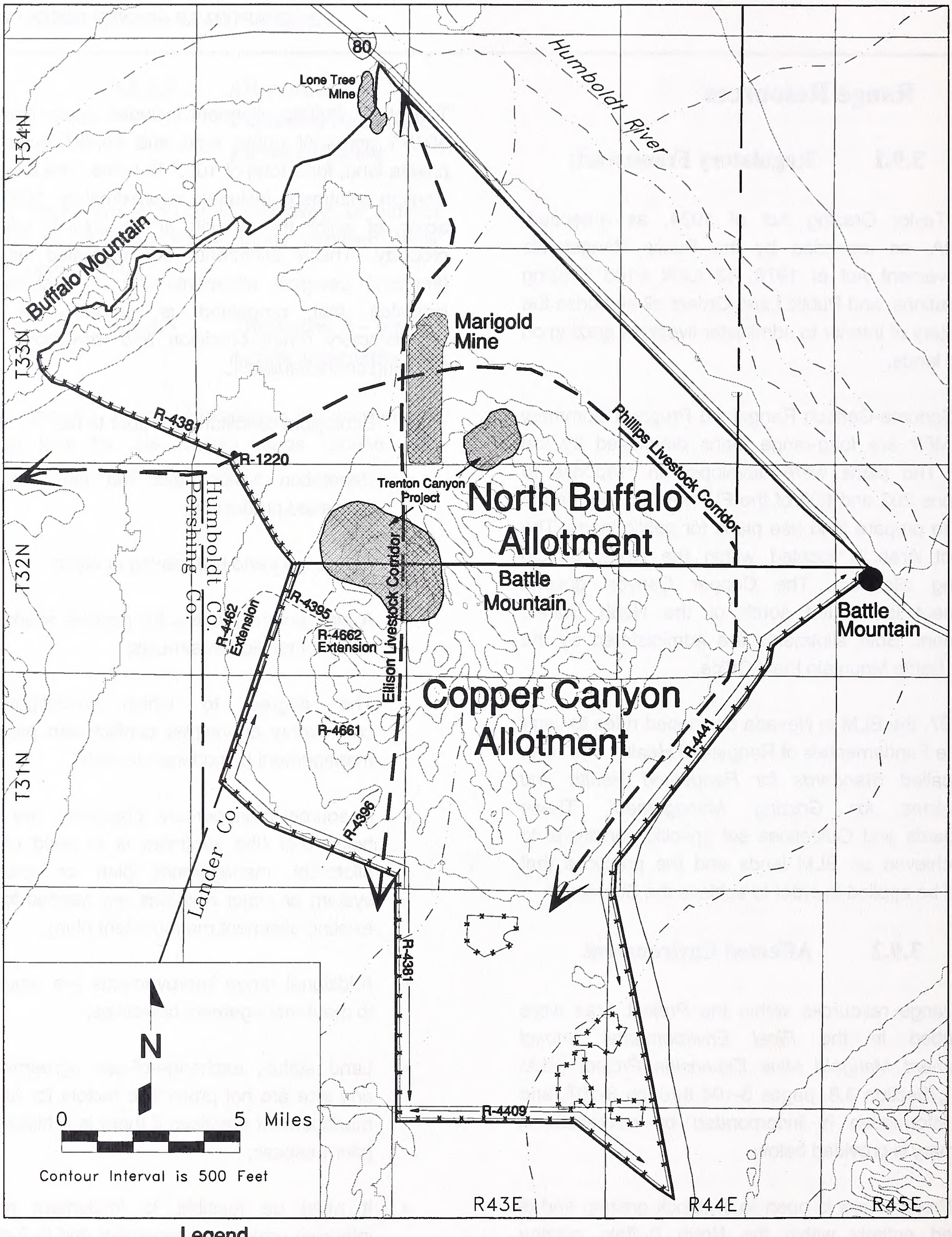
3.9.2 Affected Environment

The range resources within the Project Area were described in the *Final Environmental Impact Statement Marigold Mine Expansion Project* (BLM 2001), Section 3.8, pages 3-104 through 3-107, and this information is incorporated by reference. A summary is provided below.

The Project Area is open to livestock grazing and is located entirely within the North Buffalo grazing allotment (Figure 3-19). The Copper Canyon grazing allotment is located south of the North Buffalo allotment; these allotments are not separated by a rangeland fence thereby allowing grazing operations to occur in both grazing allotments throughout the grazing season.

The North Buffalo allotment includes approximately 55,071 acres of public land and 45,697 acres of private land, for a total of 100,768 acres. The Copper Canyon allotment includes approximately 105,000 acres, of which the majority of the area is private property. These allotments are classified as "I" (improve) category allotments. An "I" designation indicates that rangeland is currently in an unsatisfactory range condition and may have the following characteristics:

- Ecological conditions are poor to fair;
- Vegetation types have the capability of increased production;
- The range trend is declining or static;
- A high potential exists for positive economic return of public investments;
- The degree to which social/political controversy or interest conflict with present management is moderate to high;
- Resource management objectives are not being met (the allotment is in need of an allotment management plan or grazing system or major revisions are needed to an existing allotment management plan);
- Additional range improvements are required to meet management objectives;
- Land status, exchange-of-use agreements, and size are not prohibitive factors for future management practices if there is a history of prior trespass;
- It must be feasible to implement more intensive grazing management and to further develop range improvements (as compared to other allotments considering constraints of ten-year projections of funding and manpower availability); and



Legend

- County Boundary
- Interstate 80
- Road
- Stream or Intermittent Stream
- City
- Allotment Boundary
- Fence
- Water Pipeline
- Well
- Livestock Corridor

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Figure 3-19

Grazing Allotments and Range Improvements

- One or more major resource conflicts are present with critical wildlife habitat, wild horse and burro/livestock use areas, recreation, water rights, mining, lands action, Areas of Critical Environmental Concern, reintroduction of plants and animals, soil, water, and air quality.

Table 3-16 provides a list of permittees and the grazing information for the North Buffalo and Copper Canyon allotments. BLM-administered lands within North Buffalo allotment are currently leased by three permittees and have a combined total active grazing preference of 3,447 animal unit months (AUMs). Two sheep routes pass through the Project Area, with the animals being moved north in the spring and south in the late fall each year (Figure 3-19). Annual sheep migrations originate in the Copper Canyon allotment, continue northward into the North Buffalo allotment, and return to the Copper Canyon allotment at the end of the grazing season. One of these routes passes through the Project Area along the Trout Creek corridor. The sheep operator using this route has a grazing permit that extends from March 1 to April 30 (405 AUMs) and from November 1 to February 28 (789 AUMs). The second sheep route passes through the southern portion of the Project Area, less than one mile north of Mud Spring. The operator using this route has a grazing permit that extends from March 1 to March 31 (431 AUMs) and from November 1 to February 28 (1,669 AUMs). A third operator has a grazing permit to utilize 153 AUMs for yearlong cattle grazing within the project vicinity.

Table 3-16: Livestock Grazing Permits for the North Buffalo and Copper Canyon Allotments

Grazing Allotment	Permittee	Kind of Livestock	Numbers of Livestock	Grazing Period and Dates	Percent on Public Land	Active Preference (AUMs)
North Buffalo	Badger Ranch	Cattle	255	3/1 – 2/28		153
	Ellison Ranching	Sheep	1,009	3/1 – 4/30	100	405
		Sheep	1,000	11/1 – 2/28	100	789
	Agri-Beef Company	Sheep	2,115	3/1 – 3/31	100	431
		Sheep	2,115	11/1 – 2/28	100	1,669
Subtotal						3,447
Copper Canyon	Ellison Ranching Company	Sheep	300	3/1 – 4/30	100	120
		Sheep	335	11/1 – 2/28	100	264
	Badger Ranch[1]	Cattle	490	3/1 – 2/28	61	3,587
	Chiara Ranch[1]	Cattle	30	11/1 – 2/28	42	50
	Agri-Beef Company	Sheep	1,009	3/1 – 3/31	100	206
		Sheep	1,009	11/1 – 2/28	100	796
Subtotal						5,023
			TOTAL			8,470

[1]Although there are separate ranches, the owner is common to both.
Source: JBR 1998, 1999a.

The Copper Canyon allotment involves four grazing permits held by three permittees with a combined active grazing preference of 5,023 AUMs (Table 3-17).

The North Buffalo and Copper Canyon allotments include 12 range improvements, none of which are located within the Project Area (Figure 3-19). A description of these improvements is provided in Table 3-17. Most of these improvements are perimeter fencing and spring/water development pipelines in the western portion of the Copper Canyon allotment. The remaining improvements are cattleguards.

Two prominent range sites occur in the Project Area including the droughty loam, eight to ten inches of precipitation (ppt) per year, and loamy, five to eight inches of precipitation per year, sites. Dominant species associated with the droughty loam, eight to ten inch ppt site include Wyoming big sagebrush, spiny hopsage, Thurber needlegrass, and Indian ricegrass. The average annual forage production is 350 pounds per acre per year. The loamy, five- to eight-inch ppt range site occurs at lower elevations, with common species including shadscale, bud sagebrush, bottlebrush squirreltail, and Indian ricegrass. Average annual forage production is 450 pounds per acre per year.

A four-strand barbed wire fence (three top strands of barbed wire and a smooth bottom wire) currently exists to exclude livestock from the active mining operations. The area to be fenced was increased to 8,400 acres following analysis on the FEIS (BLM 2001). Natural surface water sources, including

Table 3-17: Range Improvements for the North Buffalo and Copper Canyon Allotments

Grazing Allotment	Improvement Number	Name	Location
North Buffalo	R-4381	North Buffalo Fence	Township 33 North, Range 42 East, Section 32
	R-1220	Stock Well	Township 33 North, Range 42 East, Section 32
Copper Canyon	594381	Copper Canyon Fence	Township 31 North, Range 42 East, Section 20
	594395	Mill Spring Improvement and Pipeline	Township 32 North, Range 42 East, Section 27
	594396	Rocky Spring Improvement and Pipeline	Township 31 North, Range 42 East, Section 24
	594409	Harry Canyon Division Fence	Township 29 North, Range 43 East, Section 9
	594441	Shoshone Highway 8A Fence	Township 30 North, Range 44 East, Section 5
	594661	Timber Canyon Pipeline	Township 31 North, Range 42 East, Section 1
	594662	Mill Creek Pipeline Extension	Township 32 North, Range 42 East, Section 27
	594384	Copper Canyon Cattleguard	Township 30 North, Range 42 East, Section 1
	594892	State Highway 305 Fence	Township 31 North, Range 44 East, Section 24
	594893	State Highway 305 Cattleguard	Township 31 North, Range 44 East, Section 24

Source: JBR 1998.

springs and intermittent creeks, are currently available for use by grazing livestock in the project vicinity (see Section 3.2.2.2, Surface Water).

Mud Spring is a perennial or semi-perennial (i.e., this spring has been observed to be dry during some winter months) water source utilized by grazing livestock on a seasonal basis. This spring was developed during the 1970s to improve water supply and quality. However, the improvements that were made to the spring have substantially deteriorated since that time. Ames Spring, which is a perennial spring, is located on private land less than 0.1 mile south of the proposed permit boundary and also is utilized as a water source by grazing livestock on a seasonal basis. The unnamed spring is intermittent, often without flow during periods of the year. This spring is available as a water source for livestock when flowing. Perennial reaches of Cottonwood and Trout creeks, which are located south of the Project Area, are also used as water sources by grazing livestock.

3.9.3 Environmental Consequences & Mitigation Measures

3.9.3.1 Assessment Methodology

The impact of the Proposed Action and alternatives was determined by the change in available forage from the existing condition and the change in livestock movements that would result from the current livestock use patterns.

3.9.3.2 Proposed Action

The Proposed Action would enlarge the existing fenced area by 1,586 acres. The proposed fence expansion would include the Section 16 Heap Leach Pad and Facilities, Haul Road, and all project components in Sections 19, 20, 30, 31, and 6. Mud Spring, Ames Spring, the unnamed spring, and Trout Creek would not be included within the area fenced and would remain available to livestock. The average stocking rate for this allotment is 20 acres/AUM. Therefore, the exclusion of livestock from an additional 1,586 acres of rangeland forage would result in the temporary loss of approximately 79 AUMs, which would reduce the active grazing preference within the North Buffalo allotment from the current 3,447 AUMs to 3,368 AUMs for the life of the project. The loss of 79 AUMs represents approximately two percent of the active grazing preference. A permanent loss of 270 acres of rangeland or approximately 14 AUMs would result from pit expansion and new pit development that would not be reclaimed to support livestock forage after mine closure and reclamation. Successful reclamation of and increased forage productivity associated with the waste rock storage areas may partially compensate the loss of 14 AUMs.

Approximately 150 acres of the 8-South Waste Rock Storage Area has been accepted by BLM as reclaimed and released from the bond surety. This acreage is currently within the perimeter fence and is not available to livestock grazing.

Private land that is not under GMMC control would not be included in the fenced perimeter. Therefore, impacts to private grazing leases would not occur.

Residual impacts of the Proposed Action for range resources would include the permanent loss of 14 AUMs. This total represents less than one percent of the total AUMs for the North Buffalo allotment.

Construction of the range perimeter fence would block the seasonal sheep movements through the Mud Spring-Trout Creek area (Figure 3-19). The Section 30 Heap Leach Pad and North Waste Rock Storage Area would be constructed within the existing trail route. Rerouting the sheep around the Millennium Expansion Project facilities would increase the trail from a one-mile route to a five-mile route. However, the haul road currently used by NMC at the Valmy Pit also creates a barrier to this route in combination with the Millennium Expansion Project facilities. Water sources currently available to the livestock would remain available (i.e., Ames Spring, Mud Spring, unnamed spring, and Trout Creek). GMMC has also provided stockwater north of the mine facility that would be available if the operator chooses to trail around the mine to the north.

The livestock operators have indicated that trailing around the mine site does not constitute a major impact or inconvenience (J. Phillips, personal communication; B. Hall, personal communication)

3.9.3.3 Alternative 1 – Trout Creek Diversion Realignment

Realignment of the Trout Creek Diversion would not impact livestock operations. The construction work would be conducted during the non-flow season and livestock would have access to the seasonal flow when the diversion is completed. The existing Trout Creek channel above and below the new diversion would remain in place, and the existing diversion would be reclaimed to provide forage.

All other impacts would be the same as described for the Proposed Action.

3.9.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Expansion of the amount of backfill and the creation of a berm at the west highwall of Red Rock Pit would not impact range resources. The pit acreage has previously been included in the acreage of permanent forage loss. The partial backfill would be reclaimed, but would not be readily accessible to livestock.

All other impacts would be the same as described for the Proposed Action.

3.9.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, additional impacts to range resources would not occur from development and operation of the Proposed Action. Presently, permitted mine and mineral exploration projects associated with the Marigold Mine would exclude 3,008 acres of rangeland from livestock use. This exclusion has resulted in the temporary loss of 150 AUMs, based on an average stocking rate of 20 acres per AUM. No impact to forage availability beyond that which has been previously authorized would occur from the No Action Alternative.

The perimeter fence under the No Action Alternative would not interfere with existing sheep trail routes.

3.10 Land Use and Access

3.10.1 Regulatory Framework

Public lands under BLM administration are managed for multiple use under the guidance of the Sonoma-Gerlach MFP (BLM 1982). This plan provides that land use within the Project Area is open for mineral exploration and development. One of the objectives in the MFP is to make public lands and federally-owned minerals available for exploration and development of mineral and material commodities.

The BLM surface management regulations, 43 CFR Subpart 3715 – *Use and Occupancy Under the Mining Laws*, address the unlawful use and occupancy of unpatented mining claims for non-mining purposes. The regulation limits such use or occupancy to that which is reasonably incident.

The Project Area is zoned M-3 (Open Land Use District) by Humboldt County for open space and provides a wide array of rural land uses, including mineral extraction, under this land use classification. Mining is a principal permitted use within this zoning district. Mining operations must comply with Article 10 of the Humboldt County Zoning Ordinance and obtain a Special Use Permit.

3.10.2 Affected Environment

Information detailing the land use and access in the area of the Proposed Action is provided in the FEIS (BLM 2001), and is summarized below.

3.10.2.1 Land Use

Publicly administered lands, including land managed by the BLM, the USDA Forest Service, and the State of Nevada, comprise the majority of lands in Humboldt County and account for approximately 80 percent of the county's land base (Harris et al. 2001). Private lands comprise approximately 20 percent of Humboldt County and generally are interspersed with public lands in a checkerboard pattern for a distance of 20 to 25 miles on either side of the Humboldt River. Surface ownership in the Project Area is shown in Figure 3-20.

Land uses within the Project Area consist primarily of mineral exploration and development, livestock grazing, wildlife habitat, and dispersed recreational use. The Marigold Mine has been in operation since 1988. The existing permit boundary encompasses approximately 8,400 acres of public and private lands, of which 4,420 acres are managed by the BLM. There are no state-administered lands within the GMMC property boundary; however, a section (approximately 640 acres) of private land is owned by the University of Nevada, Reno.

There are several other gold mines located in proximity to the Project Area. The Trenton Canyon Mine is located immediately to the south of the Project Area. The active Lone Tree Mine is located approximately eight miles northwest of the Marigold Mine. Another major industrial development in the project vicinity is the Sierra Pacific Power Company North Valmy Generating Station, located approximately ten miles to the north.

The Project Area is located within the 100,768-acre North Buffalo Grazing Allotment that includes both private and public lands. See Section 3.9, Range Resources, for a discussion of livestock grazing. Section 3.11, Recreation, contains a discussion of dispersed recreational use in the Project Area.

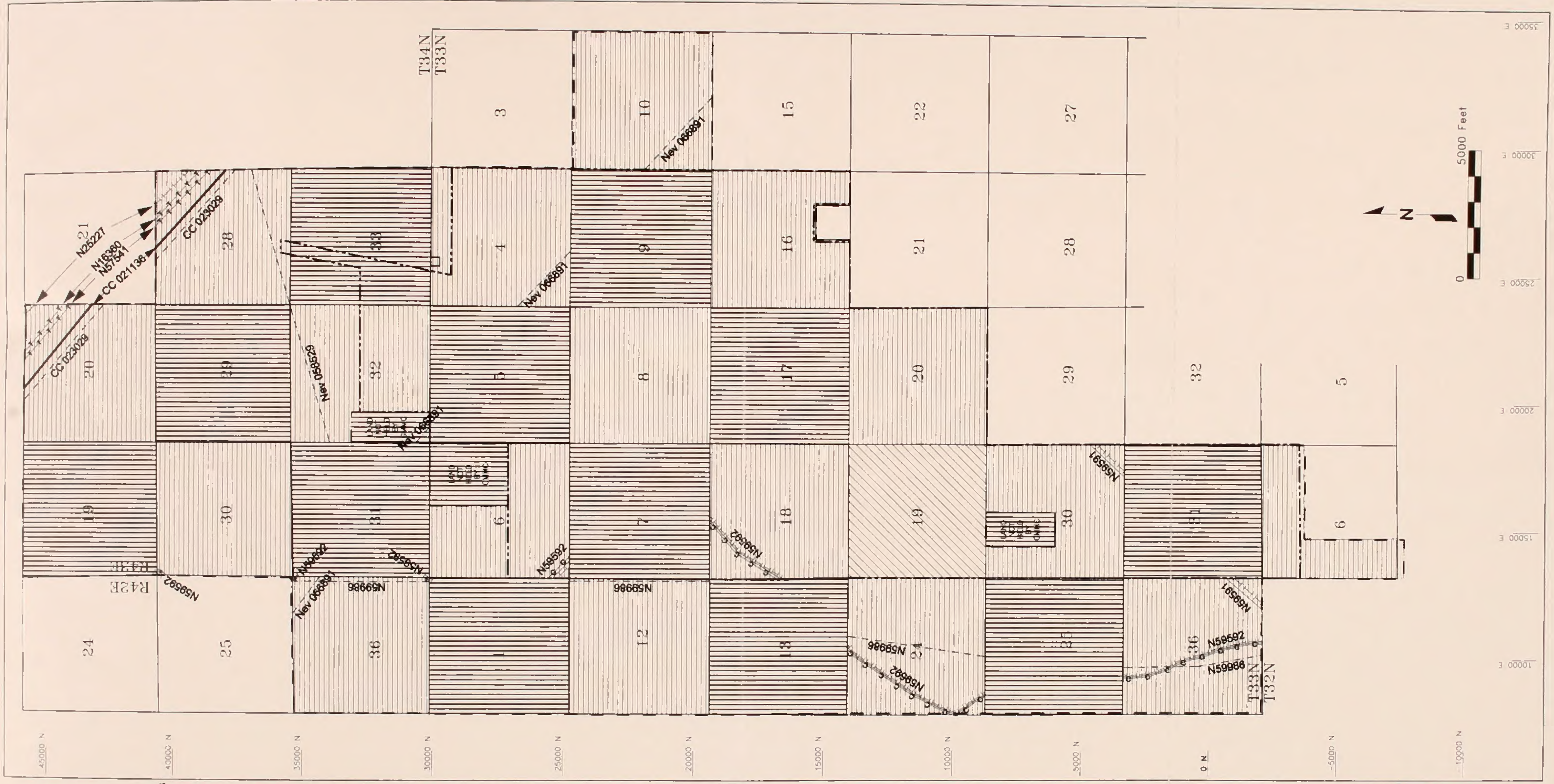
There are no residences within the Project Area. The nearest residential dwellings are located approximately three miles to the north in the community of Valmy.

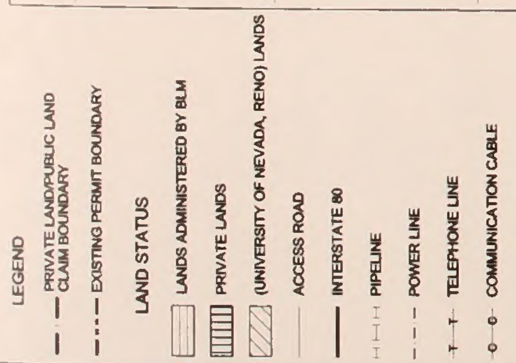
3.10.2.2 Rights-of-Way

The major Right-of-Way (ROW) in the vicinity is Interstate 80 (I-80), which lies to the northeast of the Project Area. A 120-kV transmission line and associated ROW also passes through the Project Area. Other ROWs near the Project Area include a water supply line that serves the mine site. Figure 3-20 depicts existing ROWs in and near the Project Area. Table 3-18 provides a detailed listing of ROWs within the Project Area.

Table 3-18: Existing Rights-of-Way Within the Project Area and Land Position Boundary

Serial Number	Type of Land Use	ROW Holder	Location	Width
N-25227	N. Valmy Station Power Line (23kV), Water Pipeline (18") and Patrol Road	Sierra Pacific Power Company	T34N, R43E, Sections 20 and 28	30 feet
N-16360	Telephone/Telegraph Line	Nevada Bell	T34N, R43E, Sections 20 and 28	10 feet
N-57541	Telephone/Telegraph Line	Nevada Bell	T34N, R43E, Sections 20 and 28	20 feet
CC-021136	Interstate 80	Nevada Department of Transportation	T34N, R43E, Sections 20 and 28	400 feet
CC-023029	Power line	Sierra Pacific Power Company	T34N, R43E, Sections 20 and 28	100 feet
Nev-066891	Power line (120kV)	Sierra Pacific Power Company	T34N, R42E, Section 36; T33N, R43E, Sections 4 and 10; T34N, R43E, Section 32	75 feet
Nev-058529	Power line (7.2kV)	Sierra Pacific Power Company	T34N, R43E, Sections 28 and 32	40 feet
N-59986	Power line (24.9kV)	Santa Fe Pacific (to NMC)	T33N, R42E, Sections 12, 24, and 36; T34N, R42E, Section 36	30 feet
N-59591	Patrol Road	Santa Fe Pacific (to NMC)	T33N, R42E, Section 36 T33N, R43E, Section 30	Variable
N-59592	Water pipeline, road, and communication cable	Santa Fe Pacific (to NMC)	T33N, R43E, Section 6; T33N, R42E, Sections 24 and 36; T34N, R42E, Section 36; T33N, R43E, Section 18; T34N, R43E, Section 30	100 feet





Millennium Expansion Project

Figure 3-20

Existing Rights-of-Way Within the Project Area

3.10.2.3 Access

Access to the Project Area is via I-80, Valmy Interchange, and the unpaved Buffalo Valley Road which is maintained by Humboldt County. A security gate at the entrance to the mine prevents unauthorized public access to the existing mine property.

Access to upper reaches of Trout Creek, where potential fisheries resources are located (refer to Section 3.7 – Wildlife and Fisheries Resources), is to the south from Buffalo Valley Road, along a dirt road running parallel to the creek (Figure 1-3). This road skirts the western perimeter of the existing Marigold Mine property, on the west side of the creek. As this road enters the southern portion of Section 31, it crosses Newmont's existing Valmy Haul Road (ROW N-59591), which runs northeast-southwest. The Trout Creek access road has been appropriately tied in to the haul road to allow for safe crossing.

Public access to Ames, Mud, and the unnamed springs, located along the east boundary of the Marigold Mine area, is generally from the east, along a dirt road from Mote Interchange of I-80. This access is completely outside of the Project Area. The road from the springs continues on through Section 19, providing access to the middle reaches of Trout Creek from the east (Figure 1-3).

3.10.3 Environmental Consequences & Mitigation Measures

3.10.3.1 Assessment Methodology

The Proposed Action and alternatives were compared with existing land uses and land use plans to determine if they would adversely affect these land uses or conflict with existing land use plans. To evaluate impacts to access, the Proposed Action and alternatives were reviewed against existing conditions and local transportation plans.

3.10.3.2 Proposed Action

The Proposed Action would include an access road and utility corridor constructed from the existing office complex area to the Millennium Expansion Project facilities. New roads would be constructed from the Terry Zone Pit and the Antler and Basalt Pits to the Section 30 Heap Leach Facility and nearby new shop area. Access and haul roads from the Antler and Basalt Pits to the Section 30 Heap Leach Facility and new shop area would be constructed in concert with construction of the waste rock storage areas, and would not require additional disturbance. All of these additional access roads and corridors would be within the secured project perimeter, and generally not accessible to the public.

The combined disturbance from the proposed roads would be 52 acres (27 acres of public land and 25 acres of private land). A utility corridor would be constructed within the footprint of the access road corridor. The utility corridor would include electrical, communications, and water conveyance structures/facilities.

The Proposed Action would occur on both public and private lands. As currently planned, total new disturbance would be approximately 807 acres on public land and 667 acres on private land, resulting in a total project disturbance of approximately 1,474 acres. Development of the pits, waste rock dumps, and construction of haul roads/access roads for the Millennium Project, would require use of public lands administered by the BLM. The Proposed Action is consistent with plans and policies of the BLM that recognize the importance of mineral exploration and development within the Project Area. Proposed mining activities on private lands would be consistent with the Humboldt County Zoning Ordinance, provided that expansion on private lands complies with Special Use Permit requirements of the County. Therefore, the proposed project would not conflict with adopted plans and policies of government entities that regulate land use.

The existing road ROW across Section 30 (N-59591, Table 3-18) was established in anticipation of construction of a processing facility at the NMC Trenton Canyon Valmy Pit. The mine plan was modified to allow the ore to be hauled to an off-site processing facility; therefore, the ROW exists, but no pipeline has been constructed or is planned for construction at this time (Barto 2002, personal communication).

Currently accessible reaches of both upper and lower Trout Creek would not be encumbered or eliminated as a result of development of the Millennium Expansion Project. Access to the creek along Buffalo Valley Road would remain open; however, approximately one mile of dirt- road access from Mud Spring and unnamed spring, through the southwest portion of Section 20 and southern half of Section 19, would be temporarily restricted during mine operation and reclamation. Persons attempting to access Trout Creek from Mud Spring and the unnamed spring would have to back track around the mine to the wooden pole transmission line road or the I-80 frontage road to access the creek along Buffalo Valley Road, a detour of at least eight miles. The access to Trout Creek from Mud Spring would be reestablished following reclamation, at the discretion of the BLM.

Public access to Ames, Mud, and the unnamed springs would continue along the existing access roads from the Mote Interchange or from the Buffalo Valley Road.

Public use of the existing mine area is currently prohibited. The Proposed Action also would preclude any public use of the Millennium Expansion Project Area, an additional 1,394 acres for the life of the mine. For both safety and security reasons, public access to the active mining and processing areas would be precluded to the maximum extent permitted by law. Consequently, dispersed recreational use of lands within the proposed Project Area would be restricted as well. Similarly, the wildlife habitat and livestock grazing land uses would be reduced and discontinued, respectively, over the life of the mine (see Sections 3.7 and 3.9 for a discussion of impacts to these resources).

Mine expansion and development has the potential to change or modify administrative land use ROWs within the Project Area. All ROWs necessary to support operations at the existing Marigold Mine are in place and current. The Project would not affect major ROW easements, such as I-80. The existing ROW across Section 30 (N-59591, Table 3-20) would be impacted/modified by the construction of the North Waste Rock Storage Area. However, the ultimate disposition of ROW N-59591 would be subject to agreements between NMC and GMMC, and may include vacating the ROW, or moving it to accommodate construction.

Average daily traffic volumes on local roadways, including I-80, are not expected to change significantly from current levels as a result of the proposed project. The expected increase in the mine work force (and associated daily community trips) would comprise only a small fraction of average daily traffic on the interstate. In addition, the proposed project is not expected to result in a significant increase in truck traffic to or from the mine. Mine vehicles do not leave the permit area onto public roads and GMMC does not ship or receive ore from other mine sites. Therefore, the Proposed Action would not be a major source of material being transported on the under-carriage of vehicles to I-80 or other public roadways.

The closure, abandonment, and reclamation of the mine area would return approximately 1,204 acres of disturbed lands associated with the Proposed Action to the pre-mining land use as rangeland, wildlife habitat, and dispersed recreation. These areas would be reshaped and revegetated, and public access would be established. A combination of safety berms, fencing, and warning signs would be placed around the open pits to prevent public access.

The Proposed Action would result in the long term loss of up to 270 acres of public lands utilized for livestock grazing, wildlife habitat, dispersed recreation, and mineral exploration resulting from surface disturbance associated with the open pits. This acreage represents a residual adverse impact for land use. There would be no residual adverse impact to access resulting from the Proposed Action.

3.10.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to land use and access from the Trout Creek Diversion Realignment are generally the same as those described for the Proposed Action. While access along the creek would be modified (moved 100 to 200 feet to the west) and improved, that access would not be encumbered or eliminated as a result of realignment activities. Therefore, no additional impacts to access associated with this alternative are anticipated.

3.10.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to land use and access from the Red Rock Pit Stabilization Alternative are generally the same as those described for the Proposed Action. No additional impacts to land use or access are anticipated under this alternative.

3.10.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, GMMC is currently authorized to disturb 1,831 acres of public land as a result of the construction and operation of the Marigold Expansion Project. Potential impacts on land use under the No Action Alternative would be the same as those described and analyzed in the FEIS (BLM 2001, pages 3-114 through 3-115). Under the No Action Alternative, additional disturbance to lands within the Project Area would not occur. Access to undeveloped portions of the Project Area would be preserved, and the existing land uses would be maintained, including grazing on the North Buffalo Allotment.

Residual impacts to land use relate primarily to the success of the reclamation efforts and unreclaimed acreage. Upon project completion, the affected land area would be reclaimed to provide for former land uses, except for the acreage of the unreclaimed open pits (603 acres). This unreclaimed acreage represents the residual adverse effects of the No Action Alternative.

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3.11 Recreation

3.11.1 Regulatory Framework

Public lands under BLM administration are managed for multiple use, including recreation, under the guidance of the Sonoma-Gerlach MFP (BLM 1982).

The Nevada Statewide Comprehensive Outdoor Recreation Plan defines outdoor recreation, conservation, and open space needs for the state and provides a comprehensive description of statewide recreational issues and strategies to guide federal, local, and private recreation suppliers.

3.11.2 Affected Environment

Section 3.10 of the FEIS (BLM 2001, page 3-116) states there are no developed recreational resources in the vicinity of the Marigold Mine Project Area and characterizes the Project Area as having dispersed outdoor recreation. The nearest developed facility is the Mill Creek Recreation Area located 24 miles south of Battle Mountain. The Mill Creek Recreation Area, which is maintained by the BLM, contains picnic facilities, camp sites, and restrooms.

The Millennium Expansion Project area is not a highly used recreational area, but recreational activities include off-road vehicle use, hunting, and other forms of dispersed recreation. Data, maintained by NDOW on angling in Trout Creek, indicate little to no use of this recreational resource from 1992 through 1998 (French 1999).

3.11.3 Environmental Consequences & Mitigation Measures

3.11.3.1 Assessment Methodology

Potential effects on recreation resources were evaluated based on comparisons of the Proposed Action and alternatives, with recreational planning information obtained from Humboldt County, the Nevada Division of State Parks, and the BLM to determine the potential for, and anticipated extent of conflicts with existing and planned recreational uses. Potential effects on recreational resources can be categorized as short-term (i.e., during the life of the Project) and long-term. Short-term loss of recreation would occur in areas subject to surface disturbance and subsequent reclamation. Long-term loss of recreation would occur in areas that would not be reclaimed (i.e., pits that are not backfilled).

3.11.3.2 Proposed Action

As determined for the Marigold Mine Expansion Project (BLM 2001), the proposed Millennium Expansion Project would have a minimal effect on recreation. No parks, concentrated recreational use areas, designated wilderness areas, wilderness study areas, or special recreation management areas would be directly affected by the proposed mine expansion. The Proposed Action would not affect public access to Trout Creek. Developed recreational facilities within the region, such as the Mill Creek Recreation Area, are not projected to be adversely affected by the increase in the construction and operation work force required for mine expansion.

As with the Marigold Mine Expansion, construction and operation of the proposed Millennium Expansion Project would directly affect recreation through loss of public lands managed for multiple uses, including dispersed recreation, in areas subject to surface disturbance. The additional 1,474 acres of disturbance would not be available for dispersed recreation during mining and reclamation. The impact would occur through active mining (2013) and until reclamation efforts have established vegetation that would support wildlife habitat and recreational activities (at least until 2016).

The Project Area does not offer unique recreational opportunities not found elsewhere in the vicinity. Public access to the immediate area would be restricted for safety and security reasons. This area would be reopened to the public as soon as the mine reclamation and closure have been completed as determined by BLM and NDEP. The restoration of recreational opportunities within the Project Area would depend on both the successful reclamation of the land and the status of other mining activities that may exist at that time.

The Proposed Action would result in the loss of up to 270 acres of public land managed for multiple uses, including dispersed recreation, resulting from surface disturbance associated with the proposed Millennium Expansion Project open pits. This loss would also represent a residual adverse impact.

3.11.3.3 Alternative 1 – Trout Creek Diversion Realignment

Impacts to recreation from the Trout Creek Diversion Realignment Alternative are generally the same as those described for the Proposed Action. No additional impacts to recreation are associated with this alternative.

3.11.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Impacts to recreation from expansion of the Red Rock Pit Stabilization Alternative are generally the same as those described for the Proposed Action. No additional impacts to recreation are anticipated under this alternative.

3.11.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, disturbance associated with the proposed project would not occur, and existing dispersed recreational opportunities on public lands within the Proposed Action area would continue to be available. Temporary impacts from the continued operation of the currently authorized action analyzed in the FEIS (BLM 2001) would continue until 2007.

3.12 Aesthetics

3.12.1 Regulatory Framework

Section 102(a)(8) of FLPMA emphasizes the protection of the quality of scenic resources on public lands. Section 101(b) of NEPA requires that measures be taken to ensure that aesthetically pleasing surroundings be retained for all Americans. The BLM developed the Visual Resources Management (VRM) System to identify visual values, establish objectives for managing these values, and provide information to evaluate the visual effects of proposed projects. The inventory of visual values combines evaluations of scenic quality, sensitivity levels, and distance zones to establish visual resource inventory classes, that are "informational in nature and provide the basis for considering visual values in the land use planning process. They do not establish management direction and should not be used as a basis for constraining or limiting surface disturbing activities" (BLM 1986).

VRM classes for public lands are determined through the use of the visual resource inventory as part of the BLM's land use planning process. Four VRM classes have been developed, and one class is assigned to each unit of public land. Each VRM class has specific objectives. The objectives of these classes vary from very limited management activity to activity that allows major landscape modifications (Table 3-19). Short-term (three to five years) exceptions are allowed if VRM objectives are met in the long term (10 to 20 years).

The state of Nevada and Humboldt County do not have criteria or standards for evaluating auditory resource impacts associated with mining operations. Therefore, auditory resource impacts would be evaluated according to the estimated degree of disturbance to the nearest sensitive receptor sites.

3.12.2 Affected Environment

3.12.2.1 Visual Resources

The Project Area is visible over approximately ten miles along I-80. Maximum visibility of the Project Area and the existing mine occurs at the Valmy Interchange and at the Valmy rest stop, located approximately 2.5 miles northeast of the existing mine. The study area also is visible from the Buffalo Valley Road and a portion of the California Emigrant National Historic Trail.

The portion of the Glamis Marigold Mine located within three miles of I-80 is located within a VRM Class III visual management landscape (Table 3-19). The remainder of the Project Area lies within a VRM Class IV area. These designations were created prior to the onset of mining activities at the site in 1988, and reflect that the area is visible to thousands of motorists on I-80 each day.

Landscape character type is a unit of physiographic area having common characteristics of landforms, rock formations, water forms, and vegetation patterns. The study area and existing Marigold Mine are located in the Great Basin region of the Basin and Range Physiographic Province. Basin and Range landscapes in northern Nevada are typically characterized by broad, open basins bounded by isolated mountain ranges covered by pinyon-juniper and/or sagebrush vegetation. This type of landscape allows for long viewing distances. The Project Area is located on the piedmont slopes of Battle Mountain and slopes toward the Humboldt River to the north and east. Elevation within the Project Area ranges from approximately 4,800 to 6,200 feet amsl.

Battle Mountain forms the backdrop for views of the mine site from I-80 and the California Emigrant National Historic Trail. The natural forms of the mountains are pyramidal, whereas the foothills tend to be more rolling to rugged. Vegetation in the area, which consists mainly of sagebrush/shadscale and grasses, provides relatively uniform coverage on the alluvial slopes near the mine area, while shrub

Table 3-19: BLM Visual Resource Management Classes

Class	Description
I	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
II	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant natural features of the characteristic landscape.
III	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
IV	The objective of this class is to provide for management activities, which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

Source: BLM 1986.

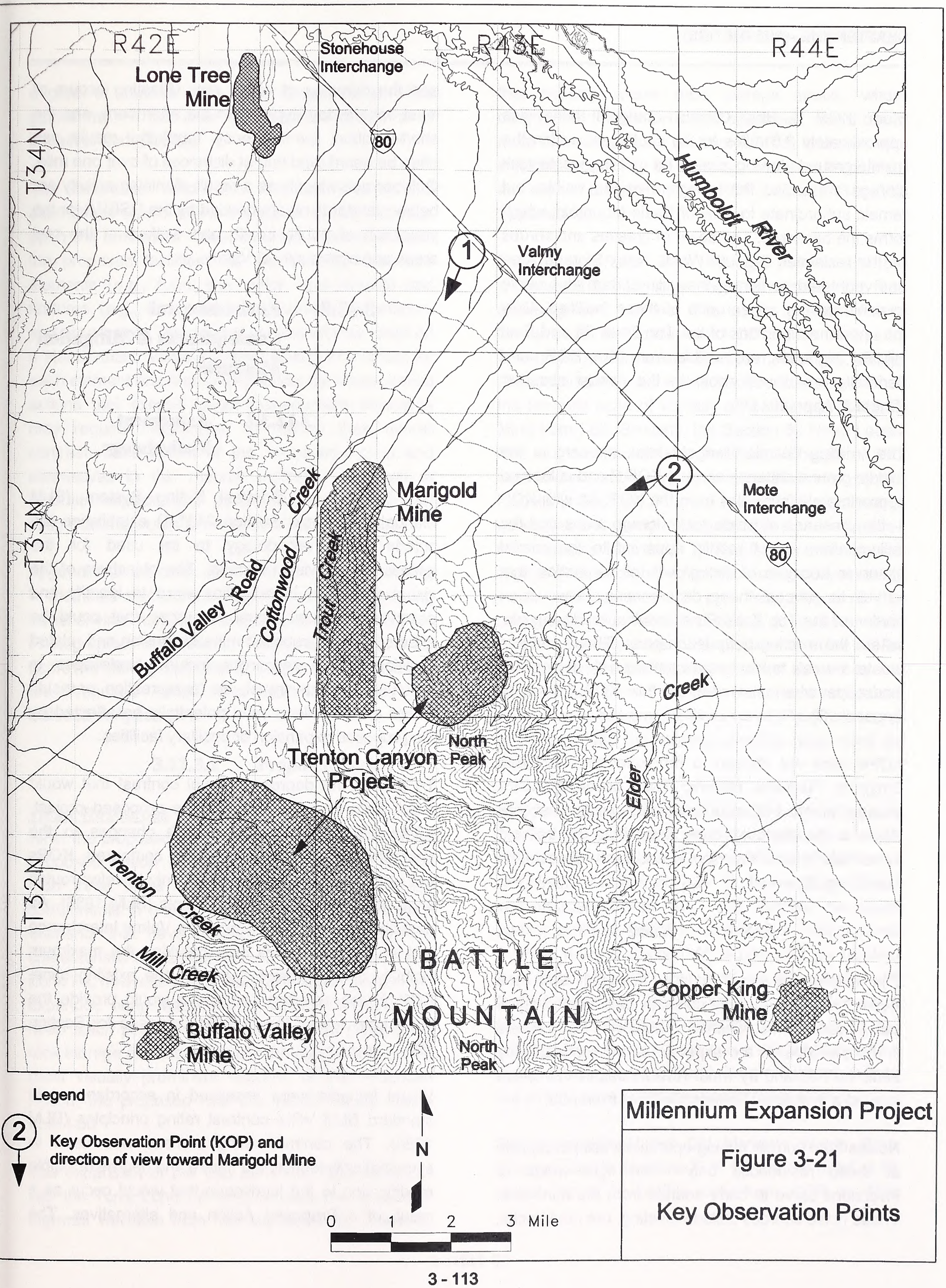
coverage on the slopes of Battle Mountain is irregular and patchy.

At present, the most dominant man-made features within the study area include I-80, the Valmy rest stop, the Valmy Power Station, and waste rock storage areas associated with the NMC Lone Tree Mine, which are readily apparent from I-80 near the Stonehouse Interchange. The Marigold Mine is viewed at a distance of at least 2.5 miles by motorists on I-80, and is not apparent to the casual observer. Upon close inspection, the squat, geometric forms of the existing reclaimed 8-South Waste Rock Storage Area and the tailings dam provide only minor contrast to the sagebrush-dominated foothills of Battle Mountain. These facilities essentially screen views of other mine elements.

The California Emigrant National Historic Trail generally parallels I-80 about one mile north, from the Edna Mountain foothills to the community of Battle Mountain. There is interest by groups such as the Oregon-California Trails Association, Trails West, Inc., and the Nevada Commission on Tourism concerning development that affects viewsheds along the California Emigrant National Historic Trail (Dodd 1997). Most of the California Emigrant National Historic Trail has been marked, mapped, and described in detail. The Trail section from the Edna Mountain foothills to Battle Mountain has four trail markers and published diary accounts for each location (Helfrich and Hunt 1984).

Important visual resources are defined for this study from key observation points (KOPs) where the maintenance of the surrounding visual environment is important to people's enjoyment of an area. For the purposes of this analysis, the following KOPs have been identified for the SEIS. The location of the viewpoints and the direction of the view toward the study area are listed below and shown in Figure 3-21 and Sheet 1 in Appendix D.

- KOP 1 - Mile marker 215.5 on I-80, near the Valmy rest stop; and
- KOP 2 - Mile marker 221 on I-80, approximately 1.5 miles west of the Mote interchange.



Millennium Expansion Project

Figure 3-21

Key Observation Points

From KOP 1, the Glamis Marigold Mine lies approximately 3.5 miles to the southwest, within the middle ground viewing zone. The existing waste rock storage areas and the tailings dam are visible, but remain subordinate to view of Battle Mountain, which forms the backdrop. The cover of grasses and shrubs on the reclaimed 8-South Waste Rock Storage Area and vegetated portion of the tailings dam also serve to minimize the appearance of these facilities. Only the uppermost portions of the Top Zone Pit and East Hill Pit highwalls are visible from this KOP, and generally are unnoticeable to the casual observer (Sheet 2, Appendix D).

The existing Glamis Marigold Mine appears in the middle ground distance zone of KOP 2 and is located approximately four miles from the KOP. As with KOP 1, the presence of waste rock storage areas and the tailings dam is not readily apparent to the casual observer because of the growth of vegetation that serves to conceal these disturbances. However, a portion of the Top Zone Pit highwall is readily visible, as are the existing heap leach pads. These facilities create a weak to moderate contrast with the natural landscape when viewed from this KOP (Sheet 5, Appendix D).

KOPs were not chosen to represent the California Emigrant National Historic Trail because KOPs chosen along I-80 represent viewpoints that are closer to the Marigold Mine; views from the trail are more distant, and the mine is not easily discernable from these distances.

3.12.2.2 Noise

The nearest residents to the Marigold Mine are located at Valmy. Current noise levels in the vicinity of these residents are unknown; however, noise levels in the overall area are expected to be dominated by traffic on I-80 and by wind. Residences in Valmy are located a distance of at least 500 feet from I-80.

Noises from current mining operations are perceptible at these residences only when light winds or inversions serve to carry sounds from the mine site. These noise sources include blasting, ore haul trucks, and the dumping of waste rock. Blasting occurs at least once a day (typically in the afternoon), and the short-duration, low-frequency "thud" that results can often be heard (and felt) at distances of over one mile. Outdoor noise levels as a result of mining activity are below standards recommended by the USEPA for the protection of public health and welfare at the rest areas and community of Valmy.

3.12.3 Environmental Consequences & Mitigation Measures

3.12.3.1 Assessment Methodology

The BLM Visual Contrast Rating System (BLM Manual Handbook, Section 8431-1) establishes the criteria and methodology to be used for the assessment of visual impacts. The objectives of the visual resources investigation were to identify and describe important visual resources that could be affected by the proposed mine expansion and related facilities. Visual resources include landscapes in which viewers may travel, use for recreation, or reside where existing views may potentially be affected by the proposed expansion or ancillary facilities.

To assess the degree of visual contrast that would result from implementation of the proposed project, KOPs were selected from which changes to the characteristic landscape could be compared. KOPs are typically chosen along commonly traveled routes or at other likely observation points (BLM 1986). As described above, KOP 1 near the Valmy Interchange and at the Valmy rest stop provides the maximum visibility of the Project Area and the existing mine. KOP 2 was selected because it would provide the maximum view of the facilities proposed for Section 30.

Visual impacts were assessed in accordance with standard BLM VRM contrast rating principles (BLM 1986). The contrast rating process was used to systematically identify the nature and degree of visible modification to the landscape that would occur as a result of a Proposed Action and alternatives. The degree of contrast was then compared to VRM guidelines for the area to determine the level of impact or compatibility.

The extent to which the Proposed Action and alternatives would affect the visual quality depends upon the amount of visual contrast created between the proposed facilities and the existing landscape elements (e.g., form, line, color, and texture) and features (e.g., land and water surface, vegetation, and structures). The degree of contrast was rated on a standardized Visual Contrast Rating Worksheet for each element and feature (Appendix D). Management actions that exceed visual management objectives may require modification to reduce their overall contrast. Assessment of the Proposed Action and alternatives in this manner indicated the level of potential impacts and guided the development of mitigation measures to meet the VRM objectives.

Appendix D contains BLM Visual Contrast Rating Worksheets that include descriptions of the existing visual environment as viewed from each of the KOPs. Photographic simulations, representing currently approved mining operations, height of mining under the Proposed Action, and reclamation, also are included in Appendix D.

3.12.3.2 Proposed Action

Visual Resources

All of the proposed and expanded components of the Proposed Action would occur at distances greater than three miles from I-80, placing all of these components in a VRM Class IV area. Major mining elements that have potential to contrast with the characteristic landscape include the expanded Terry Zone Pit, new waste rock storage areas in Section 30, expanded heap leach pad in Section 17, and new heap leach pads in Sections 30 and 16. The waste rock storage areas and heap leach pads would be the most visually prominent features of the Proposed Action; the proposed new pits would not be visible from I-80.

The expansion of the Top Zone and Red Rock pits into the Terry Zone Pit may increase the amount of highwall viewable from this expanded pit. However, the existing waste rock storage areas, when constructed to their permitted capacities, would block most of the expanded pit from KOP 1; it is currently shielded from view by existing the heap leach pad and natural topography from KOP 2 (Sheets 3 and 6, Appendix D).

The North Waste Rock Storage Area would be constructed in lifts to a height of almost 600 feet above ground surface. The upper portion of this facility would be visible from KOP 2. The foothills in Section 20 and 21 would obscure most of this facility, and it would only be visible for less than one-half of the ten-mile zone of visibility of the Glamis Marigold Mine from I-80. Similarly, the Section 30 Heap Leach Pad would be constructed in lifts to a height of 300 feet, and would be partially shielded from view by the foothills in Sections 20 and 21. The ADR plant would be visible, but barely distinguishable due to the five-mile distance from KOP 2. The horizontal lines and regular shapes of these facilities during active mining would contrast with the pyramidal shape of the background mountains and rolling, irregular shaped foothills. However, due to the distance from the KOPs and the general backlighting condition caused by the southern direction of the view, these contrasts would not be easily discernable from the KOPs. The degree of contrast with the existing condition was rated as weak.

In contrast, the Section 16 Heap Leach Pad and Section 17 Heap Leach Pad, constructed to a height of 300 feet, would be partially visible from KOP 1 and completely visible from KOP 2. The existing tailings impoundment would block the view of the lower portion of these facilities from KOP 1. The process facilities area in Section 16 would also be blocked from view from KOP1, but would be visible from KOP 2. The horizontal linear element created by these facilities would contrast with the rolling line of the adjacent foothills during the active mining period. The contrast rating for this facility was moderate, due to the distance and southern view from the KOP.

The expansion of the Old Marigold Waste Rock Storage Area in Sections 7, 8, 17, and 18 (total of 16 acres) would be visible only from KOP 1. This expansion would be similar to the existing contrast created by this waste rock storage facility.

Dust plumes originating from the mine area could occasionally be visible for distances of several miles. Dust could be generated as a result of blasting in the pit area, vehicular traffic on haul roads, and by the dumping of waste rock. The creation of large dust plumes would be minimized by wetting dirt roads as proposed by GMMC.

The maximum potential visual contrast scenario represents the maximum disturbance possible under the Proposed Action without the benefit of proposed reclamation. The visual benefits expected as a result of reclamation have not been incorporated into these simulations in order to depict the maximum potential visual contrast at the end of mining (year 2013).

At the end of mining (2013), the proposed expansion would be consistent with VRM Class IV objectives, which state that the level of change to the characteristic landscape can be high and management activities may dominate the view and be the major focus of viewer attention (Table 3-21).

During mining closure activities, the waste rock storage areas would be graded to eliminate the benches between lifts, reduce the side slopes to an approximate 3H:1V grade, and round-off top benches to approximate more natural contours. The 8-South Waste Rock Storage Area, which has been released from the bond surety, provides a preview of the final form and appearance of the proposed facilities after reclamation. Similarly, the heap leach facilities would be recontoured and revegetated. Reclamation activities proposed by GMMC are described in Section 2.2.18, Reclamation, and include slope grading and stabilization, the application of growth media, and the seeding of disturbed areas. Sheets 4 and 7 in Appendix D depict anticipated conditions ten years after reclamation begins under the proposed expansion. The grading of waste rock and heap leach slopes from angle of repose to approximately 3H:1V would create undulating slopes that would more closely approximate the appearance of natural slopes in the area. These efforts would reduce any moderate contrasts in land forms and lines associated with the proposed expansion to weak contrasts, which would not tend to attract the attention of the casual observer.

Revegetation practices at the Glamis Marigold Mine to date, in such areas as the 8-South Waste Rock Storage Area, have been extremely successful and have resulted in densities of grasses, forbs, and shrubs similar to those of adjacent undisturbed areas. Assuming the revegetation program for the proposed expansion meets with similar success, visual contrasts associated with all current and proposed mine disturbance would be greatly reduced over time. Within a few years, grasses, forbs, and shrubs on the waste rock storage areas and leach pads would allow these areas to blend with the color and texture of the existing natural landscape, thereby eliminating any remaining contrasts associated with the proposed expansion. Therefore, visual contrasts associated with the proposed expansion would be reduced over time and would repeat the basic elements of form, line, color and texture found in the characteristic landscape.

The reclaimed mine area would not attract the attention of the casual observer when viewed from either of the KOPs used in this analysis. Consequently, the proposed expansion would not exceed the conditions of VRM Class IV guidelines after the reclamation period.

Noise

Blasting during the life of the proposed expansion would occur during daylight hours only, and noise experienced at any one site would be of very short duration (approximately 0.5 second). Blasting would occur below ground level and noise from blasting would largely be attenuated by the surrounding terrain and increased distance between Proposed Action components and Valmy. No changes in the size of charges used or method of detonation from the existing (on-going) blasting program are anticipated. Under the proposed expansion, blasting noise would continue an additional six years at regular intervals on a daily basis. The proposed expansion would represent only an increase in the duration over which currently ongoing noises would occur.

Although the Proposed Action would perpetuate the types of noises that currently are generated by mining activity at the mine, it also would extend the overall life of the mine, during which time sensitive receptors would continue to experience mine-related noises throughout the day and night. Specifically, the proposed project would extend the life of current mining operations an additional six years, through the year 2013. Sound levels from mining activities during this period are expected to be similar to those that occur now. Blasting would continue within the open pit during daylight hours and construction equipment (i.e., drills, bulldozers, loaders, and haul trucks) would operate 24 hours per day; however, the majority of the Proposed Action components would be farther away from Valmy than the current mine operations and the existing topography and existing mine facilities would deflect much of the noise away from Valmy.

The proposed expansion is not expected to result in a long-term increase in traffic over current mining-related levels. Consequently, the proposed project would not contribute to an increase in noise along local roadways during the extended life of mining operations.

Noise levels associated with mine closure and reclamation activities would not be expected to differ significantly from those described for mining operations, since the primary noise sources would be from the use of bulldozers and other heavy equipment; however, these noise-generating activities would only occur during daylight hours. Blasting would cease with mine closure. After the reclamation period, noise in the vicinity of the mine site would return to pre-mining levels.

3.12.3.3 Alternative 1 – Trout Creek Diversion Realignment

Visual Resources

The construction associated with Alternative 1 would occur in Sections 18 and 19 on the west side of the existing disturbance. This area of the mine site is not visible from either KOP, or from any point along I-80. This alternative would not result in any change in the contrast rating or impacts from the Proposed Action.

Noise

Additional construction would be required for the realignment of the Trout Creek Diversion, but this would occur during the period of active mining and would not appreciably change the noise levels, source of noise, or impacts from noise on the receptors at Valmy. Construction would only occur during daylight hours.

3.12.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Visual Resources

The backfilling and berm construction associated with this Alternative would occur in Sections 18 and 19 on the west side of the existing disturbance. This area of the mine site is not visible from either KOP, or from any point along I-80. This alternative would not result in any change in the contrast rating or impacts from the Proposed Action.

Noise

The backfilling of a portion of the Red Rock Pit would not be in addition to any other waste rock disposal. The waste rock would be placed in the Red Rock Pit rather than one of the other waste rock storage areas. Alternative 2 would not change the impacts of noise from those identified for the Proposed Action.

3.12.3.5 Alternative 3 – No Action Alternative

Visual Resources

Under the No Action Alternative, currently permitted mining operations would continue through 2007, after which time the Glamis Marigold Mine would cease operations. The additional disturbance associated with the Proposed Action (expansion and development of the open pits, waste rock storage areas, and the construction of two new heap leach pads and other mining-related facilities) would not occur within the Project Area. The visual environment at the end of current mining operations from each of the three KOPs would be similar to that depicted in

Sheets 2, 4 and 6 in Appendix D of the FEIS (BLM 2001). GMMC would be required to reclaim surface disturbances associated with its permitted operations.

Noise

Noise from current mining operations would continue under the No Action Alternative until 2007. Noise levels in the mine area would return to pre-mining levels after closure and reclamation activities were complete.

3.13 Social and Economic Values

3.13.1 Regulatory Framework

The regulations contained in 40 CRF§1508.8 recognize that effects may include ecological, aesthetic, historic, cultural, economic, social, or health; therefore, social and economic values need to be considered in the analysis process. However, 40 CFR§1508.14 states that "*economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic and social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.*"

3.13.2 Affected Environment

The bulk of the information provided in the following sections is summarized from the FEIS (BLM 2001). The Project Area is located in southern Humboldt County. As determined by the employee residence pattern and the mine location (BLM 2001), the analysis area for social and economic issues encompasses primarily Humboldt and Lander counties and the communities of Winnemucca and Battle Mountain.

3.13.2.1 Population and Demography

Population statistics for Humboldt and Lander counties from 1990 through 2001 are provided in Table 3-22. Humboldt County population has increased 23.7 percent during this period, or an average of 2.4 percent per year, while the population of Lander County has decreased 8.6 percent over the same period.

According to 2000 U.S. Census data, 13.3 percent of Lander County's population and 13.9 percent of Humboldt County's population are made up of minorities, reflecting the relatively large number of Hispanics employed in agricultural labor. Age distribution in Humboldt County is similar to the pattern in the rest of the state and nation, while the Lander County population is generally younger than the rest of the state and nation (Tri-County Development Authority 1996a, 1997).

According to the Nevada State Demographer's *Nevada County Population Projections* (Nevada State Demographer's Office June 2002), continued growth is anticipated for Humboldt and Lander counties through 2010. However, it appears that these projections were made prior to release of the official 2000 census data, and did not account for the impact of the downturn in mining during 1999, 2000, and 2001. Should the projections hold, Humboldt County would see an overall increase of 1,888 over the next ten years, while Lander County can expect an increase on the order of 400 new residents.

Approximately 45 percent of Humboldt County's population resides in the town of Winnemucca, which had a 2000 population of 7,174 (Nevada State Demographer's Office June 2002). Winnemucca's population increased 16.1 percent from 1990 to 2000, or an average of 1.6 percent per year. Approximately 50 percent of Lander County's population resides in the town of Battle Mountain, which had a 2000 population of 2,871 (Nevada State Demographer's Office June 2002). Battle Mountain's population has decreased 45.6 percent from 1990 to 2000. However, the decline did not occur steadily over the decade. For the most part, Battle Mountain's population remained relatively stable for most of the 1990's, but dropped off significantly from 1999 through 2000.

3.13.2.2 Economy, Employment, and Income

<u>Overview of the Economy</u>

The economies of Humboldt and Lander counties continue to be based primarily on the mining industry, and to a lesser extent on agriculture and tourism. A study conducted by the Economic Development Administration's University Center for Economic Development at the University of Nevada, Reno reported that over 56 percent of total economic

Table 3-20: Study Area Population

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Percent Change 1990-2000	Average Annual Growth Rate 1990-2000
Humboldt County	13,020	13,500	14,000	14,510	15,640	16,270	16,460	16,900	15,920	18,090	16,106	15,322	23.7	2.4
Winnemucca Division	6,180	6,560	6,640	6,910	7,170	7,380	7,890	8,140	7,482	8,860	7,174	--	16.1	1.6
Lander County	6,340	6,370	6,380	6,430	6,410	6,440	6,710	7,030	7,040	7,010	5,794	5,480	-8.6	-0.9
Battle Mountain Division	5,276	5,300	5,308	5,350	5,341	5,341	4,932	5,170	5,360	4,220	2,871	--	-45.6	-4.6

Data Sources:

State of Nevada Demographer, 2000, Nevada Small Business Development Center,
Estimates from NV Department of Taxation and NV State Demographer, University of NV, Reno.
U.S. Census Bureau.

activity in Humboldt County is created by the gold mining sector. While direct employment by the mining industry accounted for one-third of the labor force in Humboldt County, the industry provided over half of the economic activity and three-quarters of the income in the county (Tingley et al. 1993; Tri-County Development Authority 1996a).

Economic development plans have been developed for both Humboldt and Lander counties to provide direction and support in developing other industries and economic activities in order to diversify the economy, and reduce the historic dependence on the mining industry. This dependence has made the regional economy more vulnerable to external conditions, such as fluctuations in world metals demand and prices. Target industries for future development include gaming/tourism, recreation, agriculture, geothermal resources, and industrial development (Tri-County Development Authority 1996a, 1997).

Agriculture continues to contribute to the base of economic activity in both Humboldt and Lander counties. In 1997, there were 76 farms and ranches in Lander County, encompassing 486,017 acres, and 218 farms and ranches in Humboldt County, encompassing 733,418 acres. Humboldt County is one of the leading agricultural counties in Nevada. The livestock industry plays an important role in both counties, with 21,000 head of cattle in Lander County and 63,000 in Humboldt County in 1998 (Nevada Department of Administration 1999).

Tourism has become increasingly important in the economy with the growth in the gaming industry. While these sectors contribute to overall regional economic diversity of the counties, these sectors are ultimately tied to the mining/agriculture economies, and tend to exhibit similar trends in numbers and wages.

Employment and Income

Lander County and Humboldt County labor force, employment, and wage statistics are shown in Tables 3-21 and 3-22. Between 1993 and 1998, the Lander County labor force remained fairly constant, at an average of 2,970 (Research and Analysis Bureau 1991-1995; Employment Security Division 1999). However, since 1998, the labor force has dropped of by at least 760. The unemployment rate has fluctuated between 7.7 and 11.4 percent since 1993, averaging about 9.3 percent.

The Humboldt County labor force increased 11.3 percent in the five-year period from 1993 to 1997, but has subsequently dropped off nearly 21 percent to a 2001 low of 6,960. The unemployment rate has remained fairly constant, averaging around 5.4 percent from 1993 to 2001. The highest unemployment rates for both counties were recorded in 1998.

Non-agricultural employment by sector information for Lander and Humboldt Counties is displayed in Tables 3-21 and 3-22, respectively. The most important non-agricultural employment sectors in Lander County are mining (34 percent of 2001 employment), government (31 percent), trade (21 percent), and services (six percent) (Nevada Department of Employment 2002). In the six years from 1993 to 1998, growth occurred primarily in the government sector. Mining employment increased slightly. In 1997, there were four major mining operations in Lander County, and mining provided approximately 45 percent of total county non-agricultural employment (Tri-County Development Authority 1999).

Humboldt County's distribution of non-agricultural employment by sector is similar to Lander County's, with slightly smaller portions attributed to mining (23 percent), government (18 percent), trade (21 percent), and services (23 percent), reflecting the commercial activity in Winnemucca. Employment in most sectors increased from 1993 to 1997, and has declined from 1997 to 2001 (Nevada Department of Employment 2002).

The 2001 average annual pay in Lander County over all industries was $36,192, while the average pay in the mining sector was $52,832. Average annual pay in the manufacturing sector was $55,692, making it the highest paid non-agricultural employment sector in the county; however, mining still provided 59

Table 3-21: Lander County Labor Force Summary

	1993	1994	1995	1996	1997	1998	1999	2000	2001	Percent of Employment 2001	Percent of Payroll 2001	Average Annual Pay 2001
Total Labor Force[1]	2,980	2,890	2,900	3,060	3,060	2,930	2,540	2,320	2,170	---	---	---
Unemployment	340	300	260	260	210	300	240	180	210	---	---	---
Unemployment Rate	11.4%	10.4%	9.1%	8.6%	6.9%	10.3%	9.4%	7.7%	9.6%	---	---	---
Employment by Sector:[2]												
Mining	1,030	980	1,080	1,210	1,290	1,110	990	810	640	34%	59%	$52,832
Construction	50	120	90	100	30	30	30	30	30	2%	1%	$29,224
Manufacturing	40	40	40	40	40	40	40	30	40	2%	6%	$55,692
Transportation, Communication, & Utilities	120	120	90	90	90	80	70	80	70	4%		$44,200
Wholesale and Retail Trade	320	410	430	470	460	400	360	390	390	21%	7%	$16,016
Finance, Insurance, & Real Estate	30	30	30	30	30	40	30	20	20	1%	1%	$15,808
Service Industries	290	230	220	240	230	190	170	140	110	6%	3%	$15,132
Government	500	520	540	560	560	690	590	590	580	31%	23%	$34,112
TOTAL, All Industries	2,380	2,440	2,510	2,740	2,740	2,490	2,280	2,090	1,880	100%	100%	$36,192

[1]Reflects employment by place of residence.
[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.
Sources: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.
Nevada Department of Employment, Training & Rehabilitation, Information Development & Processing Division, Research & Analysis Bureau - http://detr.state.nv.us/lmi/index.htm

Table 3-22: Humboldt County Labor Force Summary

	1993	1994	1995	1996	1997	1998	1999	2000	2001	Percent of Employment 2001	Percent of Payroll 2001	Average Annual Pay 2001
Total Labor Force[1]	7,880	7,870	8,030	8,390	8,770	8,570	7.770	7,350	6,960	---	---	---
Unemployment	480	460	350	340	350	560	510	380	430	---	---	---
Unemployment Rate	6.1%	5.8%	4.3%	4.1%	4.0%	6.5%	6.5%	5.1%	6.1%	---	---	---
Employment by Sector:[2]												
Mining	2,090	2,075	2,305	2,490	2,450	2,010	1,720	1,390	1,250	22.8%	35%	$58,968
Construction	370	369	414	570	550	390	330	310	260	3.5%	4%	$34,372
Manufacturing	100	102	134	190	200	180	320	310	350	4.2%	5%	$32,500
Transportation, Communication, & Utilities	300	305	335	370	400	410	500	510	430	6.5%	10%	$46,176
Wholesale and Retail Trade	1,170	1,271	1,394	1,460	1,580	1,730	1,560	1,480	1,410	20.6%	12%	$19,032
Finance, Insurance, & Real Estate	100	107	102	110	110	110	120	120	130	1.5%	1%	$23,504
Service Industries	1,520	1,860	1,955	1,630	1,710	1,530	1,520	1,500	1,460	22.6%	13%	$16,380
Government	1,230	1,163	1,130	1,300	1,370	1,410	1,380	1,430	1,330	17.5%	20%	$39,312
TOTAL, All Industries	6,890	7,253	7,770	8,100	8,360	7,760	7,450	7,100	6,600	100%	100%	$33,280

[1]Reflects employment by place of residence.
[2]Reflects non-agricultural employment by place of employment.

Note: Numbers may not add to total due to rounding.
Sources: Research and Analysis Bureau 1991-1995; Employment Security Division 1999.
Nevada Department of Employment, Training & Rehabilitation, Information Development & Processing Division, Research & Analysis Bureau - http://detr.state.nv.us/lmi/index.htm

percent of the total direct payroll earned in Lander County in 2001. Manufacturing provided greater than six percent (government was second highest, with 23 percent). Figures for Humboldt County show similar trends. Mining accounted for 35 percent of the total direct payroll earned in 2001, government 20 percent, and services 13 percent. Average annual pay over all industries is slightly lower in Humboldt County (at $33,280) than in Lander County (Nevada Department of Employment, 2002).

Indirect Contributions of Mining

As stated before, the total economic contribution provided by mining is greater than simply direct employment or wages. Mining industry employment supports secondary employment in other industries, particularly services, through the spending of workers' wages in the local economy, and also through the purchase of goods and services by mining firms. Secondary employment is calculated for the mining industry using a multiplier of 1.24 for rural settings in Nevada (Dobra 1988, 1989). For every direct job in the mining industry, 0.74 indirect jobs are created in the local economy, and 0.5 jobs are created in the large urban economies of the state, which serve as supply centers.

Mining, as an export industry, is an important income-generator for the state, having the largest earnings multipliers of any industry. The majority of the revenue from the sale of the product is spent within the state on wages, taxes, purchases of goods and services, and other production expenses. The total earnings generated through mining activity, as income cycles through the economy, can be estimated using a multiplier of 1.57 (Dobra 1989). This number applies to the amount spent directly on payroll (i.e., for every payroll dollar in the mining industry, an additional $1.57 in earnings is generated for other Nevadans in the form of wages and salaries, rents, interest, and business incomes).

3.13.2.3 Housing and Community Services

Housing and community services are analyzed to the extent that they would be impacted by population changes generated by the proposed project. Based on the current employee residence distribution, the primary communities affected would be Winnemucca and Battle Mountain. Residence of employees in other communities is negligible. This section describes the housing and basic public services available in these communities.

Housing

The 2000 U.S. Census indicated that there were 6,954 total housing units in Humboldt County, with 1,221 of these units vacant (U.S. Department of Commerce 2001). The housing stock consisted of 3,175 single detached family units, 604 attached and apartment units, and 2,943 mobile homes. Demand for housing in Humboldt County has kept home prices relatively high, with a median value of $117,400 in the year 2000. There are 1,554 renter-occupied housing units in Humboldt County, with a median monthly rent of $531.

The 2000 U.S. Census reported that there were 2,780 total housing units in Lander County, with 687 units vacant (U.S. Department of Commerce 2001). The housing stock consisted of 947 single-family, detached units, 143 attached and apartment units, and 1,543 mobile homes. Housing in Lander County is primarily owner-occupied, and the majority of rental properties are mobile homes. The 2000 median value for specified owner-occupied housing units in Lander County was $82,400. There are 478 renter-occupied housing units in Lander County, with a median monthly rent of $496.

Temporary housing in Humboldt County is concentrated in Winnemucca. There are an estimated 1,600 hotel/motel rooms in Winnemucca (Tri-County Development Authority 1996b). At least a third of these rooms are available for rental by the week (JBR 1995). Temporary housing in Lander County is concentrated in Battle Mountain. There are eight hotels/motels in Battle Mountain, with approximately 386 rooms (Tri-County Development Authority 1997). Parking and hook-up services for recreational vehicles also are available in the area. The busiest tourist season begins in June and ends in September. Weekend vacancy rates for temporary housing accommodations in Winnemucca during this period are frequently near zero (BLM 1996a).

Water Supply

It is estimated that 50 percent of Humboldt County households are served by either a public or private water company. The Winnemucca area is served by the city's water system. Two other water districts exist in the county. The remainder of the county utilizes water from individually-drilled wells, developed springs, or localized non-community systems. The Winnemucca water system serves approximately 3,000 customers. The average demand is 3.0 million gallons per day (mgd), with a peak demand of 6.5 mgd during the summer months. Water is supplied by a system of four deep wells and one developed spring. Total storage capacity is 7.85 million gallons in several storage tanks. Current annual use on the system is approximately 2,500 acre-feet per year. A 2,400-gallon per minute well went online in 1999 (JBR 1999b). A recent study concluded that an ultimate build-out (full development) of the Winnemucca service territory would require approximately 11,205 acre-feet per year. It is estimated that the system is capable or nearly capable of providing this amount of water (Tri-County Development Authority 1996a).

Battle Mountain Water and Sewer provides water to approximately 4,000 people in the Battle Mountain area. The remainder of Lander County utilizes individual wells or developed springs. The annual average demand in the Battle Mountain area is 1.0 mgd and approximately 2.0 mgd in summer. Water is supplied by three wells that are currently operating at about half capacity.

Wastewater Treatment

Approximately 66 percent of all Humboldt County households are connected to a wastewater treatment facility. Winnemucca has a wastewater treatment facility; two other small treatment facilities exist in the county. The remainder of the county utilizes individual septic systems. The Winnemucca facility has a 2.5 mgd capacity, and serves approximately 2,800 customers. The average flow in the system is 1.2 mgd. The collection system presently consists of three large and two small lift stations. Excess capacity exists in the system to serve additional customers; however, any development outside of the present service area would require construction of additional lines (Tri-County Development Authority 1996a; JBR 1999b).

Battle Mountain Water and Sewer treats 430,000 gallons per day in sewage. All rural areas in Lander County utilize individual septic systems. The system has the capacity to handle approximately 1.2 mgd; service is presently operating at approximately 36 percent of capacity (Tri-County Development Authority 1996a, 1997; JBR 1999b).

Solid Waste Disposal

In 1995, there were ten rural landfills in Humboldt County. Most of these were scheduled to be closed by the end of 1997 due to recent changes in federal and state regulations. A private operator currently directs the Winnemucca Area Solid Waste Management District, under contract with the City of Winnemucca and Humboldt County. The regional landfill is located five miles north of Winnemucca. The landfill is being permitted as a non-hazardous municipal solid waste landfill. The current site encompasses 240 acres and has a life expectancy of 40 years. Collection service in the Winnemucca area is provided by two private operators (Tri-County Development Authority 1996a; JBR 1999b).

Solid waste disposal in the Battle Mountain area is provided at a Class II disposal site which has the capacity to process up to 20 tons of waste per day. At current disposal volumes, the facility is expected to be able to handle the area's waste disposal needs for the next 13 years (JBR 1999b).

Schools

Winnemucca has three elementary schools, one middle school, one junior high school, and one high school, with a an enrollment of 3,991 students in the year 2000. The ratio of students to teachers has been 15:1 during recent years, with a student to institutional computer ratio of 6:1. Several of the schools are nearing capacity, and modular classrooms are utilized to accommodate additional students, where necessary.

The Lander County School District has three elementary, one junior high, and one high school located in Battle Mountain, and an additional smaller elementary school and high school located in Austin. The total district enrollment in the fall of 2000 was 1,471 students. This enrollment number dropped by nearly 6.25 percent in 2001 to 1,379 students. The average ratio of students to teachers in 2000 was 20:1, with a student to institutional computer ratio of 10:1 (the student/computer ratio ranged from 19:1 for 2nd and 3rd Grade classes to 6:1 for junior high and high school students). Student to teacher ratios in 2001 remained unchanged, while the average student to computer ratio dropped to 9:1.

Law Enforcement and Fire Protection

Law enforcement in Humboldt County is provided by the Humboldt County Sheriff's Department, the Winnemucca Police Department, and the Nevada Highway Patrol. The Humboldt County Sheriff's Department provides police protection throughout Humboldt County. In addition to law enforcement, the sheriff's department oversees the Humboldt County Detention Center, which has a capacity of 61 inmates. The Winnemucca Police Department serves the City of Winnemucca, and additional areas, in cooperation with the Sheriff's Department, as necessary.

Law enforcement in Lander County is provided by the Lander County Sheriff's Department, based in Battle Mountain. The new Lander County Public Safety Facility was completed in July, 2000, and has a capacity for up to 50 inmates. The Nevada Highway Patrol also maintains a substation in Battle Mountain. (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999b).

Fire protection in the region is provided by local, state, and federal agencies. The Winnemucca City Fire Department, with approximately 24 volunteers (two of whom are Emergency Medical Technicians), handles all fires within Winnemucca city limits. The Winnemucca Rural Fire Department, with 25 volunteers (two of whom are Emergency Medical Technicians), is responsible for an area of 230 square miles around the town of Winnemucca, and has a mutual aid agreement with the BLM. The Battle Mountain Volunteer Fire Department has 25 firefighters (12 of whom are Emergency Medical Technicians), and owns six trucks equipped with first aid supplies. The department is generally responsible for the northern half of Lander County, and has a mutual aid agreement with the BLM and Nevada Division of Forestry. The most common types of fires in the area are wildland fires. The departments also respond to accidents, structural fires, and hazmat incidents. The Nevada Division of Forestry is equipped to fight wildland fires. It is directly responsible for fighting fires on state lands, and assists local and Federal agencies under mutual aid agreements. Both the U.S. Forest Service and BLM provide fire fighting capabilities on Federal lands (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995).

Medical Services

Medical services in Humboldt County are provided by the Humboldt General Hospital, located in Winnemucca. The hospital has 22 acute care beds and 30 long-term care beds, and services include an intensive care, obstetrics, coronary care, out-patient surgery, and emergency room. Several renovations and additions were completed in 1995, including construction of a skilled nursing facility. The medical staff includes three family practice staff, one general practice staff, six family physicians, one surgeon, one internist, 25 registered nurses, and 11 licensed practical nurses. In addition, specialists including cardiologist, ENT, ophthalmologists, orthopedics, urology, and podiatrists make routine visits to provide additional services. Emergency transportation services are provided by the Humboldt County Volunteer Ambulance Corps, under the jurisdiction of the hospital. In 1997, an expansion of ambulance facilities was completed, including a conference room, additional bays, sleeping quarters, and an office for the EMS coordinator. In 2002, additional expansion of the hospital was completed to include a full time CT and MRI, Bone Densitometry, and Mammography. Mental health services are provided by the Winnemucca Mental Health Center. Home Health Services of Nevada has an office in Winnemucca and provides at-home nursing care. Winnemucca also has eight dentists (in four group practices) and two physical therapists (BLM 1996a; Tri-County Development Authority 1996b; JBR 1995 and 1999b).

Medical services in Lander County and Battle Mountain are provided primarily by the Battle

Mountain General Hospital and Nursing Home. The hospital provides 24-hour services in emergency, laboratory, x-ray, tele-radiology, respiratory therapy, acute care, and long-term care. In 1996, an expansion was completed which included a new patient wing with 23 beds (16 long-term care and seven acute). In 1997, the second phase of the project was completed, which moved the clinic into the existing hospital's patient wing. The hospital staff consists of medical doctors in family practice, internal medicine, emergency, tele-radiology, and pathology, as well as medical technologists and technicians, physical and respiratory therapists, and numerous other nursing and administrative staff members. The Battle Mountain Medical Clinic offers services in family practice, internal medicine, and some minor surgery. Mental health services are provided by the Battle Mountain Mental Health Center, a sub-satellite of Winnemucca Mental Health Center. Home Health Services of Nevada has a location in Battle Mountain and provides skilled nursing care, home health aides, homemaker services, hospice care, physical therapy, medical social work, and speech therapy (JBR 1999b). Lander County also contributes to health care in Battle Mountain through its Public Health Department. This department offers limited preventative health services.

3.13.2.4 Government and Public Finance

County Governments

Both Humboldt and Lander counties utilize a commissioner form of government; Humboldt has five elected commissioners and Lander has three. The counties administer many services, including fire protection, roads, recreational facilities, library, water supply, wastewater treatment, and planning for their respective jurisdictions. The county governments are primarily supported by ad valorem (property tax) and sales tax revenues. The counties also receive taxes on the net proceeds of mines, assessed at the same ad valorem rate as other property taxes within each respective taxing district. The largest expenditures for Humboldt County are public safety, general governmental functions, public works, and the judiciary. The largest expenditures for Lander County are public works, general governmental functions, public safety, and culture and recreation. (Tri-County Development Authority 1996a, 1997).

Tax Revenues

Property taxes are determined from the assessed valuation of properties and the ad valorem tax rate. The assessed valuation is 35 percent of the estimated full value of the property. Trends in assessed valuation and taxable sales for Humboldt and Lander Counties are shown in Table 3-25. According to the Nevada Department of Taxation, the total assessed valuation in Humboldt County in FY2000-2001 was $611,646,827. The total assessed valuation in Lander County in FY2000-2001 was $403,833,455.

The assessed valuation of mining properties in Humboldt County was $275,792,450 in FY2000-2001, or 45 percent of the county's total assessed valuation (Table 3-23). The proportion of assessed value contributed by the mining companies peaked in 1999 at approximately 50 percent of the total county assessed value. The assessed valuation of mining properties in Lander County was $89,518.040 in FY2000-2001, or approximately 22 percent of the county's total assessed valuation. The proportion of assessed value contributed by the mining companies in Lander County peaked in 1998 at approximately 52 percent of the total county assessed value.

Taxable sales increased steadily in Humboldt County from 1993 to 1996, but have fallen off slightly since then. The FY2000-2001 taxable sales for Humboldt County were $307,040,994. Lander County's taxable sales decreased from 1993 to 1994 then increased an average of 28 percent per year from 1994 to 1996. Since then, they have experienced a steady decline to $71,903,316 in FY2000-2001, their lowest level in the last decade (Nevada Department of Taxation 2002).

Table 3-23: Trends in Assessed Valuation and Taxable Sales - Humboldt and Lander Counties

	FY 92-93	FY 93-94	FY 94-95	FY 95-96	FY 96-97	FY 97-98	FY 98-99	FY 99-00	FY 00-01
Humboldt County									
Taxable Sales	$282,901,000	$288,019,000	---	$400,494,000	$494,927,346	$406,865,804	$366,955,999	$330,731,176	$307,040,994
Assessed Valuation	$474,371,000	$505,350,000	$544,309,000	---	$526,430,596	$585,321,935	$677,480,155	$619,115,603	$611,646,827
Assessed Valuation of Mining Properties	$148,953,000	$161,335,000	$175,182,000	$194,728,000	$245,513,950	$259,504,310	$337,769,250	$298,847,610	$275,792,450
Lander County									
Taxable Sales	$82,584,000	$78,378,000	$102,990,000	$128,268,000	$162,887,144	$110,238,996	$98,016,481	$87,148,291	$71,903,316
Assessed Valuation	$156,637,000	$252,779,000	$244,630,000	$241,975,000	$228,402,431	$251,563,078	$434,681,461	$462,387,416	$403,833,455
Assessed Valuation of Mining Properties	$88,501,000	$81,221,000	$78,101,000	$79,318,000	$105,406,130	$130,869,470	$111,788,520	$98,153,910	$89,518,040

Sources: Tri-County Development Authority 1996a, 1997.
State of Nevada, Department of Taxation, Annual Reports: Fiscal 1997 – 1998, 1998-1999, 1999-2000, 2000-2001.

3.13.3 Environmental Consequences & Mitigation Measures

3.13.3.1 Assessment Methodology

The expected requirements of the project, in terms of employment, housing, and public services, were compared to the socioeconomic characteristics of Humboldt and Lander Counties and the communities of Winnemucca and Battle Mountain, from which the bulk of the mine's labor force would be derived. Fiscal effects of the project were evaluated based on information gathered for Humboldt and Lander Counties.

3.13.3.2 Proposed Action

The FEIS (BLM 2001) described the Millennium Expansion Project as a "reasonably foreseeable future action" and anticipated future expanded mining and heap leaching activities at the Glamis Marigold Mine. As described in Section 4.4.4 of the SEIS, the reasonably foreseeable impacts attributable to the Millennium Expansion Project included a potential increase in the size of the workforce to as many as 125 employees. The Glamis Marigold Mine currently has approximately 115 employees. A temporary workforce of up to 30 additional people would be employed during the short construction phase of Millennium Expansion Project facilities. During mining operations (2003-2013), the number of full-time employees is not expected to exceed 125 individuals at any given time. The Millennium Expansion Project would thus add as many as 10 people to the overall permanent workforce. These additions would likely occur within two years of approval of the Project.

The Proposed Action would extend mining activities an additional six years, through 2013, with ongoing leaching and reclamation operations following for approximately five more years. During this period, there would be a continuation of the economic benefits to local and state governments through sales taxes, net proceeds taxes, and property taxes paid during construction and operation of the Project facilities. A somewhat reduced workforce would continue beyond 2013 to 2018 or beyond, as the mine moves into a reclamation and closure mode. The minor additions to the work force are expected to come from unemployed or underemployed workers already living in the area.

Population Effects

The Proposed Action would not substantially change social and economic values. The same types of impacts described in the FEIS (BLM 2001) (e.g., no changes in housing demand or impacts to community services and increased tax revenues for local and state governments) are anticipated for the Proposed Action.

The Proposed Action would primarily utilize the existing GMMC work force, with up to 10 additional new, full-time hires; therefore no impact to the population of the study area would be realized. The additional employees would likely be derived from currently unemployed or underemployed workers residing in the study area, many of whom were released from employ at area mines during the recent downturn in the mining industry. By utilizing the existing workforce, the Project would not induce substantial growth or concentration of population. This would be a beneficial impact of the Project, and no mitigation measures are required.

Employment Effects

Unemployment levels in the study area have been rising in recent years due to the decline in the price of gold and subsequent layoffs in the mining industry. It is expected that the continued employment of 115 workers and new employment of up to 10 new workers, through implementation of the Proposed Action, would be welcome in an area facing shrinking job opportunities and growing unemployment. In particular, at least six additional years (through 2013) of continued employment in the mining industry, one of the highest paying industries in the area, would be a positive benefit to the study area.

In addition, the Proposed Action would have an indirect positive impact on employment. Based on the projected employment of 125 workers, and using an employment multiplier of 1.24 (Dobra 1989), a total employment impact of 155 jobs, or 40 additional jobs (10 mining jobs and 30 mine-supported jobs), would continue through 2013.

An average annual payroll of $4,500,000 million is estimated by GMMC for the years 1999 through 2007, the original life expectancy of the Marigold Mine and expansion. With implementation of the Millennium Expansion Project, GMMC anticipates an annual average operations payroll between 2003 and 2013 of approximately $6,000,000. The total payroll through the life of the Millennium Expansion Project is estimated to be on the order of $60,000,000. This includes the operation and closure of the Marigold Mine through 2007.

A standard multiplier of 1.57, from John Dobra's *The Economic Impacts of Nevada's Mineral Industry* (1989), is frequently used to estimate the total earnings generated through mining activity in Nevada, as income cycles through the economy ($1.57 in total earnings within the state for every mining payroll dollar spent). Applying this multiplier to the total payroll and benefits paid through the life of the project ($60,000,000) yields estimated total earnings of $94,200,000 within the state of Nevada. These earnings are generated by the re-spending of workers' income, and direct purchases of goods and services by the mining company, both of which support secondary businesses and industries within the study area. This would be a beneficial impact of the Project, and no mitigation measures are required.

Housing Effects

The employment analysis assumes that the study area has a sufficient resident population in the needed industry classifications to meet the requirements for ten to 30 additional temporary and full-time workers proposed for the Millennium Expansion Project. It is not likely that workers would need to be imported from outside of the study area. As a result, no new demand for temporary (rental) or permanent (purchase) housing would be realized. In fact, the Proposed Action may keep up to ten additional units off of the market for at least the duration of the project.

Public Services Effects

Because the Proposed Action would not induce growth in the study area, it would not create additional demand for public services. Public services would only be affected by the Project for the additional length of time (six years) that GMMC employees would require them. Given the reduction in population in the study area over the past few years, public service providers should be able to continue to meet the needs of the current residents, including GMMC employees, through the life of the Project.

Fiscal Effects

The primary impacts of the Proposed Action on public finance would be the benefits of increased sales taxes during construction and operation, the continuation of economic contributions provided by on-going operation of the mine, and the loss of tax revenues following mine closure.

During construction activities, additional sales taxes would be generated in the area from employees' spending of wages and contractors' purchases of goods and services. Sales taxes provide substantial revenues for both counties and cities, and portions also accrue to the State of Nevada. Indirect sales tax revenues would be greater than the direct amount as income cycles through the economy (i.e., money is re-spent on goods and services).

Continued operation of the Glamis Marigold Mine, through the Millennium Expansion Project, would provide for the on-going benefits of property tax, net proceeds tax, and sales tax revenues for Lander County, Humboldt County, and local city governments. Property taxes would accrue to Humboldt County. Mining currently provides a substantial tax base for Humboldt County, of which the Marigold Mine is a primary part. Mining properties currently provide for approximately 45 percent of total assessed valuation in Humboldt County.

Sales taxes would continue to accrue from workers' spending of wages in the local economy, and the mine's purchases of goods and services. Projected payroll salaries and wages (for 125 full-time employees) are $6,000,000 per year from 2003 through 2013, and $60,000,000 for the life of the project. If 70 percent ($42,000,000) of this is disposable income spent locally on goods and services, direct sales taxes (at 6.5 percent) of a maximum of $273,000 per year, or $2,730,000 total, would result. Sales taxes provide revenues for the state, counties, and cities. Cities, in particular, are highly dependent upon sales tax revenues. A large portion of the sales tax revenues resulting from spending of payroll income would occur in the communities of Winnemucca and Battle Mountain, where most of the workers live and, therefore, spend their income. In addition, the continued support of commercial and residential activity in Winnemucca, Battle Mountain, and other local communities would continue to contribute to the tax base and provide property taxes for local cities and counties.

With mine closure (2013), tax revenues from the mine would begin to decrease. Humboldt County would experience dramatic reductions in property tax and net proceeds tax revenues. This could cause budget constraints and necessitate finding alternate sources of revenues or altering county budget expenditures. Sales tax revenues would decrease for Humboldt and Lander Counties, Winnemucca, Battle Mountain, and other local communities. The loss of these revenues would have negative impacts on local government entities.

The short-term impact (i.e., over the life of mine) would be beneficial to the socioeconomic environments of Humboldt and Lander counties, and no mitigation measures are required.

3.13.3.3 Alternative 1 – Trout Creek Diversion Realignment

Under this Alternative, approximately 12 acres of additional surface disturbance would occur. The design and construction of the diversion would result in some additional contract work and labor costs. This cost is estimated to be $100,000 or less.

The additional work created by Alternative 1 would increase the amount of dollars contributed to the local and regional economy. However, the amount is relatively minor in terms of the overall economic benefit of the mine.

3.13.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Under this Alternative, backfilling and buttressing of the Red Rock Pit, waste rock that was scheduled to be placed in another waste rock storage facility would be placed instead in the Red Rock Pit. The alternative placement of the waste rock would create some economic impact to the mine by changing haul distance, creating backfill operation design costs, and resulting in some operation costs for construction of the buttress, but would not appreciably change the overall economics of the Project.

The additional work created by Alternative would increase the amount of dollars contributed to the local and regional economy. However, the amount is relatively minor in terms of the overall economic benefit of the mine.

3.13.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the economic benefits of the Proposed Action would not occur. The mine would cease operation in 2007 and the impacts of increased unemployment and loss of income to the local and regional economy would occur six years earlier.

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3.14 Hazardous Materials

3.14.1 Regulatory Framework

Definitions of important terms and listed substances of concern can be found at the following locations:

"Hazardous substance" is defined under CERCLA at 40 CFR 300.5. Briefly, CERCLA hazardous substances are those substances designated as hazardous under CERCLA or identified as hazardous under the Clean Water Act (CWA), the Clean Air Act (CAA), the Resource Conservation and Recovery Act (RCRA), and the Toxic Substances Control Act (TSCA). Listed hazardous substances are presented in 40 CFR 302.4. The term "hazardous substance" includes "hazardous waste" identified by RCRA.

"Extremely hazardous substance" is defined under Title III of the Superfund Amendments and Reauthorization Act (SARA) at 40 CFR 355.20. Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986 SARA Title III is also titled the Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986. Appendices A and B of 40 CFR 355 list extremely hazardous substances.

The terms "hazardous material", "hazardous substance", and "hazardous waste" are defined by the Department of Transportation at 49 CFR 171.8. Hazardous materials for purposes of transportation of are those materials are listed in 49 CFR 172.101.

Hazardous waste is defined under RCRA at 40 CFR 261.3. Specific hazardous wastes are listed at 40 CFR 261.30. Hazardous wastes also include materials which are hazardous because they are corrosive, ignitable, reactive, or toxic.

The mine is regulated under federal and Nevada regulations. The Mine Safety and Health Act of 1977 sets forth mandatory safety and health standards for the mine. The standards for surface metal mines are found at 30 CFR 56.

Releases of hazardous materials are also regulated by the federal and state governments. A "Spill Prevention, Control, and Countermeasures Plan (SPCCP)" is required by the Environmental Protection Agency (EPA) under 40 CFR 112. The SPCCP specifically addresses prevention and cleanup of oil spills. Spills of hazardous substances and petroleum are regulated by CERCLA under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) at 40 CFR 300. Nevada requires a hazardous Material Spill and Emergency Response Plan under NAC 445.242 through 445A.243.

3.14.2 Affected Environment

Hazardous substances are those chemical products purchased for use in the mining and mineral processing operations which require special handling because of their physical or chemical characteristics. They are transported to the site, stored on the site, and consumed in the mining or milling processes. Hazardous wastes are chemical materials which are generated during mining, assaying, and ore processing, and are not subsequently usable by the mining company. Hazardous waste can include byproducts of chemical reactions in ore processing or the assay laboratory, artificial concentrations of naturally occurring minerals, and products which become contaminated through use. Hazardous wastes must be properly disposed or recycled.

Materials such as spent heap leach ore and mill tailings are exempted from subtitle C of the RCRA, under the Bevill Amendment. The Bevill Amendment specifically exempts from classification as hazardous waste, those materials uniquely associated with the extraction and beneficiation process.

Information pertaining to hazardous materials is provided in Section 3.13 of the FEIS (BLM 2001, pages 3-145 through 3-149). The potentially affected environment resulting from the presence of hazardous materials and waste includes air, water, soil, and biological resources. The environment could be affected in the event of an accidental release of hazardous materials or wastes during transportation to and from the Project Area or during storage and use at the project site.

GMMC currently transports process- and mining-related chemicals to the mine by truck from numerous locations within Nevada and surrounding states. All of the hazardous materials are transported along I-80, which is located within the Humboldt River floodplain both east and west of the site. The hazardous materials that are currently used at the site are listed in Table 2-5.

The existing operations include transporting, handling, storing, using, and/or disposing of the following materials classified as hazardous by 49 CFR 172.101:

- Diesel fuel, gasoline, propane, petroleum oils, lubricants, ethylene glycol, acetylene, oxygen, and solvents used to operate and maintain equipment;
- Sodium cyanide, sodium hydroxide, hydrochloric acid, lime, flocculent, and antiscalant used in the gold extraction processes;
- Ammonium nitrate and explosives used for blasting in the open pit; and
- Various by-products and chemicals classified as hazardous waste from the assay laboratory.

Of the chemicals cited above, sodium cyanide, sodium hydroxide, hydrochloric acid, and ethylene glycol are hazardous substances that also are listed in 40 CFR 302.4 (CERCLA) and the appendices of the SARA. There are established quantities for these chemicals, which apply to the reporting requirements associated with a release of each chemical. Petroleum products also have an established reportable quantity, but are excluded as hazardous substances under CERCLA Section 101(14). A summary of the CERCLA reportable quantities for those chemicals discussed above is presented in Table 3-24. The reportable quantity for petroleum products is 25 gallons released to the ground surface, as regulated by Nevada Administrative Code 445A.347.

Trucks are used to transport a variety of non-hazardous materials as well as hazardous materials to and from the project site. Based on their hazardous characteristics, volume, and number of deliveries, the materials of greatest concern are sodium cyanide, sodium hydroxide, and diesel fuel.

Sodium cyanide may be considered the most hazardous material to be delivered to the site, due to the toxic nature of the chemical. Sodium cyanide would be transported to the site up to six times per month during peak production in 18,880-pound loads. Another potentially hazardous chemical delivery is that of sodium hydroxide, which would be

Table 3-24: CERCLA Reportable Quantities

Material	CERCLA Reportable Quantities (pounds)
Sodium Cyanide	10
Sodium Hydroxide	1,000
Hydrochloric Acid	5,000
Ethylene Glycol	5,000
Solvents	10 – 5,000

delivered approximately five times per year in 26,000-pound loads. Although diesel is not among the most toxic of materials used at the site, it would be delivered in the greatest quantity and frequency. All hazardous substances are transported by commercial carriers or vendors in accordance with the requirements of Title 49 of the CFR. Carriers are licensed and inspected, as required by the Nevada Department of Transportation and the USDOT. Tanker trucks have a Certificate of Compliance issued by the Nevada Motor Vehicle Division. These permits, licenses, and certificates are the responsibility of the carrier. Title 49 of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and must include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers.

In the event of a release off the project site, the transportation company would be responsible for response and cleanup. Each transportation company is required to develop a SPCCP to address the materials it would be transporting. Local and regional law enforcement and fire protection agencies also may be involved initially to secure the site and protect public safety.

GMMC has developed an integrated ERP to address, among other things, release of fluids from mine facilities. Over the life of the project, the probability of minor spills of materials such as lime or oils and lubricants (from loading or unloading activities) is relatively high. The plan addresses the following items:

- Accidents/medical emergencies;
- Fires/explosions;
- Chemical releases (fluid management and spill control);
- Natural disasters;
- Evacuation plans;
- Power failure/outage; and
- Criminal activities.

The section of the ERP that addresses chemical releases contains procedures for the control of leaks or spills of sodium cyanide (solid and liquid), sodium hydroxide, hydrochloric acid, lime, antiscalant, propane, diesel or gasoline, and other petroleum products. The section also contains the following:

- Fluid management plan describing the containment and leak detection systems to control and monitor process fluids at the facility;
- Monitoring plan describing the inspection of process areas for potential leaks and sampling of monitoring ports once per quarter to detect migration of process fluids from the mill, leach pads, tailings pond and other ponds;
- List of reportable quantities;
- Notification and reporting requirements; and
- Location and contents of spill kits and other protective equipment.

Continued operation in accordance with the ERP would assist in keeping spills localized and contained to allow for efficient clean up. GMMC has the necessary spill containment and cleanup equipment and trained personnel available at the site to quickly respond to minor releases.

Hazardous materials storage tanks require secondary containment sufficient to hold 110 percent of the volume of the largest tank within the containment system. Management of all tanks and vessels comply with manufacturer's recommendations, state and federal regulations, and best management practices. All hazardous substances are handled in accordance with applicable MSHA or Occupational Safety and Health Administration regulations (Titles 30 and 29 of the CFR).

Non-hazardous solid waste generated on the site is disposed in an approved waivered Class III on-site landfill. Used tires are either recycled by the suppliers or buried in the waste rock dump. Used equipment such as batteries, alternators, starter motors, etc., is recycled for remanufacture. Slag from GMMC's on-site lab is recycled. Crucibles and cupels from the lab are sent to a licensed hazardous waste landfill for disposal. GMMC is a small quantity generator of hazardous waste. Used petroleum products, antifreeze, and freon are transported off-site to approved recycling facilities.

3.14.3 Environmental Consequences & Mitigation Measures

3.14.3.1 Assessment Methodology

The sodium cyanide and sodium hydroxide used at the site is supplied by a vendor located approximately 64 road miles from the site. The diesel fuel is supplied by a vendor located approximately 197 road miles west of the mine site. Sodium cyanide, sodium hydroxide, and diesel fuel are transported directly to the mine site on I-80.

The risk of an accident involving deliveries of these three substances was previously evaluated using Hazardous Materials Transportation Risk Analysis (Rhyne 1994). According to these national statistics, the average rate of truck accidents on a rural freeway resulting in a release of the contents is 0.12 accidents per million miles traveled. Using these statistics, the probability of a transportation accident resulting in a release of the three chemicals was evaluated over the proposed extended life of the project.

3.14.3.2 Proposed Action

The Proposed Action would extend the life of the mine, resulting in continuation of the current hazardous materials use practices through the year 2013.

The potential for impacts to the environment exists with the presence of hazardous materials and wastes at the site. Environmental impacts could result from an accidental release of hazardous materials or wastes during transport to or from the site or a release related to use or storage at the site. The criterion for evaluating potential impacts by hazardous materials and wastes is the risk of a spill and resultant impacts to sensitive receptors along transport routes or exposure pathways.

The Proposed Action would result in an increase in the rate of transportation and duration of storage of sodium cyanide, sodium hydroxide, antiscalant, ammonium nitrate, diesel fuel, and gasoline. The following evaluates the risk of an accident from the transportation of sodium cyanide, sodium hydroxide, and diesel fuel which were previously identified as the three most hazardous materials. Calculations are based on life of mine estimated quantities that would be used.

Sodium Cyanide:

390 truck deliveries x haul distance of 64 miles x 0.00000012 accidents per mile traveled = 0.003 accidents involving a release over the life of the project.

Sodium Hydroxide:

39 truck deliveries x haul distance of 64 miles x 0.00000012 accidents per mile traveled = 0.0003 accidents involving a release over the life of the project.

Diesel Fuel:

2,450 truck deliveries x haul distance of 197 miles x 0.00000012 accidents per mile traveled = 0.058 accidents involving a release over the life of the project.

An incremental increase in the transportation or use of hazardous materials or wastes would occur for both diesel and cyanide. The above analysis indicates that the probability of an accident over the extended life of the project, during the transport of any of these substances, would be low; however, the risk of a release of all three materials increases due the increased time over which the deliveries would occur. There have been no reportable releases of any of these substances during transportation and mine operation to date.

The probability of an accident involving a release of one or more of the hazardous materials over the life of the project is relatively small, and the emergency measures for responding and containing any spills, either on the mine site or during transportation, are in place under applicable law.

As previously discussed, the proposed mine expansion would require continued use and storage of hazardous materials. If some of the chemicals used at the site were to enter the environment in an uncontrolled manner, there could be associated direct or indirect adverse environmental effects. The effects of a release would depend on the substance, quantity, timing, and location of the release. The event could potentially range from a minor petroleum spill on the project site, where cleanup equipment is readily available, to a large release of sodium cyanide solution. Some of the chemicals could have immediate destructive effects on aquatic resources and water quality if a release were to enter a surface water body. A hazardous material or waste release also could seep into the ground and contaminate the local groundwater. Depending on the proximity of such a release to populated areas or water supplies, the use of degraded water for human consumption could affect human health.

The potential for stored and used chemicals to spill or otherwise be released into the environment exists. Potential impacts to surface and ground water exist.

The hazardous substances to be used are handled as recommended on the manufacturer's MSDS. With the above-listed design features and operational practices in place, the probability of a reportable release occurring at the site is low. In the event of a major or minor spill occurring on-site, GMMC would follow procedures presented in the ERP that establishes procedures for preventing, controlling, and reporting environmental releases within or from facilities located at the site. All spills, including transportation and loading/unloading related spills occurring on-site, are cleaned up or neutralized and reported, as required, to the Nevada Division of Emergency Management, the BMRR, the USEPA, the National Response Center, the BLM, the Humboldt County Department of Public Works, and Lander County Emergency Planning.

Residual adverse effects from the continued use of hazardous materials on the project site for the Proposed Action would depend on the substance, quantity, timing, location, and response involved in an accidental spill or release. Operation in accordance with the facility's ERP and prompt cleanup of spills minimizes the possibility of residual adverse effects due to hazardous materials.

3.14.3.3 Alternative 1 – Trout Creek Diversion Realignment

Implementation of Alternative 1 would not change the transportation, storage, or handling of hazardous materials at the Glamis Marigold Mine. Therefore, the impacts from this alternative would be identical to the impacts from the Propose Action.

3.14.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Implementation of Alternative 2 would not change the transportation, storage, or handling of hazardous materials at the Glamis Marigold Mine. Therefore, the impacts from this alternative would be identical to the impacts from the Propose Action.

3.14.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the current hazardous materials transportation, storage, or use described for the Proposed Action would be discontinued after the year 2007.

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3.15 Cultural Resources

3.15.1 Regulatory Framework

The goals of cultural resource management are to identify, maintain, and enhance both historic and prehistoric cultural resource values, as represented in archaeological deposits, architectural remains, and traditional cultural properties. These non-renewable cultural resources may provide valuable information concerning the cultural heritage of local populations that otherwise have no voice in the historic record. It is for this reason that federal, state, and local laws, ordinances, and guidelines have been designed to protect, preserve, and interpret these tangible remains.

The Antiquities Act of 1906 (PL 59-209), the Archaeological Resources Protection Act of 1979 (PL-96-95), and the National Historic Preservation Act of 1966, as amended (16 USC 470-470w-6; as amended to 1992), provide the federal policy for supporting and encouraging the preservation of cultural resources for present and future generations, by directing federal agencies to assume responsibility for considering these resources in their activities. Section 106 of the National Historic Preservation Act (36 CFR Part 800) requires federal agencies to take into account effects of their undertakings on properties eligible to the National Register of Historic Places (NRHP). The NEPA, as amended (42 USC 4371 et seq.), also requires that agencies consider the effects of their actions on cultural resources. The 1992 amendment directs federal agencies to consult with appropriate tribes as part of their Section 106 process.

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), as amended, requires consultation with appropriate Indian tribes prior to excavation of human remains, funerary objects, sacred objects, or objects of cultural patrimony on federal lands.

The FLPMA provides general direction to the BLM regarding the protection of the quality of scientific and other values, the systematic inventory of public lands, the use of the inventory for developing management plans, and the management of such lands and resources through easements, licenses, and permits. Cultural resources are included within the scope of these directions.

3.15.2 Affected Environment

The Cultural Setting section of the FEIS (BLM 2001, pages 3-151 through 3-161) is a contextual summary that outlines the prehistoric and historic periods by characterizing periods of significance, data pertinent to those periods, and information previously acquired. The focal points of the cultural setting are summarized below.

The cultural setting discussion for the project region has been divided into prehistoric and historic periods, with the prehistoric period ranging from approximately 12,000 years before the present (BP) to the first arrival of Euro Americans.

3.15.2.1 Prehistoric Period

The prehistoric period in the Great Basin region is divided into the Pre-Archaic (approximately 12,000 BP to 7,000 BP) and the Archaic (approximately 7,000 BP to the first arrival of Euro Americans [approximately 150 BP]). Studies in the western and eastern portions of the Great Basin indicate that human occupation occurred in the area as early as 12,000 BP. Information for this time period is limited, but suggests that the groups were small, very mobile, and may have relied on hunting in an environmental setting that was wetter and cooler than the present climate (Obermayr and Dugas 1996). The Pre-Archaic lifestyle focused on big game hunting, utilization of smaller animals, and consumption of easily available and easily processed plant materials generally associated with the lacustrine/marsh environment present at the time (Obermayr and Dugas 1996).

The beginning of the Archaic period coincided with the onset of a warming and drying period in the region. The period has been subdivided into the Early, Middle, and Late phases. The Early Archaic

(7,000 to 4,000 BP) is marked by the development of plant processing. Early Archaic period sites tend to be found in valley bottoms near permanent water sources, and indicate seasonal occupation. Human presence in the vicinity of the proposed project was probably sparse during this time period (Obermayr and Dugas 1996).

Drier climatic conditions became more apparent in the Middle Archaic (4,000 to 1,200 BP), with resultant increased habitation in optimal areas. Regional human adaptation to the climatic changes included a broadening of exploitation of the resource base and establishment of semi-permanent seasonal habitations within a home range. Consumption of plant foods and smaller animals was increased, groups generally became more mobile in response to seasonal resource dispersion and density, and long-term storage of resources was developed. This was evidenced by wider site distribution, greater variability in assemblages, and the appearance of larger and more complex living structures and storage (Obermayr and Dugas 1996). During the Middle Archaic, use of upland settings appears to have increased, and sites found in these areas are generally associated with resource procurement activities and forays (hunting, plant gathering and processing, and wood gathering) (Skinner 1996; Miller et al. 1996).

The late Archaic (1,200 to 150 BP) was marked by the introduction of the bow and arrow and a continued use of a wide variety of ecozones and food sources. Pottery and horticulture were not developed in the region; instead populations made seasonal rounds relying on a great variety of fauna and flora with the emphasis changing from riverine to desert species. Sites at Rye Patch Reservoir, to the north and west of the Project Area, indicate that rabbits were highly utilized (Skinner 1996; Miller et al. 1996).

Linguistic evidence suggests that Numic speaking people reached the area sometime between 1000 and 1300 AD. These people were the ancestors of the Paiute and Shoshone, who were living in the area at the time of the incursion of Euro American trappers, explorers, and settlers into the region (Clay 1989).

3.15.2.2 Historic Period

The first major contact between Euro Americans and the local native populations occurred in 1828, when Peter Skene Ogden, leader of a Hudson's Bay Fur Company trapping party, entered the study area. Ogden made two more expeditions through the area in 1829 and produced a map of the Humboldt Basin. During the second expedition, his group encountered a large band of Native Americans in the area (Skinner 1996). From 1833 to 1834, Joseph Walker explored the Humboldt River area along an east to west route that would become the California National Historic Emigrant Trail (Clay 1989). Expeditions usually left limited site evidence since they were of short duration and involved small groups of individuals.

Settlers bound for Oregon and California followed the trappers and explorers along the Humboldt River, north of the Project Area, beginning with the Bidwell-Bartleson party in 1841. The California Gold Rush saw over 197,600 emigrants and their livestock using the California National Historic Emigrant Trail route between 1849 and 1860. In the vicinity of the Proposed Action, the California Trail route crossed south of the Humboldt River near Lone Tree Hill. The emigrants often used areas away from the Trail for campsites, water and forage for stock, and to hunt. From the 1850s to 1915, the Stonehouse Station, a stage station, inn, and post office located approximately six miles northwest of the Project Area, provided meals and protection to travelers and emigrants along the Trail.

Mining activity began in north-central Nevada in the late 1850s with the discovery of mineral wealth near Dayton and Virginia City, Nevada. The Battle Mountain Mining District, which includes the Marigold Mine, was established in 1866 and remained relatively active until 1885. By 1870, 32 mines, a mill, and two smelters operated in the District. The first records for the Marigold Mine were from 1938 and included a mining assessment that lists $600 in improvements to claims in the area, including a few hundred feet of crosscuts, drifts, buildings, and roads (Newsome 1994; Obermayr and Dugas 1996).

Agricultural settlement patterns were influenced by the distribution of the mines and the arrival of the railroad. Many of the early small farms supported the local mines. During the 1870s and 1880s, cattle ranching became an important economic factor along the Humboldt River and in the project region. Sheep ranching increased during the 1890s to 1920s, because sheep were better able to withstand the harsh conditions. Ranching and farming remains include trash scatters from sheep camps, irrigation ditches, corrals, watering troughs, and fence lines (BLM 1995).

Mining resurfaced in the project vicinity in the early twentieth century with an emphasis on silver and copper, and the Battle Mountain Mining District boomed again.

3.15.2.3 Cultural Resources within the Project Area

The baseline data presented in the FEIS (BLM 2001, pages 3-151 through 3-161) is incorporated by reference. A summary of the previous cultural resource inventories conducted to date is included in Table 3-25. The previous cultural resource analysis is updated and modified on the basis of an enlarged boundary of a previously recorded site and a recent survey within the Project Area of potential effect (APE) conducted subsequent to the FEIS. The lands included in the previous cultural surveys are displayed in Figure 3-22.

The first modification of the previous cultural resource analysis concerns prehistoric archaeological site CrNV-22-6085 that was first discovered and described by Newsome (1994) as a non-significant lithic scatter. Subsequently, Obermayr and Dugas (1996) remapped the site during a second visit, considerably increasing its size and redefining its content, resulting in a revised recommendation that the site is eligible for nomination to the NRHP under Criterion d. Although the FEIS mentions the reassessment of the site's NRHP eligibility status resulting from the 1996 reassessment, the site's newly enlarged boundaries were not reported in the FEIS (BLM 2001).

The FEIS analysis is also updated by the addition of a very recent survey (Obermayr 2002) completed for NMC that extended into the southwest quarter of Section 30, T.33N, R.43E, within the present project's APE. The survey was conducted prior to the construction of an access/haul road from the Valmy Pit to the process area. Archaeological site CrNV-21-7476, a multi-component archaeological site possessing both prehistoric and historic loci, was discovered. The site was located along the terrace and fan/slope of Trout Creek. Although the historic loci were described as mundane and unworthy of further investigation, the four prehistoric site loci were deemed eligible for nomination to the NRHP under Criterion d due to the fact that they contain flake debitage, flaked and ground stone tools, fire-fractured rock, and possibly sourced toolstone (Tosawihi chert), in an overall geomorphic context that may yield a buried constituent.

Prehistoric resources in the Project Area include lithic scatters, temporary camps, and isolated finds, whereas historic resources are most often related to mining activities. Architectural remains are not present. In summary, seven NRHP eligible historic properties (CrNV-22-6085, -6094, -6199, -6204, -6205 -6376, and 21-7476) and one unevaluated site (CrNV-22-6090) have been identified as lying very near, entirely within, or partially within the APE. Five NRHP eligible sites (CrNV-22-6195, -6246, -6247, -6248, and -6264) are located within 500 feet of the APE.

3.15.3 Environmental Consequences & Mitigation Measures

3.15.3.1 Assessment Methodology

The maps of the Proposed Action and alternatives were compared to the cultural resource reports to ensure that the entire area of proposed surface disturbance had been previously surveyed for cultural properties. The reports were also reviewed for the contextual setting of the area. Based on the previous surveys, the locations of known sites were compared to the location of the proposed disturbance. Areas of site boundary overlap or close proximity to disturbance were further evaluated for potential impacts.

GMMC has proposed environmental protection measures for cultural resources (see Section 2.2.16). The assessment of potential impacts from the Proposed Action and alternatives was based on the implementation of these protection measures.

3.15.3.2 Proposed Action

The examination of cultural resources reports revealed that there are segments of the western half of the Proposed Action permit area within T33N, R43E that have not been surveyed. These segments include the N½ and portions of the S½ of Section 7; portions of the W¼ of the W½ of Section 18; the W¼ of the W½ and the S¼ of the S½ of Section 19; and portions of the W¼ of the W½ of Sections 30 and 31 (see Figure 3-17).

The following discussion of potential project impacts is limited to historic properties in or near the APE. Reports detailing the results of prior surveys and site evaluations are on file at the BLM field offices.

As stated above, seven NRHP eligible sites (CrNV-22-6085, -6094, -6199, -6204, -6205, -6376, and CrNV-21-7476) and one unevaluated site (CrNV-22-6090) were identified as lying very near, partially, or entirely within the APE. Five NRHP eligible sites (CrNV-22-6195, -6246, -6247, -6248, and -6264) were located within 500 feet of the APE. All of these historic properties could be directly or indirectly impacted by the proposed project.

Historic property CrNV-22-6085, as remapped by Obermayr and Dugas (1996), appears to be located immediately to the west of the proposed Antler Pit and associated infill disturbance Section 31, T33N, R43E and Section 6, T32N, R43E. These facilities would be bounded by a proposed fence line. Direct impacts to this large prehistoric lithic scatter could result from project activities such as fence line and pit construction, and infill disturbance. The disturbance of the infill bordering the pit might also result in impacts to this historic property due to changes in the amount or configuration of erosion.

Four other historic properties, CrNV-22-6094, -6199, -6090, and -6376, are all prehistoric lithic scatters located near proposed improvements such as the perimeter fence line, the proposed haul road, and/or the Section 16 Heap Leach Facility. CrNV22-6094 is associated with Mud Springs, and would be up-gradient of the proposed haul road and facilities in Section 20. CrNV-22-6199 is located immediately up-gradient of the proposed haul road and infill area. CrNV-22-6090 would also be up-gradient of the proposed haul road, but close to the disturbance footprint. CrNV-22-6376 is located on private land up-gradient and outside of the Project perimeter. Impacts to this property are not anticipated.

Historic properties CrNV-22-6204 and -6205 are located up-gradient of the existing Buffalo Valley Road, within the Project perimeter, but not in the immediate vicinity of any proposed surface disturbance. Impacts to these two properties are not anticipated.

The proposed new pits and waste rock storage areas located in Sections 30 and 31, T33N, R43E, all of which would be bounded by a proposed fence line, are located immediately west of newly discovered historic property, CrNV-21-7476 (Obermayr 2002). Direct impacts to this large prehistoric lithic scatter could result from project activities such as fence line, pit, or waste stockpile construction and operation. Should the historic property be situated outside the proposed fence line, it would remain vulnerable to increased vandalism due to exposure to recreationists and others diverted around the project property. Altered topography, caused by construction of the waste stockpile, might also result in impacts to the historic property, due to changes in the amount or configuration of erosion.

NRHP eligible sites CrNV-22-6195, -6246, -6247, -6248, and -6264 are located within 500 feet of the APE; however, these five sites are not immediately

Table 3-25: Cultural Resource Inventories Completed Within or Adjacent to Marigold Mine's Area of Potential Effect (APE)

BLM Report Number	Report Title	Reference	Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories)	Comments
CR2-83	Archaeological Reconnaissance Along Proposed 230KV Transmission Line Right-of-Way of Sierra Pacific Power Co. Part 1. Tracy to Valmy, Nevada	Rusco & Seelinger 1974	1 (0 are eligible)	Not able to locate complete report
CR2-248	Survey of Material Test Areas South of Valmy, Nevada EA #70820	Wallof and Cunningham 1977	0	
CR2-2236	A Cultural Resources Inventory of the Marigold Mine Project, Humboldt County, Nevada	Harmon et al. 1988a	4 (0 are eligible)	
CR2-2236 (Addendum)	Preliminary Report Of Field Investigations for a Supplement to a Cultural Resources Inventory of the Marigold Mine Project	Harmon et al. 1988b	1 (0 are eligible)	Supplement to CR2-2236
CR2-2294	Cultural Resource Inventory of the Trout Creek Project, Humboldt County, Nevada	Clay 1989	0	
CR2-2384	The Stonehouse Mine Project: A Cultural Inventory of Approximately 835 Acres in Humboldt County, Nevada for Marigold Mining Company	Johnson 1990	0	
CR2-2612	Cultural Resource Inventory of 1,880 Acres South of the Marigold Mine, Humboldt County, Nevada	Newsome 1994	10 (1 is eligible; 7 are not eligible; 1 site has one component as eligible and one component as not eligible); and 1 site requires additional data collection before NRHP status can be finalized	

Table 3-25: Cultural Resource Inventories Completed Within or Adjacent to Marigold Mine's Area of Potential Effect (APE)

BLM Report Number	Report Title	Reference	Number of Sites Recorded in the APE (Sites may be Duplicated between Inventories)	Comments
CR2-2681	A Class III Inventory of 685 Acres Within the Trenton Canyon Project Study Area of Santa Fe Pacific Gold Corporation, Humboldt County, Nevada	Dugas 1995	2 (1 is eligible, 1 is not eligible)	
CR2-2632	A Cultural Resources Inventory in the Trenton Canyon Area, Humboldt and Lander Counties, Nevada	Obermayr & Dugas 1995	12 (4 are eligible, 8 are not eligible)	
CR2-2686	A Class III Inventory of Section 21, T33N, R43E for the Trenton Canyon Project, Humboldt County, Nevada	Dugas 1996	1 (requires additional data collection before NRHP status can be finalized)	
CR2-1256	A Cultural Resource Inventory of 187 Acres for the Marigold Mine Rock Dump Project near Valmy, Humboldt County, Nevada	Crosland & Prince-Mahoney 1996	0	
CR2-1316	A Cultural Resource Inventory of 690 Acres for the Marigold Mine Project Near Valmy, Humboldt County, Nevada.	Martin-Moore 1997	0	
CR2-1460	A Class III Cultural Resource Inventory of 520 Acres Within the Newmont Mining Corporation Valmy Project Proposed Access/Haul Road, Humboldt County, Nevada	Obermayr 2002	2 (1 is eligible, 1 is not eligible)	

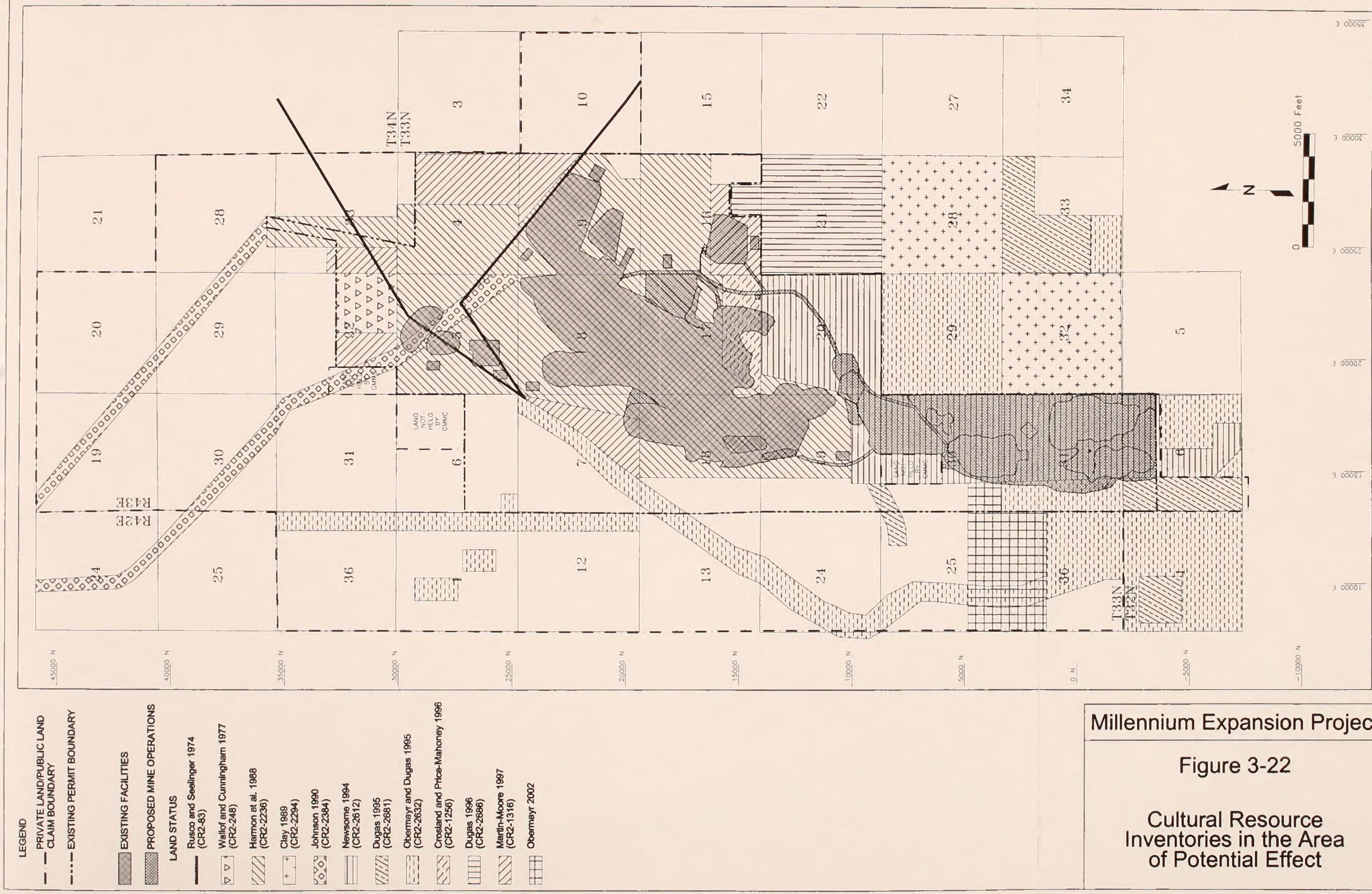

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Figure 3-22

Cultural Resource Inventories in the Area of Potential Effect

adjacent to any of the proposed facilities, and direct impacts to these sites are not anticipated. Indirect impacts, such as altered erosional patterns or changed travel pattern created by the mining activity, resulting in increased vandalism of the sites, may occur.

The seven NRHP-eligible sites would be avoided during the life of the proposed expansion. GMMC has proposed protection measures that include:

- fencing the boundaries of the site with a 30-meter buffer prior to work in the area;
- initiating avoidance activities that would be monitored by a permitted archaeologist whenever mine activities come within 30 meters of the site;
- an employee education program regarding the implementation of a systematic avoidance strategy and value of cultural properties; and
- the implementation of appropriate erosion control measures, such as a berm at the base of the waste rock storage areas, to control sediment and runoff.

Access by mine employees and equipment would be prohibited outside the permit boundary, which would be clearly marked, and known site locations or unsurveyed lands would be avoided. No mitigation, beyond the proposed environmental protection measures, is necessary or recommended. In addition, the construction and operation of the Section 16 Heap Leach Facility (heap leach pad, ADR, and access roads) would depend on the availability of economic grade ore. Should these facilities not be constructed, the potential impact to CrNV-22-6199, -6090, -6094, and -6376 would be greatly reduced.

3.15.3.3 Alternative 1 – Trout Creek Diversion Realignment

Realignment of the Trout Creek Diversion would place the Trout Creek channel within the western half of Section 19, T33N, R43E, approximately 100 to 200 feet west of the existing channel. This option results in about 12 acres of disturbance to the immediate west of the existing channel located near lands that have not been surveyed for cultural resources. Construction of this diversion involves armoring with rip rap at some locations and movement of native material. Should this option be implemented, areas to the west of the existing channel that have not been surveyed may be directly or indirectly affected by construction or ensuing erosion/drainage patterns, with potential impacts to unknown cultural resources. Should the diversion result in a changed pattern of baseflow with seasonal overbank deposit affected by an immature riparian community, there would be potential to effect downstream properties such as CrNV-21-7476 or CrNV-22-6085.

A Class III cultural survey would be conducted prior to any surface disturbance to identify the presence of any cultural properties and to determine the impact of the Trout Creek Diversion realignment on any identified cultural properties. Mitigation of potential effects, should they be needed, could take the form of an engineered solution to avoid the impact (avoidance) or mitigation of the historic properties prior to construction. Should any discovered resources be deemed eligible for nomination to the NRHP, impacts would be mitigated by a treatment plan approved by the BLM, the Nevada SHPO, GMMC, and the Advisory Council (as necessary), or through approved site avoidance, or by not implementing this option.

3.15.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Under this Alternative, the implementation of the expanded stabilization of the Red Rock Pit highwall (west side of the new Terry Zone Pit, Figure 2-13) would have no impact on known cultural properties.

3.15.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the increased surface disturbance associated with the Proposed Action would not occur and potential impacts to cultural resources would be as described and approved in the Marigold Expansion Project FEIS.

3.16 Native American Cultural Values

3.16.1 Regulatory Framework

NEPA requires that agencies consider the effects of their actions on the cultural environment, including cultural values and physical resources important to Native American tribes and individuals. Other federal laws and regulations set guidelines for identifying such cultural values and resources, as well as mandating agency consultation with Native American tribes.

The 1992 amendments to NHPA (discussed in 3.15.1) also mandate that federal agencies consult with appropriate tribes as part of the Section 106 process.

The American Indian Religious Freedom Act (AIRFA) of 1978 (PL 95-341) directs the federal agencies to assure that their policies and procedures protect and preserve the rights of American Indians to affirm, express, and exercise traditional religions, including access to sites; use and possession of sacred objects; and freedom of worship through ceremonials and traditional rights. Executive Order 13007 of 1996, "Indian Sacred Sites" adds an element of enforcement to the policy set forth by AIRFA.

The NAGPRA, as amended (25 USC 3001 and PL 101-601), requires extensive consultation with appropriate Native American tribes and focuses on the repatriation of human remains and Native American cultural items to affiliated tribes. Because this law addresses remains and items found during archaeological discovery situations, it needs to be carefully coordinated with NHPA compliance.

3.16.2 Affected Environment

Information detailing ethnography in the area of the Proposed Action is provided in the FEIS (BLM 2001, pages 161 through 164), and is summarized below.

The Project Area is located near the traditional boundary between the Northern Paiute and the Western Shoshone, which is generally considered to be at Iron Point, about 20 miles north-northwest of the Project Area. The Project Area itself lies within the aboriginal territory of the White Knife, or Tosawihi, band of the Western Shoshone (Harris 1963; Steward 1997). However, it is possible that the area may also have been utilized by Northern Paiutes who belonged to either the Makuhadökadö (also referred to in the available literature as the Pauide tuviwarai, Pauide tuviwarai, It-sa'-a-ti-a-ga, or idza'a-teaga-tekade) or Sawawaktödö tuviwarai (Fowler and Fowler 1971; Fowler and Liljeblad 1986; Loud and Harrington 1929). The Tosawihi, named for the white chert found at the Tosawihi Quarry located about 40 miles northeast of the Project Area, wintered in a few small villages scattered along the Humboldt River between Battle Mountain and Iron Point. Northern Paiutes traveled into the area east of Winnemucca for hunting and gathering (Harris 1963; Steward 1997).

These groups maintained a semi-nomadic lifestyle that corresponded to the availability of floral and faunal subsistence resources on a seasonal basis and involved seasonal movement between different vegetation zones and exploitation of a wide variety of food resources. Hunting of large and small game, including antelope, rabbit, waterfowl and rodents; fishing using nets, harpoons, and weirs; and gathering of grass seed, roots, berries, and pine nuts provided subsistence (Mires and Kautz 1997). The size and structure of the groups fluctuated in response to the availability and abundance of food resources. During winter, extended family groups gathered near caches of pine nuts that had been gathered during the fall. Movement in winter was minimized, and camps were maintained in areas with plentiful food resources, commonly along rivers, or near cached supplies of nuts, seeds, dried meat or other foods. Groups of Western Shoshone wintered on the Humboldt River, both above and below the Project Area (Obermayr and Dugas 1996). Wintering camps located near the Project Area included one at Tonomudza (greasewood point) near Battle Mountain, one at Bohowia (sagebrush pass) near Iron Point, and one at Pagowe near Stonehouse (Steward 1997). The groups separated into nuclear families in the spring, and foraged until fall, when they gathered together in camp groups to perform communal hunts and gather pine nuts (Newsome 1994). A few hunting and gathering areas were located within the general vicinity surrounding the Project Area. These include Pagawi at Stonehouse, Pü: wünük (plain against the hills) near Iron Point, Buffalo Mountain, Humboldt River, and Mud Springs. Rabbit drives were held at Pagawi and along the Humboldt River. Antelope drives were held at Pü: wünük. Buffalo Mountain was an area where pine nuts were gathered (Bengston 2002a). Mud Springs, located just south of the Project Area, was a place where sage grouse were hunted as recently as 1992 (Bengston 2002b). Representatives of the Battle Mountain Band indicated that the area including the current Marigold Mine was once used for hunting and gathering by the Western Shoshone. They also said that trails used by the Western Shoshone during their seasonal hunting and gathering migrations crossed the area.

Between 1879 and 1880, a large number of Western Shoshones, primarily members of the Tosawihi band, were moved to the Duck Valley Reservation. In 1917, the federal government set aside 688 acres for the Battle Mountain Indian Colony through an Executive Order. Most of the Western Shoshones who now live at Battle Mountain are descendents of the Tosawihi (Bengston 2002a).

3.16.3 Environmental Consequences & Mitigation Measures

3.16.3.1 Assessment Methodology

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This section summarizes the process used to gather information from Native Americans whose cultural values may be affected by the proposed Millennium Expansion Project. A complete report detailing the information gathering process has been prepared and submitted to the BLM, Winnemucca Field Office.

The Native American cultural values contractor conducted a thorough archival and literature review to ascertain the presence or absence of specific previously identified places within the general vicinity of the Marigold Mine that might be culturally important to the Western Shoshones or Northern Paiutes. Although a few subsistence areas were identified in the area surrounding the mine, this review did not reveal any specific previously identified culturally significant places associated with either the Western Shoshones or Northern Paiutes within or adjacent to the Project Area itself.

In August 2002, consultation was initiated by the BLM Winnemucca Field Office through notification letters summarizing the proposed mine expansion and requesting input from five tribal groups: Battle Mountain Band, Duck Valley Shoshone-Paiute Tribe, Te-Moak Tribe of Western Shoshone, Fort McDermitt Tribe, and Winnemucca Tribe. These tribal groups were identified as possibly having cultural affiliation with the proposed Project Area. The letters were followed up by telephone calls by the Native American cultural values contractor.

Following issuance of the August 2002 letters, the Proposed Action was presented by GMMC and the BLM at an informational meeting held at the Elko Te-Moak Housing Authority Band Offices among several Western Shoshone bands and tribes and the BLM, Battle Mountain, Elko, and Winnemucca Field Offices. This was a general informational meeting and included discussion of other projects in addition to the proposed Millennium Expansion Project. Attendees of this meeting included Aurora Aboite (Wells Band); Jennifer Bell (Te-Moak Tribe of Western Shoshone); Alfreida Jake (Elko Band); Wayne Bill (South Fork Band); Joan Whitney, Lois Whitney, and Chris Sewall (Western Shoshone Defense Project), Les Boni, Regina Smith, Gerald Dixon, Caleb Hiner, Bobbie McGonagle, Kellie Green, Tim Murphy, and Fred Holzel (BLM); Karen Kumiega (U.S. National Forest Service); Dave Cook and Tina Reynolds (GMMC); Ginny Bengston (SWCA, Inc. Environmental Consultants); and Gary Back (SRK Consulting). Questions raised during the presentation of the Proposed Action included water quality, heap closure, disturbance to the Trout Creek watershed, use of Trout Creek as a control for monitoring sediment from the Trenton Canyon Project, backfilling during reclamation, protection of Native American cultural sites, and disposition of topsoil removed prior to start up of the proposed mining operations.

Based on the interest expressed by the tribal groups at the meeting, and through follow-up telephone contacts by the BLM and the Native American cultural values contractor, the following tribes and tribal organizations were invited to participate in a tour of the Project Area: Battle Mountain Band, Duck Valley Shoshone-Paiute Tribe, Te-Moak Tribe of Western Shoshone, Fort McDermitt Tribe, Winnemucca Tribe, South Fork Band, Elko Band, Wells Band, Western Shoshone National Council, Western Shoshone Defense Project, and Joan Whitney. Representatives from the Battle Mountain Band responded to the invitation to visit the Project Area and participated in the mine tour held on September 17, 2002. During the tour several questions were asked regarding wildlife, springs, sediment, reclamation, protection of existing cultural sites, water use, and ore processing. The representatives from the Battle Mountain Band indicated that the Western Shoshones had used the area encompassing the Marigold Mine for hunting and gathering. They also indicated that trails used for these pursuits crossed the Marigold Mine lands. No specific traditional use areas were identified within the Project Area. A Battle Mountain Band representative expressed concern that tribal members have been prohibited from using the area in the past and are currently not allowed access to the proposed project area for hunting and food gathering. The representative also considered the loss of access to the area for hunting and gathering as cumulative over time.

Consultation and contact with the appropriate Native American tribes will continue throughout the NEPA process.

3.16.3.2 Proposed Action

As stated above, although representatives from the Battle Mountain Band indicated that the general vicinity encompassing the Project Area was used for hunting and gathering purposes, no specific traditional use areas were identified within the Project Area itself. It is, therefore, anticipated that the Proposed Action would not impact any National Register-eligible traditional use areas within the Project Area. Loss of access would be temporary and would last only until mining activity ceases and closure activities have been completed (about ten years).

Representatives from the Battle Mountain Band said that they no longer had access to traditional hunting and gathering areas within the vicinity encompassing the Project area. Current access to the mine area is regulated under the MSHAct of 1977. Under this act, access to active mining sites is limited to those who have obtained the required hazard training. MSHA, in conjunction with BATF, prohibits the possession of firearms on the mine site; hunting is also prohibited on active mining sites. The loss of access is a temporary impact that would last until mining activity ceases and reclamation and closure activities have been completed.

3.16.3.3 Alternative 1 – Trout Creek Diversion Realignment

The realignment of the Trout Creek Diversion would create an additional 12 acres of disturbance. Most of the disturbance would be revegetated; however, the armored portions (i.e., rip rapped) of the diversion would support much less vegetation. The diversion would be designed as a permanent facility and would not be reclaimed at the cessation of mining. The permanent nature of the diversion would create a permanent residual, adverse impact

3.16.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

The expanded Red Rock Pit stabilization option would not create an impact with regard to Native American cultural values.

3.16.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the increased surface disturbance associated with the Proposed Action would not occur and potential impacts to Native American cultural values would be as described and approved in the Marigold Expansion Project FEIS (BLM 2001).

3.17 Paleontology

Information detailing paleontological resources is provided in Sections 3.14.1.3 and 3.14.2.1 of the FEIS (BLM 2001, page 3-164 through 3-166 and 3-171 through 3-174) and is incorporated by reference. A summary of the information is provided below.

3.17.1 Regulatory Framework

The BLM regulates the collection of fossils on public lands under its jurisdiction through the several laws and regulations. The FLPMA of 1976 provides general direction to the BLM regarding the protection of the quality of scientific and other values, the systematic inventory of public lands and resources, the use of the inventory to develop management plans for public lands and resources, and the management of such lands and resources through easements, licenses, and permits. The collection of invertebrate and paleobotanical fossils is regulated under 43 CFR 8365.1-5, which provides the direction to protect significant localities of these fossils. Vertebrate fossils may only be collected by permit under specific conditions. The collection of petrified wood is subject to the provisions of 43 CFR 3622.

3.17.2 Affected Environment

Potential fossil bearing geologic units that outcrop in the vicinity of the Project Area include the Valmy Formation, the Havallah sequence, the Battle Formation, and Quaternary alluvium (older and younger) deposits. Formations that do not outcrop in the immediate area, but are found at depth within the Project Area include the Harmony Formation, the Antler Peak Limestone, and the Edna Mountain Formation. A complete description of the geologic units that outcrop in the Project Area and the fossil occurrence within each unit is provided on pages 3-164 through 3-166 of the FEIS (BLM 2001). A description of the geologic formations in the Project Area is provided in Section 3.2, Geology and Minerals.

The Valmy Formation is Ordovician and contains a large percentage of marine clastic rocks (quartzite, chert) and volcanic materials (greenstone) suggesting that the environment of deposition may have been in or near a volcanic archipelago (Roberts 1964). This formation is identified as having a low potential for yielding significant fossil deposits.

The Havallah sequence is located within the Project Area. This unit is comprised of sandstone and interbedded minor amounts of conglomerate, shale, siltstone and chert. The paleontological significance for this formation is low.

The Antler Peak Limestone and the Battle Formation are generally Pennsylvanian-Permian and Pennsylvanian in age and are included in the Antler Sequence. The Antler Peak Limestone consists of thick extensive limestone units. The Battle Formation is comprised mainly of conglomerates and sandstone with thin limestone beds (Roberts 1964). The paleontological significance for this formation is considered to be low.

Quaternary older and younger alluvium deposits within the Project Area generally consist of gravels in a sandy and clayey matrix. No vertebrate fossils have been identified within the proposed mine permit boundary in Quaternary alluvium deposits; however, fragments of Quaternary vertebrate fossils from either a horse or camel were collected in alluvium in Section 30, west of the Valmy Deposit (BLM 1995). The erosional and depositional nature of the alluvial deposits makes it difficult to predict the potential for fossil occurrences. Any fossils that may be located within the alluvium could have been transported long distances from their original depositional area. The paleontological significance for these units would be considered low to undetermined.

3.17.3 Environmental Consequences & Mitigation Measures

3.17.3.1 Assessment Methodology

The BLM has a *draft* Paleontology Program Manual and Handbook (BLM 1998b), which establishes a classification system for ranking paleontological areas for potential noteworthy occurrences of fossils. In summary, the BLM handbook states that public lands may be classified based on their likelihood to contain fossils, using the following criteria:

Condition 1 - Areas that are known to contain fossil localities. Consideration of paleontological resources will be necessary if available information indicates that fossils are present in the area.

Condition 2 - Areas with exposures of geological units or settings that are likely to contain fossils. The presence of geologic units from which fossils have been recovered elsewhere will require an assessment of these same units, if they occur in the area of consideration.

Condition 3 - Areas that are very unlikely to produce fossils based on their surficial geology, (e.g., igneous or metamorphic rocks, extremely young alluvium, colluvium, or aeolian deposits).

In keeping with the historical policies adopted by the Department of the Interior and the BLM, these classification guidelines apply primarily to vertebrate fossils. However, the BLM indicates that where noteworthy occurrences of invertebrate or plant fossils are known or expected, the same procedures should be followed.

A classification system similar to that used by the BLM was proposed by the Society of Vertebrate Paleontology in 1995 for use in defining the paleontological sensitivity of geological formations. This system includes the following paleontological categories:

High Potential. Rock units from which vertebrate or significant invertebrate fossils or significant suites of plant fossils have been recovered are considered to have a high potential for containing significant non-renewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations, that contain significant nonrenewable paleontologic resources anywhere within their geographic extent, and sedimentary rock units temporally or lithologically suitable for the preservation of fossils.

Undetermined Potential. Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential. Field surveys by a qualified vertebrate paleontologist are required to specifically determine the potentials of the rock units before programs of impact mitigation for such areas may be developed.

Low Potential. Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. These deposits generally will not require protection or salvage operations.

3.17.3.2 Proposed Action

The Project Area lies in Condition 2 and Condition 3 areas. Although fossils have been found in the project vicinity, no established fossil-collecting localities or significant deposits have been previously identified in the Project Area.

Using the Society of Vertebrate Paleontology classification system and the BLM's system, the major sequences of rocks in the Project Area, which are Paleozoic marine sedimentary rocks, were evaluated for paleontological potential. Based on the assessment methodology described above, none of the geologic units that outcrop within the proposed boundary have greater than a moderate ranking for paleontological potential, and none have a greater than low ranking for their significance. Similarly, the alluvium and geologic units that would be disturbed would have a low potential for paleontological resources. Because no significant fossil-bearing formations have been identified in or adjacent to the areas of proposed project construction or operation, no direct impacts or indirect impacts are anticipated for paleontological resources as a result of the Proposed Action.

3.17.3.3 Alternative 1 – Trout Creek Diversion Realignment

Realignment of the Trout Creek Diversion is not likely to impact paleontological resources. Surface soil and alluvium would be disturbed, with only a small amount of bedrock disturbance. The bedrock to be disturbed includes formations that have low potential for containing significant fossil resources.

3.17.3.4 Alternative 2 – Expanded Red Rock Pit Stabilization

Additional backfilling of the Red Rock Pit to increase the stability of the existing Trout Creek Diversion and Red Rock Pit highwall would have an indirect impact on paleontological resources. The process of extracting ore and waste rock from the Red Rock Pit has exposed previously unexposed formations, providing an opportunity for fossil discovery. Backfilling the pit would reduce the amount of highwall exposure, thereby reducing this opportunity.

The impact to paleontological resources from the Red Rock Pit Stabilization option of this alternative is generally the same as those described for the Proposed Action.

3.17.3.5 Alternative 3 – No Action Alternative

Under the No Action Alternative, the existing and authorized mining operations at Glamis Marigold Mine would continue through 2007. No impacts to paleontological resources would occur beyond those identified for the EIS for the existing and authorized operations.

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3.18 Relationship Between the Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term is defined as the life of the proposed project through closure and reclamation (2013). Long-term is defined as the future beyond reclamation. This section identifies the short-term impacts to the environmental resources during operation and reclamation, and the long-term impacts to resource productivity that extend beyond the end of reclamation.

Many of the impacts associated with the Proposed Action would be short-term and would cease following successful reclamation. Beneficial impacts, such as additional local employment and generation of revenue, are anticipated. Short-term adverse environmental impacts would include the temporary loss of soil, vegetation, livestock forage, wildlife habitat, and dispersed recreation opportunities, as well as increased fugitive dust emissions, interference with livestock movements, and visual impacts. Most of these impacts would end upon completion of operations, and resource levels should return to pre-mining or near pre-mining levels after successful reclamation.

Impacts to the long-term productivity of the site following reclamation would depend upon the effectiveness of the proposed reclamation. Successful reclamation that creates self-sustaining plant communities, which provide forage, wildlife habitat, and ecological diversity, would limit the long-term impacts to the acreage associated with unreclaimed pits (approximately 270 acres). Additional long-term visual impacts would occur due to the exposed pit wall and changed landscape. However, the recontouring of heap leach pads and waste rock storage areas would reduce the level of long-term visual impacts.

The short-term and long-term impacts would be similar for the Proposed Action and the two alternatives. Under the No Action Alternative, the short- and long-term impacts would be limited to those analyzed in the Marigold Mine Expansion Project.

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3.19 Irreversible/Irretrievable Commitment of Resources

Construction and operation of the proposed project would result in either the irreversible or irretrievable commitment of certain resources. Irreversible is a term that describes the loss of future options. It applies primarily to the effects of use of nonrenewable resources, such as minerals or cultural resources, or to those factors, such as soil productivity, that are renewable only over very long periods of time. Irretrievable is a term that applies to the loss of production, harvest, or use of natural resources. For example, livestock forage production from an area is lost while an area is serving as a mining area. The production lost is irretrievable, but the action is not irreversible. If the use changes and the mine is reclaimed, it is possible to resume forage production. Irreversible and irretrievable impacts of the Proposed Action are summarized in Table 3-26.

Table 3-26 Irreversible/Irretrievable Commitment of Resources - Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Water Resources and Geochemistry	No	Yes	Water that is removed during the life of the project and used for mine operations would not be available for other uses.
Geology and Minerals	Yes	Yes	Mineral resources that are mined would no longer be available for future production.
Air Quality	No	No	Emissions from the project would not deteriorate the existing air quality in the project vicinity.
Soils	Yes	Yes	Soils from the pits, waste rock dumps, heap leach pads, tailings impoundment, and other mine facilities would be salvaged as growth media for use in reclamation.
Vegetation Resources	Yes	Yes	Irreversible impacts to vegetation would result in the unreclaimed pit areas (270 acres).
Wildlife and Fisheries Resources	Yes	Yes	Wildlife habitat would be irreversibly lost in the unreclaimed pit areas (270 acres).
Special Status Species	Yes	Yes	About 211 acres of potential habitat (shadscale) for the burrowing owl and 1,183 acres of sagebrush vegetation type used by sage grouse would be irretrievably lost until after reclamation
Range Resources	Yes	Yes	Unreclaimed pit areas (270 acres) would be irreversibly lost for livestock grazing. There would be an irretrievable loss of public land available for livestock grazing, (about 1,586 acres, or 79 animal unit months) until reclamation is sufficient to restore productivity and allow this activity to resume. Forage production is expected to recover in the long-term following reclamation, with a loss of 14 animal unit months due to unreclaimed pits.
Land Use and Access	No	No	There would be no irreversible impacts to access; public access patterns would be maintained.
Recreation	No	Yes	The loss of the unreclaimed pit areas (270 acres) would minimally affect recreation. There would be an irretrievable loss of land available for dispersed recreational opportunities until reclamation is sufficient to allow dispersed recreational activities to resume.
Aesthetics	No	Yes	Impacts to visual resources would be eliminated through successful reclamation procedures.

Table 3-26 Irreversible/Irretrievable Commitment of Resources - Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Social and Economic Values	No	Yes	The eventual loss of employment, tax revenues, and other economic benefits following mine closure would be considered temporary over the long-term, as other sources of employment and tax revenues would likely be obtained.
Hazardous Materials	No	No	A spill of hazardous materials into a sensitive resource, such as a stream or wetland, is not expected during the life of the project. If a spill did occur, impacts could last for several months or years, but would not be considered irreversible. Remediation of a spill would be initiated immediately and would be expected to mitigate most impacts.
Cultural Resources, Ethnography	Yes	Yes	Disturbance near cultural sites would result in the permanent loss of site context. Continued mine operation has an adverse effect on traditional values of local Native American groups.
Paleontology	No	No	No disturbance to paleontological resources is expected. If paleontological resources are encountered they would be avoided where possible. If avoidance is not possible, irreversible and irretrievable impacts would result.

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3.20 Energy Requirements and Conservation Potential

Energy for the Proposed Action would be supplied by electricity, propane, gasoline, and diesel fuel. Electricity would be used to power all equipment in the process plant and ancillary facilities, pump water used in the operation, and to provide lighting for mining and processing activities. Propane would be used to heat buildings. Gasoline and diesel fuel would be used to power light trucks, and mobile equipment and backup generators, respectively.

Alternative 1 and Alternative 2 would not appreciably change the use and consumption of energy with respect to the Proposed Action. Alternative 3, the No Action Alternative, would eliminate the need for all energy consumption associated with the Propose Action.

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4.0 CUMULATIVE IMPACTS

4.1 Introduction

As defined in 40 CFR 1508.7 (regulations for implementing NEPA), a cumulative impact is an impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or entity undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. BLM Instruction Memo NV-90-435 specifies that impacts must first be identified for the proposed project before cumulative impacts with interrelated projects can occur. The impacts from the Proposed Action and alternatives were identified in Chapter 3.0.

The area of concern for cumulative impacts varies by resource, with impacts to certain resources being restricted to the actual area of disturbance. The cumulative assessment area for many resources encompasses an area within a few miles or less of the proposed project site. Exceptions are the cumulative assessment area for social and economic values (includes two-county area) and air (air basin). The cumulative assessment area for most resources includes the area encompassed by the two grazing allotments associated with Battle Mountain, as depicted on Figure 4-1.

4.2 Interrelated Projects

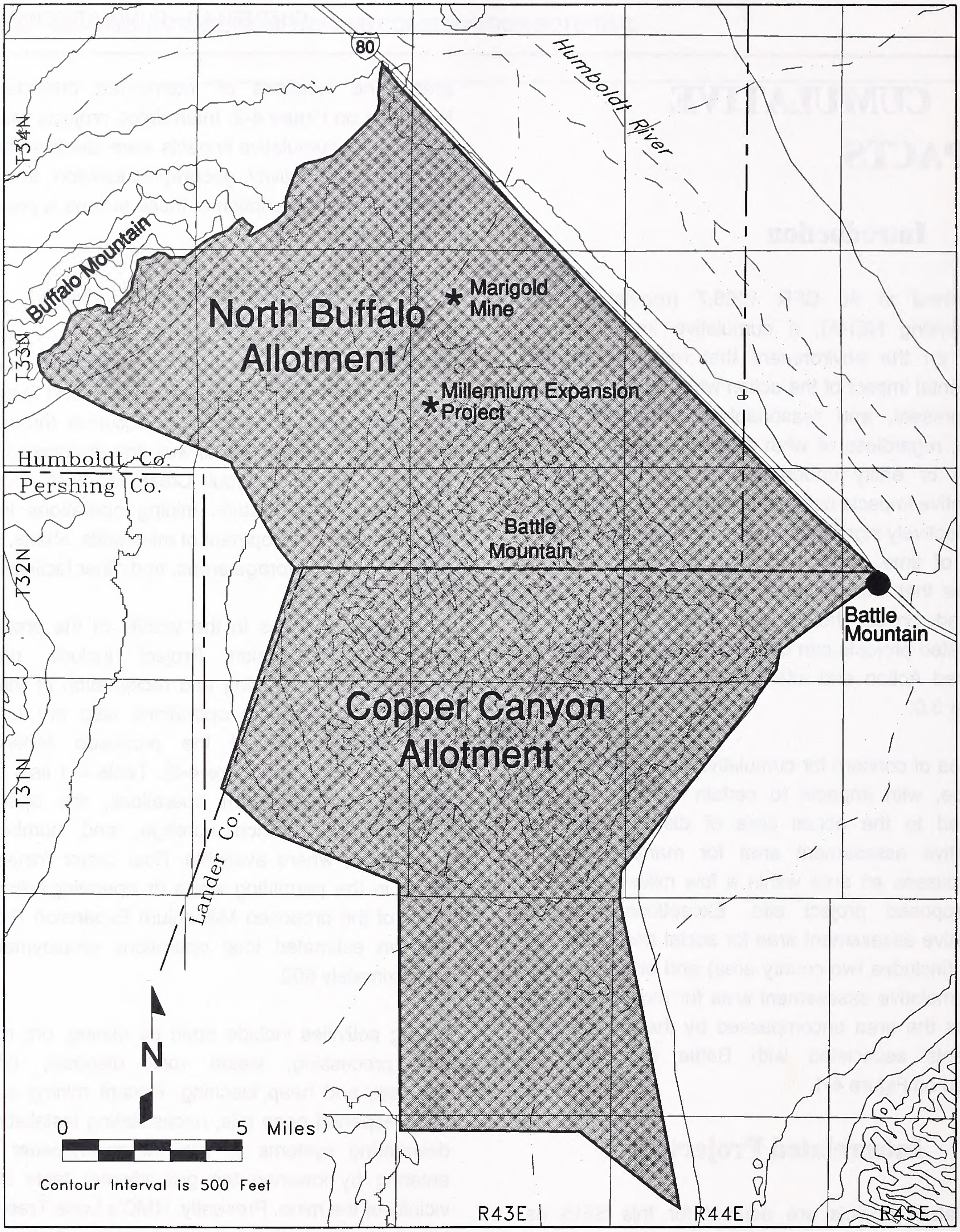
Interrelated projects are defined for this SEIS as those activities that have impacts that, when combined with impacts of the proposed project, could result in cumulative effects on the environment. Interrelated projects include past, present, and reasonably foreseeable future actions. Table 4-1 lists the past and present actions, Proposed Action, and reasonably foreseeable future actions in the Millennium Expansion Project cumulative assessment area. The locations of interrelated projects are illustrated on Figure 4-2. Interrelated projects with the potential for cumulative impacts were identified based on the type of activity, geographic location, and time period. A brief description of these actions is provided in this chapter.

4.3 Past and Present Actions

Historic activities in the area have primarily included mineral exploration and development, and livestock grazing. Mining activities have occurred throughout the Project Area since gold was first discovered on a low ridge north of Trout Creek in 1927. Surface disturbance from historic mining operations in the area includes development of mine adits, shafts, open pits, waste rock storage areas, and other facilities.

Exploration activities in the vicinity of the proposed Millennium Expansion Project include drilling, trenching, and sampling and reclamation of the drill pads. Several mining operations also are located within the vicinity of the proposed Millennium Expansion Project (Figure 4-2). Table 4-1 lists these mining and exploration operations, the operating company, disturbance acreage, and number of employees, where available. Four major mines are either in the permitting stage or operating within 20 miles of the proposed Millennium Expansion Project, with an estimated total operations employment of approximately 600.

Mining activities include open pit mining, ore milling and processing, waste rock disposal, tailings disposal, and heap leaching. Recent mining activity has deepened open pits, necessitating installation of dewatering systems to prevent groundwater from entering by lowering the groundwater table in the vicinity of the mine. Presently, NMC's Lone Tree mine is actively dewatering and would continue to be active at the same period of time as the Proposed Action. The Phoenix Project, also an NMC mine, would include dewatering when the project is activated. The North Valmy Generating Station also uses large quantities of groundwater for power generation.



Legend

- County Boundary
- Interstate 80
- Road
- Stream or Intermittent Stream
- City
- Allotment Boundary
- Cumulative Assessment Area

Millennium Expansion Project

Figure 4-1

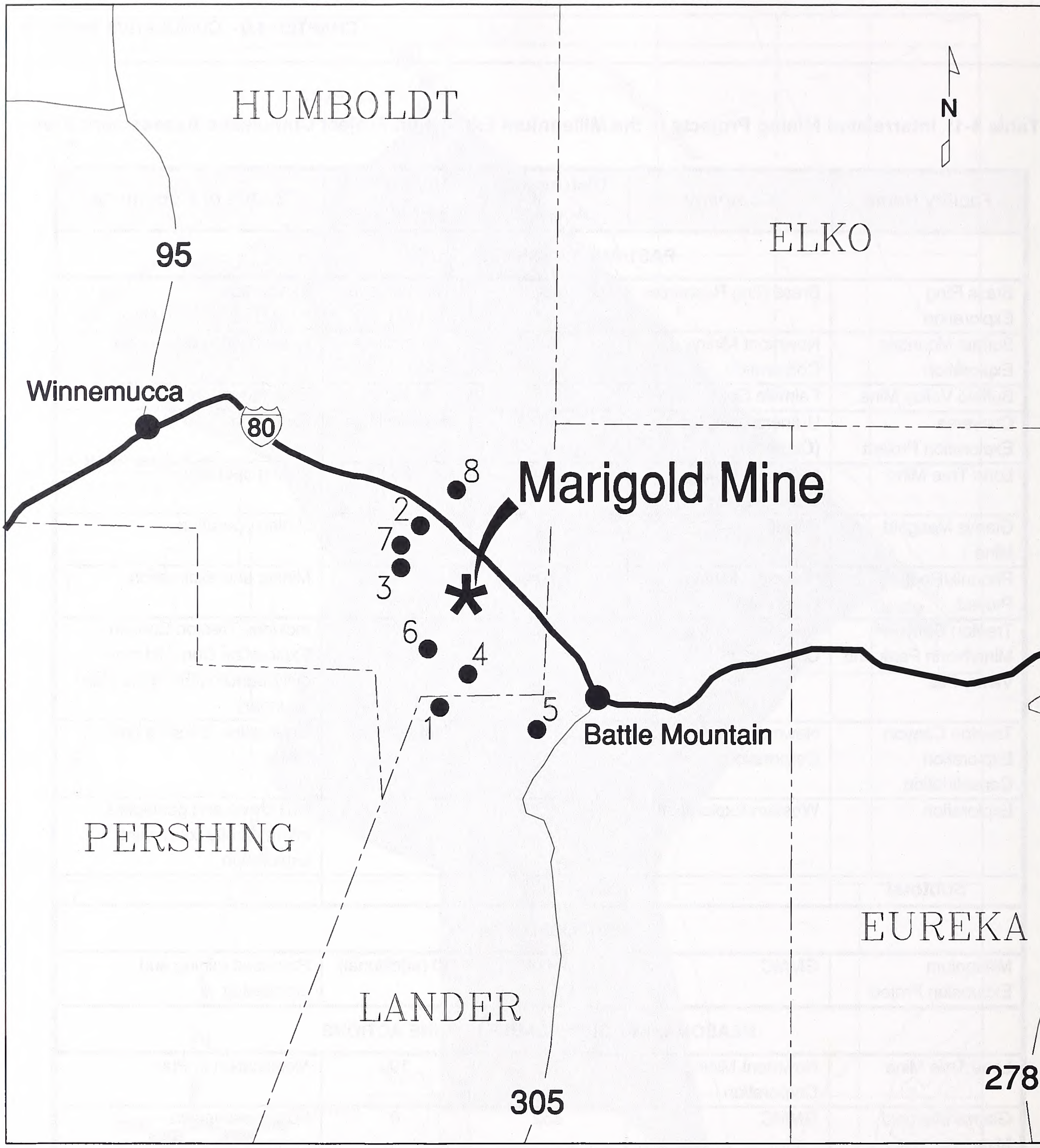
Cumulative Assessment Area for Range, Vegetation, Wildlife, Special Status Species, and Cultural Resources

Table 4-1: Interrelated Mining Projects in the Millennium Expansion Project Cumulative Assessment Area

Facility Name	Company	Disturbance Acreage	Number Of Employees	Status or Comments
PAST AND PRESENT ACTIONS				
Brass Ring Exploration	Brass Ring Resources	18	Not available	Exploration
Buffalo Mountain Exploration	Newmont Mining Corporation	18	Not available	Reclamation activity only
Buffalo Valley Mine	Fairmile Gold	146	NA	Exploration
Converse Exploration Project	Uranerz USA, Inc. (Cameco)	50	Not available	Exploration
Lone Tree Mine	Newmont Mining Corporation	4,730	350	Mining operation
Glamis Marigold Mine	GMMC	1,831	105	Mining operation
Phoenix/Reona Project	Newmont Mining Corporation	2,704	20	Mining and exploration
Trenton Canyon Mine/North Peak and Valmy Pits	Newmont Mining Corporation	2,682	130	Includes Trenton Canyon Exploration Consolidation disturbance within mine plan boundary
Trenton Canyon Exploration Consolidation	Newmont Mining Corporation	955	Not available	Exploration drill sites and roads
Exploration	Western Exploration	< 5		Drill crews and geologists intermittently conducting exploration
Subtotal		13,139		
PROPOSED ACTION				
Millennium Expansion Project	GMMC	1,474	10 (additional)	Proposed mining and processing
REASONABLY FORESEEABLE FUTURE ACTIONS				
Lone Tree Mine	Newmont Mining Corporation	50	100	Modification to Plan
Glamis Marigold Mine	GMMC	852	0	Future expansion
Phoenix Project	Newmont Mining Corporation	4,387	210	Proposed mining and processing
Subtotal		5,289		
TOTAL		**19,902**		

NA = Not applicable.

Sources: Brown and Caldwell 1999; BLM 1999; American Mines Handbook 1999; Western Mining Directory 1998; JBR 1998; BLM 1998; BLM 2001



Legend

1 Buffalo Valley Mine
2 Lone Tree Mine
3 Buffalo Mountain Exploration
4 Trenton Canyon/Valmy/ North Valmy Mines
5 Reona/Phoenix Project
6 Converse Exploration Project
7 Brass Ring Exploration
8 North Valmy Power Station

0 5 10 Miles
0 5 10 Kilometers

Millennium Expansion Project

Figure 4-2

Interrelated Projects

The following non-mining activities are located in the vicinity of the proposed Millennium Expansion Project:

- North Valmy Generating Station – a coal-fired power plant operated by approximately 110 Sierra Pacific Power Company employees in Valmy, Nevada, just north of I-80;
- Coastal Chem Ammonium Nitrate Plant – a plant producing 150,000 tons per year of ammonium nitrate. The plant employs 24 people and is located on about 15 acres of disturbance about five miles north of Battle Mountain;
- Sierra Chemical Facilities – Sierra Chemical operates the Rennox and Battle Mountain facilities for offloading sodium hydroxide, sulfuric acid, ammonium bisulfide, and hydrochloric acid from rail car to truck for delivery to area mines. The combined facilities employ seven people and disturb about two acres;
- M-I Drilling Fluids Plant – this plant is located in Battle Mountain and employs about 28 people to process barite from area mines; and
- Livestock Grazing – the livestock grazing cumulative effects area covers the Copper Canyon and North Buffalo allotments. Presently, four permittees graze cattle and sheep in these allotments.

4.4 Proposed Action

The Proposed Action is described in detail in Chapter 2, and includes the expansion of existing open pits, development of five new pits, expansion and development of waste rock storage areas, development of two new heap leach pads and facilities, expansion of existing heap leach facilities, and various ancillary facilities. Total disturbance from the Proposed Action would be 1,474 acres.

4.5 Reasonably Foreseeable Future Actions

Mining operations within the cumulative impact assessment area that have been proposed or are in the review stage are listed in Table 4-1. Reasonably foreseeable actions associated with GMMC include:

- Expand Facilities onto Private Ground. An 80-acre parcel of private land is presently owned and controlled by Western Exploration and Doby George LLC in T. 33 N., R. 43 E., Section 30, E½NW¼. The parcel is adjacent to the proposed Section 30 heap leach facility and the North Waste Rock Storage Area. Exploration activities conducted by the owner are presently ongoing. The parcel is also used for livestock grazing. If exploration results indicate the absence of economic mineralization, and pending an agreement between GMMC and the landowner, the development of additional heap leach capacity or waste rock storage is a possibility.
- Expand the South Part of the Target No. 2 Pit Across Trout Creek. The proposed Target No. 2 pit would be located in T. 33 N., R. 43 E., Section 30, S ½. Exploration drilling in the vicinity of this pit has indicated a potential for gold mineralization to the west. If economic mineralization is present, the Target No. 2 Pit may be expanded to the west and over Trout Creek.
- Mining Deeper Reserves. GMMC is proposing to mine to a maximum depth of 4,480 feet amsl, although drilling indicates the presence of deeper reserves that are not presently economic. Should the price of gold increase to allow economic mining of these resources, GMMC may excavate to deeper levels provided that the creation of pit lakes could be avoided or mitigated.
- Increasing Waste Rock Storage Area Heights. Depending on their location and local topography, the waste rock storage

areas are designed to heights ranging from 100 to 590 feet. The facilities are designed to store the volume of waste rock generated during the proposed expansion. Should the price of gold increase, GMMC would be able to economically mine resources that were not previously practical to mine, resulting in the generation of more waste rock. Portions of these storage areas could be increased in height to store additional waste rock.

- Underground Mining. GMMC is proposing to mine to a maximum depth of 4,480 feet amsl, although drilling indicates the presence of deeper reserves that are not presently economic. Should the price of gold increase to allow economic mining of these resources, GMMC may elect to use underground mining as a means of recovering the resource.

- There is potential for expansion of the 5-North facilities, including additional pit area, waste rock storage, heap leach pad extension, and ancillary facilities (Figure 4-3). In addition, the 8-South/8-North facilities may be expanded into Section 7. No expansion of the process facilities is anticipated for this potential expansion. Similarly, potential for additional pit expansion, waste rock storage capacity, and ancillary facilities of the Terry Zone-East Hill-Mackay Complex exists (Figure 4-3). The total acreage associated with the potential expansion is 852 acres.

- Exploration Activities. GMMC has an ongoing exploration program covering the 8,320 acres of private land and 10,480 acres of public land in the project vicinity. This program includes geophysical analysis, geochemical surveys, reverse circulation drilling and diamond core drilling. It is reasonably foreseeable that within a period of one to five years, discovery and development of new reserves would lead to future actions. If the economic situation for mining gold improves, GMMC would be required to modify the PoO and a separate NEPA analysis would be required with additional modeling and/or studies.

The disturbed area for past, present, and reasonably foreseeable future mining activities in the region could be as high as approximately 19,900 acres (Table 4-1). Existing mines and exploration activities have disturbed or are permitted to disturb approximately 13,140 acres, and future mining activity is projected to disturb another approximately 5,290 acres. Portions of active mines would likely be reclaimed concurrently with mining operations. Continued modification of existing mines, proposed new mines, and possible closure of existing mines can be expected in response to changes in environmental, operational, and regulatory conditions, ore grade, operating costs, and the price of mineral commodities. As new acreage is disturbed, reclamation of other facilities is likely to occur. Therefore, the total disturbance at any given time is likely to be less than 19,900 acres.

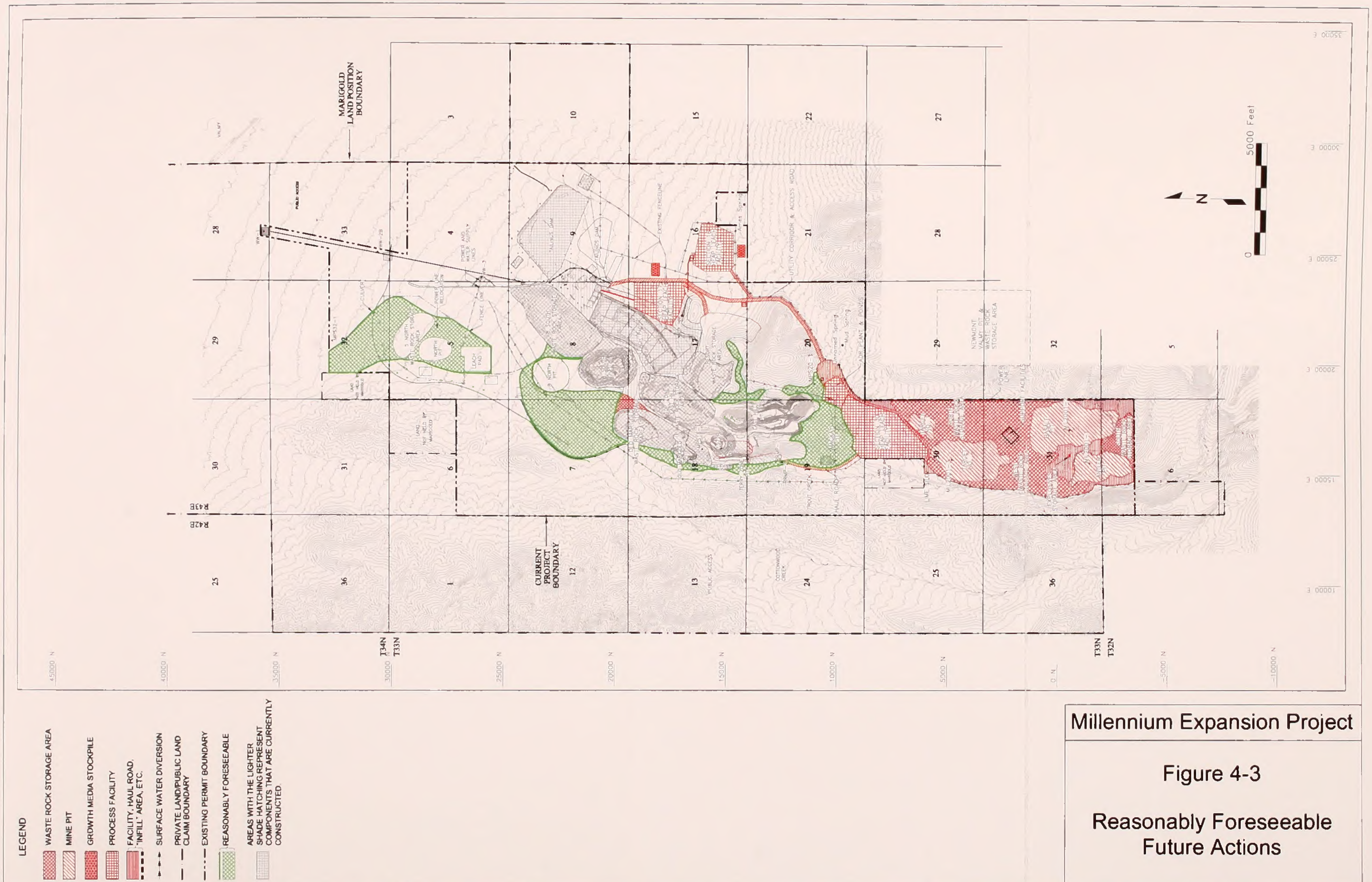
4.5.1 Reasonably Foreseeable Non-Mining Activities

The BLM is not aware of any major foreseeable change in the type or level of activity at any of the industrial facilities in the vicinity of the proposed Millennium Expansion Project. Livestock grazing is likely to continue as the principal land use in the cumulative effects area. The BLM plans to conduct a *Multiple Use Evaluation* for allotments within the jurisdiction of the Battle Mountain Field Office in 2004 or 2005 (BLM 2001), which may result in changes to livestock grazing.

4.6 Evaluation of Potential Cumulative Impacts

4.6.1 Geology and Minerals

Surface mining affects geology and mineral resources by excavating, modifying, or covering natural topographic and geomorphic features, and by removing mineral resources, thereby making these mineral resources unavailable for future use. The



Millennium Expansion Project

Figure 4-3

Reasonably Foreseeable Future Actions

cumulative assessment area for geology and mineral resources is shown on Figure 4-1. This is an area of current exploration and development of gold deposits.

Historically, this cumulative assessment area has been mined for copper, gold, and silver, with some minor development of manganese and antimony deposits. The total value of the ore removed in the Battle Mountain Mining District is not known. Mining began in 1866, and has continued to the present with intermittent periods of little or no mining alternating with periods of intense mining activity. Over 400,000 tons of copper-gold ore were removed from the Copper Canyon mine alone between 1866 and 1945. The Battle Mountain Gold complex has removed an estimated 2.2 million ounces of gold to date. It is estimated that the Lone Tree Mine would have removed 4.35 million ounces of gold by the time mining ceases around 2007 (BLM 1995). Other historical mines in the area have removed lesser amounts of copper, gold, and silver ore on an individual basis, but their cumulative total of ore may equal that of the Copper Canyon mine.

The present interest in gold in the Battle Mountain Mining District represents a renewal of intense mining activity in the cumulative assessment area. Major mines in the area are shown on Figure 3-4. The Glamis Marigold Mine, NMC's Phoenix Project, the Lone Tree Mine, and the recently discovered Trenton, Valmy, and North Peak deposits (Trenton Canyon Project) represent the major present and future mining impacts to the area. The Lone Tree Mine is expected to operate until around 2007 and remove about 555 million tons of ore and waste rock (BLM 1995). The Phoenix Project is expected to remove an estimated 1.15 billion tons of ore and waste rock containing approximately seven million ounces of gold. The Trenton Canyon Project would remove an estimated 152 million tons of ore and waste rock from at least three separate deposits (BLM 1998). The Glamis Marigold Mine and Millennium Expansion Project, when completed around 2013, would have removed an estimated 580 million tons of ore and overburden.

The primary geologic impact of mining is the permanent removal and loss of mineral resources. These resources are not available for future generations. Condemnation drilling is generally used to identify areas of no potential future economic value before waste rock storage areas, tailings impoundments, and leach pads are constructed. The surface disturbances that remain after mining usually do not result in an additional loss of mineral resources to future generations. Operations at the Glamis Marigold Mine under the Proposed Action are expected to remove all mineral resources that can be economically extracted under currently available technology and at current and reasonable foreseeable market prices for gold.

4.6.2 Geochemistry and Water Resources

As discussed under Section 3.2 (Geology and Minerals), there are many gold mines currently operating or planned for the area between Winnemucca and Battle Mountain, Nevada, including the Glamis Marigold Mine. The cumulative effects area for water resources includes the Clovers, Buffalo Valley, and Lower Reese River Valley hydrographic areas. The cumulative impact of all these open-pit gold mines is a substantial withdrawal of groundwater during mining to dewater the pits and then formation of pit lakes when the mines have ceased. The Millennium Expansion Project would not contribute to this cumulative water withdrawal because additional dewatering has not been necessary to mine the deposits at Glamis Marigold Mine, including the Millennium Expansion Project deposits. Process water obtained from the on-site wells originates from the alluvial valley system (WMCI 2002). Additional process water is obtained from NMC's Lone Tree Mine dewatering, but this represents a use of the water that NMC is providing as disposal of water from dewatering, not additional water.

The combined acreage of disturbance from the Proposed Action and other existing mining activities within or immediately adjacent to the Trout Creek and Cottonwood Creek watersheds is on the order of 2,700 acres (4.2 square miles). The combined Trout Creek and Cottonwood Creek watershed area is approximately 31 square miles. The disturbance within or immediately adjacent to the watersheds represents approximately 13 percent of their combined areas. Other nearby mining projects, such as NMC's Lone Tree Mine, Phoenix Project, and the Trenton Canyon Project, disturb additional lands and water resources in the vicinity. Of these, only the Lone Tree Mine discharges water to the Humboldt River (via Herrin Slough). With this exception, the proposed project and the other projects mentioned would have little effect on the Humboldt River because of their hydrologic setting (water occurrence or management approaches that do not create a direct hydraulic connection to the river) or their distance from the river.

A substantial amount of land disturbance has occurred in the Trout Creek and Cottonwood Creek watersheds as a result of exploration and mining activities. Several open-pit areas would essentially be withdrawn from contributing to surface runoff and streamflows. The withdrawal has greater impact in mountainous headwater areas upstream of the proposed project, where the majority of streamflow is generated and occurs. Most of the runoff generated on the Project Area is absorbed by porous alluvial deposits. Sub-basin streamflows, evapotranspiration, and groundwater recharge are not likely to be affected by the additional downgradient Millennium Expansion Project. Storm water diversions at these mining operations direct runoff water to existing draingages, settling ponds, or flat terrain to conserve the water within the watershed. However, the amount of disturbance in these watersheds is a concern, and compliance with permitting requirements is essential in order to minimize flow and water quality impacts (including erosion and sedimentation).

4.6.3 Air Quality

The predicted maximum annual concentration of particulates, at the point of closest public access beyond the mine property, boundary would be less than Nevada's annual ambient air standard of 50 $\mu g/m^3$. The total cumulative 24-hour impact would not exceed the Nevada 24-hour ambient air quality standard of 150 $\mu g/m^3$. Other permitted and non-permitted sources of air pollution are included in background concentrations measured and predicted for the Glamis Marigold Mine. Cumulative air quality impacts in the vicinity of the mine would be very slight since the particulate concentrations would fall below 5 $\mu g/m^3$ within one mile of the facility. The annual and 24-hour contributions from the mine sources would not cause the air quality in the region to degrade below national or state ambient air quality standards.

4.6.4 Soils

The cumulative assessment area for soil resources includes the North Buffalo and Copper Canyon grazing allotments (approximately 206,000 acres) (Figure 4-1). Past and present disturbances within the allotments include approximately 13,139 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately six percent of the cumulative assessment area. Mine development and operation activities associated with the Proposed Action would result in the disturbance of 1,394 acres of soils, or less than one percent of the cumulative assessment area. Reasonably foreseeable future projects identified in the cumulative assessment area would disturb approximately 5,290 acres of soils.

A total of 19,900 acres of surface disturbance would result from past, present, and proposed mining and other development activities, which represents approximately nine percent of the cumulative assessment area.

4.6.5 Vegetation Resources

The cumulative assessment area for vegetation resources includes the North Buffalo and Copper Canyon grazing allotments, with a combined acreage of approximately 206,000 acres (Figure 4-1). Past and present disturbances within the North Buffalo and Copper Canyon grazing allotment boundaries include approximately 13,139 acres that were disturbed during mining and other development activities. This disturbance accounts for approximately six percent of the cumulative assessment area. Mine development and operation activities associated with the proposed project would result in the disturbance or removal of 1,474 acres of vegetation, or less than one percent of the cumulative assessment area. Future activities could impact 4,870 acres of vegetation and 421 acres of previously disturbed area.

A total of 19,900 acres of surface disturbance would result from past, present, and future mining and other development activities in the cumulative assessment area, which represents approximately nine percent of the 206,000-acre cumulative assessment area. The loss of vegetation during development and operation activities would result in the loss of livestock and wildlife forage and protective cover for wildlife. Approximately 9,300 acres of the disturbance would occur in sagebrush-dominated vegetation (i.e., Wyoming big sagebrush-spiny hopsage, black sagebrush-mountain sagebrush/grassland, mountain sagebrush/grassland, and mixed brush communities). Approximately 9,300 acres of disturbance would occur in the shadscale-dominated vegetation (i.e., shadscale, shadscale-bud sage/grassland communities). The remaining 420 acres of mining disturbance would occur on lands previously disturbed. The loss of mature shrubs would be minimal relative to the total acreage of sagebrush and shadscale communities that occur in the cumulative assessment area. The majority of the mining-related surface disturbance would be reclaimed after mine operations cease. The vegetation communities of the reclaimed surfaces would not be identical to the pre-disturbance communities. Reclamation seed mixes would be a combination of species that have demonstrated the ability to establish on site-specific growth media. These seed mixes may include some species that previously occurred on the site, but may also include other native or introduced species adapted to the site. Depending on the plant community dynamics, a plant community resembling the pre-disturbance plant community would develop over time.

4.6.6 Wildlife and Fisheries Resources

Cumulative effects to wildlife and wildlife habitat in the cumulative effects area have resulted from past fires, mineral exploration and development, grazing, and drought. The cumulative impact analysis focused on the regional wildlife resources and how they may be susceptible to the cumulative actions identified for this project. The analysis assumed that: 1) human use of the cumulative effects area would continue to increase with or without implementation of the proposed project; 2) wildlife habitats are currently at their respective carrying capacities in and adjacent to the proposed mine expansion area; and 3) the overall region has been previously affected by the historic and current mining activities.

Cumulative effects to wildlife resources would be directly related to incremental habitat loss, fragmentation, and animal displacement that have primarily resulted from historic mining activities in the cumulative assessment area, forcing animals into smaller patches and limited distributions. Combined with these past effects, these resource issues also would be affected by the present and planned mining activities. Wildlife populations that occur in the cumulative effects area would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from the incremental development.

Overall cumulative impacts from the interrelated projects would parallel those discussed for the proposed project. The increased number of roads from mine exploration would improve human access into more remote areas. The work forces associated with mining construction and operation would increase traffic levels in the region, in addition to increasing the employees' exposure to the area. This exposure would typically result in additional human use of the region, increasing pressure on resident wildlife populations. Certain resources are more susceptible to impacts than others, such as riparian zones, seeps and springs, seasonal ranges, movement corridors, and active breeding sites (e.g., leks, raptor nests, brooding habitat). As stated for the proposed project, impacts to high-profile species are proportional to the increase in human presence, land use and recreational demands, and other regional development.

Past activities have disturbed an estimated 13,139 acres of wildlife habitat; the Proposed Action and reasonably foreseeable future actions would combine for an additional 6,763 acres. The total of 19,902 acres represents approximately 30 percent of the mule deer range within the cumulative assessment area. Almost half of this total acreage of disturbance would occur in sagebrush-dominated plant communities (see Vegetation discussion above) and the other half in shadscale-dominated plant communities. Cumulative impacts to other species would be similar, but their ranges have not been identified, and therefore, are not quantifiable.

Most of the 19,902 acres of disturbance in the cumulative assessment area would be reclaimed and returned to productive wildlife habitat. Some change in plant community composition is anticipated, and this would be reflected in the faunal composition of the region.

No impacts to perennial water or aquatic resources were identified within the cumulative effects area, and no adverse effects to water resources would result from implementation of the proposed project.

4.6.7 Special Status Species

The incremental habitat loss within the cumulative assessment area would be parallel to that described for wildlife and fisheries resources. The burrowing owl and sage grouse would be cumulatively affected by the past, present, and reasonably foreseeable future actions, based on overall habitat loss. The burrowing owl would be impacted by modification of the shadscale habitat at the lower elevations. Sage grouse impacts would be primarily from loss of sagebrush habitats on the foothills and higher elevations. Past impacts to sagebrush habitats (mountain brush communities as well as lower elevation Wyoming big sagebrush communities) are estimated at 6,800 acres. The proposed Millennium Expansion Project would increase this amount by approximately 1,200 acres. The total disturbance to sagebrush-dominated plant communities by past, present, and reasonably foreseeable future actions would be approximately 9,300 acres. The amount of sagebrush-dominated vegetation within the cumulative assessment area was estimated as approximately 77,000 acres. The cumulative disturbance to sagebrush represents approximately 12 percent of the available sagebrush vegetation. As discussed above in the Wildlife section, the disturbance would not occur at one time, but would occur incrementally over the seven-year mine life.

Other species that have likely been cumulatively affected by historic and ongoing mining activities would include nesting raptors. As the mine activities have expanded along Battle Mountain, some breeding territories have been impacted. However, inactive pits have created habitat for several raptor species. Removal of vegetation, representing wildlife habitat, has decreased the foraging areas within the region. However, it is not apparent that this has resulted in any population level impact to raptors.

Several species of bats are known to use local historic mine workings in the cumulative assessment area. Potential cumulative impacts to bats would primarily involve additional exploration and mining activities that may result in loss of individuals, and the disturbance to roost sites either through direct impacts from noise, vibrations, and human presence or through indirect effects from future mining development. The Millennium Expansion Project would not contribute to cumulative impacts to bats.

4.6.8 Range Resources

The cumulative assessment area for range resources encompasses approximately a 206,000-acre area including the North Buffalo and Copper Canyon allotments (Figure 4-1). Past, present, and reasonably foreseeable future projects within these two allotments have resulted in the short-term loss of 398

AUMs from the Copper Canyon Allotment and 617 AUMs from the North Buffalo Allotment (BLM 2002). The Millennium Expansion Project would contribute the loss of an additional 79 AUMs, bringing the total for the two allotments to 1,094, or 13 percent of the total active preference (8,470 AUMs). It is assumed that the majority (i.e., 90 percent) of the mine-related surface disturbance would be reclaimed after mine operations cease. Therefore, the cumulative impact described here is a short-term temporary impact.

The interference with livestock movements, specifically sheep trailing, represents another impact to range resources. The proposed perimeter fence for the Millennium Expansion Project would impede livestock movements between Mud Spring and Trout Creek. The permittees have indicated that there is not a specific trail that is used during the trailing of the sheep, and the sheep can be moved around the mine with minimal interference.

4.6.9 Land Use and Access

No impacts to land use and access were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative land use and access effects beyond those discussed for range resources and dispersed recreation.

4.6.10 Recreation

Past disturbance and present actions have resulted in the incremental loss of public lands available for dispersed recreation in this area. This has created displacement of these activities to other areas where mining or other development activities are not occurring. However, this has not manifested in the overuse of other nearby recreational areas, and given the amount of public land available in the surrounding area, the impact would be considered minimal.

No wilderness, developed recreation areas, parks, or other protected areas are located within the cumulative assessment area.

4.6.11 Aesthetics

Cumulative effects to aesthetic resources were considered for all past, present, and reasonably foreseeable future developments listed in Section 4.2, Interrelated Projects, which have the potential to be visible from either of the two KOPs identified in Section 3.12. These developments include the existing Lone Tree Mine and the Trenton Canyon Mine, in addition to the Glamis Marigold Mine/Millennium Expansion Project (Figure 4-2).

The Lone Tree Mine is located approximately five miles north of the Glamis Marigold Mine in the vicinity of Lone Tree Hill. Several mine-related facilities (e.g., waste rock storage areas, heap leach pads) are located within one mile of I-80 and tend to attract the attention of motorists. A waste rock storage area associated with the Lone Tree Mine lies within the field-of-view of KOP 1, and dominates the view of motorists on I-80 as they approach Lone Tree Hill.

The Trenton Canyon Mine, located along the northern and northwestern flanks of Battle Mountain and several miles south of the Glamis Marigold Mine (Figure 4-2), is higher in elevation and receives a different lighting angle because of the aspect of the pit and waste storage area locations. Disturbance associated with the Trenton Canyon Mine would be visible and could serve to attract the attention of motorists on I-80. The relative level of visual contrast created by the Trenton Canyon Mine would be stronger than that created by the expanded Glamis Marigold Mine; however, the Trenton Canyon Mine would be located entirely within a VRM Class IV area where the allowable levels of change to the characteristic landscape can be high.

The Proposed Action would contribute minimally to the cumulative visual impact. As described in Section 3.12, most of the Millennium Expansion Project components would be shielded partially or entirely by existing facilities or topography. The distance from I-80, and background sunlight, minimize the visual contrast of those mine components that are visible from I-80.

Following reclamation, the heap leach pads, waste rock storage areas, and other facilities would be recontoured and revegetated. Only the East Hill Pit and Terry Zone Pit high walls would be partially visible from the interstate.

No impacts to noise levels were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative noise level effects beyond those discussed in Chapter 3.

4.6.12 Social and Economic Values

The cumulative assessment area encompasses those counties and communities wherein the social and economic impacts from regional development would be expected to occur. Given geographical and demographic characteristics, impacts from the Proposed Action would occur in Lander County, Humboldt County, Winnemucca, Battle Mountain, and to a lesser extent, other small communities near the mine site. These areas define the socioeconomics cumulative assessment area for the project.

Socioeconomic impacts resulting from reasonably foreseeable future actions would depend on the schedule and scope of potential new mining activities and any other large-scale development projects in the vicinity of the proposed project. Continued mining operations and expansions, in particular, may extend the types of beneficial and negative impacts similar to those described for the proposed project. In addition, the timing of mine closures could compound the effects of mine shut-downs. The current major mining projects and reasonably foreseeable future projects, with their estimated employment numbers, are listed in Table 4-1 and illustrated on Figure 4-2.

The cumulative assessment area has long been dependent on the mining sector for economic activity and employment. Likewise, it is the mining sector that has done much to define this region. Rapid growth over the last 15 years is largely attributable to the increased mining in the area. Cumulative impacts from mining, therefore, are not a new phenomenon. The impacts include a substantial infusion of economic resources, which has been beneficial. Mining has contributed substantially to the regional economic base, providing jobs, high wages, tax revenues, and indirect economic benefits. This has fueled economic expansion and helped to provide capital for infrastructure development in local communities, a foundation for further economic growth (BLM 1996a; Nevada Bureau of Mines and Geology 1991).

The drop in gold prices during the late 1990s resulted in mergers, closures, and layoffs, all of which reduced the number of mine-related jobs within the cumulative assessment area. As a result, demands for infrastructure development have leveled or declined. The Phoenix Project would require 210 operations personnel. The Lone Tree Mine Modification would require approximately 100 employees. If these projects induce population increases at the same time that the Glamis Marigold Mine is employing its construction or operations work force, a modest rebound in economic activity is anticipated. Due to the recent declines in employment opportunities and population within these communities, no additional impacts to infrastructure would be anticipated.

Positive benefits also would be contributed by the cumulative mining projects. The Lone Tree Mine and the Glamis Marigold Mine are located in Humboldt County, and the Phoenix Project is located in Lander County. These projects would add to the mining employment and income in Humboldt and Lander counties and contribute to the tax bases. These benefits would continue through the life of the mines. In addition, sales tax revenues would be further increased in local communities where workers reside (primarily Winnemucca and Battle Mountain).

The recent increase in the price of gold, if sustained, may also stimulate additional exploration, mine expansion, or extend the life of existing operations. Depending on the level to which gold prices rise and length of time that the price remains high, there is potential for growth beyond the level of the most recent "boom." If this scenario occurs, then there is potential for impacts to the existing municipal infrastructure.

Both present actions and reasonably foreseeable future actions can contribute to the scale of the impacts resulting from mine closure. Mine shut-down dates are highly subject to change as mines continue exploration and expansion activity, which can extend the mine life. If several mines in the cumulative assessment area close simultaneously or within a relatively short period of time from each other, the negative effects of unemployment, loss of income, decreasing population, and loss of tax base can be compounded. These cumulative impacts are speculative, however, given the high variability in mine lifetimes. In addition, prevailing economic conditions at the time, and the start-up of other mines, have the potential to off-set these impacts.

4.6.13 Hazardous Materials

Since the potential for accidents involving trucks delivering hazardous materials to the site is low, cumulative impacts resulting from continued shipment of hazardous materials to the Glamis Marigold Mine site is minimal. The cumulative effects of using and storing hazardous materials on the project site have been minimized by implementation of the *Emergency Response Plan*.

4.6.14 Cultural Resources

Past, present, and reasonably foreseeable future actions within the cumulative assessment area, that have involved or could involve effects to cultural resources include, the Buffalo Valley Mine and Exploration Projects, the Lone Tree Mine Project, the Trenton Canyon Mine and Exploration Consolidation Projects, the past and present Glamis Marigold Mine Projects, the past and future Phoenix Mine Projects, the Converse Exploration Project, Western Exploration Project, and the Brass Ring Exploration Project (see Table 4-1).

Including surveys completed within the proposed APE, 62 cultural resource inventories associated with past, present, and reasonably foreseeable future actions have been conducted in the cumulative assessment area. These inventories have identified 477 known cultural sites. These included approximately 76 sites that are eligible for the NRHP with SHPO concurrence, 266 sites not eligible for the NRHP with SHPO concurrence, and 135 unevaluated sites that require concurrence from the SHPO or additional data collection.

The majority of past disturbance in the cumulative assessment area has consisted of historic mining operations or associated activities; they have in turn impacted an unidentified number of prehistoric and proto-historic sites. Historic and existing projects in the area have impacted at least 19 percent of the known cultural sites within the cumulative assessment area. This includes 21 sites previously affected by the Trenton Canyon Project, including four eligible sites, and 27 sites affected by the Lone Tree Mine Project, including three eligible sites (BLM 1995, 1998a). Existing operations at the Phoenix Mine have impacted 29 sites, including at least nine eligible sites. In addition, proposed activities at the Phoenix Mine could disturb an additional 44 ineligible sites (BLM 2002).

Past operations at the Glamis Marigold Mine appear to have disturbed or destroyed three sites (Cr-NV-4244, -4245, and -4247). This equates to less than one percent of the total number of sites identified within the cumulative assessment area. The Proposed Action would not impact any sites eligible for the NRHP.

Current disturbances, including ongoing Glamis Marigold Mine operations, have been subject to cultural heritage resource protection laws. The majority of the areas have been surveyed to Class III standards for cultural heritage resources, and, in the case of current work, sensitive sites were avoided or impacts were mitigated. All mitigation actions associated with the proposed project would be in accordance with established guidelines and a project-specific treatment plans developed among GMMC, BLM, the SHPO, and, if necessary, the Advisory Council on Historic Preservation.

Future mining or other ground-disturbing activities within the cumulative assessment area could impact NRHP-eligible or unevaluated sites. As directed by law, cultural heritage resource inventories and consultations would be conducted and impacts would be avoided or mitigated, as appropriate. Additional cultural inventories and consultations required for future expansions would add to the information base for cultural heritage resources within the cumulative assessment area. Compliance with Sections 106 and 110 of the NHPA would result in evaluation and mitigation or development of treatment plans for impacts to significant properties identified during the inventories for future actions, and also would increase the overall knowledge of cultural heritage resources in the cumulative assessment area.

In any federal undertaking, direct impacts to cultural resources would be considered. Even with mitigation, physical destruction of sites could still occur in the future, and there could be a permanent loss of some cultural heritage sites. Permanent loss of sites also has occurred within the areas disturbed by past and present actions. Indirect impacts, such as vandalism and illegal collecting, have and could occur to cultural heritage resources through increased access and development, as a result of past, present, and future activities. Indirect effects to cultural resources by existing and future actions may be reduced, but not eliminated by implementing environmental protection measures or mitigation, such as those identified in this SEIS.

4.6.15 Native American Cultural Values

Cumulative effects to some Native American cultural values have occurred over time as a result of development associated with past projects and previous actions in the general area encompassing the Marigold Mine. For safety reasons, and to comply with mining regulatory laws as discussed in Section 3.16, the general public, including Native American people, has been denied access to the lands included in the Marigold Mine. For Native Americans, this means that they have not had access to areas used traditionally in the recent past for hunting and gathering purposes. The loss of access has been and continues to be cumulative over time. This cumulative effect is temporary, however, and will last only until mining activity ceases and reclamation and closure activities have been completed.

No cumulative effects are attributable to specific Native American religious or traditional use areas. Because none of these types of places were identified within the Proposed Action area either during archival and literature research or through contact with tribal representatives, the Proposed Action should not contribute any cumulative effects to these types of places.

Cumulative effects discussions related to other areas of concern identified during Native American consultations, such as wildlife and water issues are addressed in the appropriate sections of Chapter 3. No additional significant cumulative effects from implementation of the Proposed Action are anticipated for these types of resources.

4.6.16 Paleontology

No impacts to significant paleontological resources were identified as a result of the Proposed Action. Consequently, the Proposed Action would not contribute to cumulative impacts to paleontological resources.

5.0 PUBLIC SCOPING

An NOI to prepare the SEIS was published in the Federal Register on July 12, 2002, which set the public scoping period and solicited public scoping comments. A letter was sent to all individuals, groups, and agencies that were on the Marigold Millennium Expansion Project SEIS mailing list, announcing the proposed Millennium Expansion Project and public informational meeting dates and times. This information was also published in the local newspapers on various dates between July 19, 2002 and July 30, 2002. Public informational meetings were held in Winnemucca and Battle Mountain, Nevada. No written comments were received at either of these meetings. Nine written comment letters were received by the BLM within the public comment period.

A tour of the site was conducted for grazing permittees for the affected allotments on September 12, 2002 to discuss the fencing and range issues.

Consultation with local Native American tribal organizations was initiated with a letter describing the proposed project and a request to be added to the agenda of the regularly scheduled monthly Native American-BLM coordination meeting. BLM and GMMC provided an overview of the project and fielded questions at the meeting on August 21, 2002. Native American tribal organizations were also invited to tour the existing and proposed mining areas in an effort to identify cultural and ethnographic issues. A tour was conducted on September 17, 2002, with three tribal representatives in attendance.

The following individuals attended the public informational meetings and/or provided scoping comments:

U.S. Fish and Wildlife Service
Western Exploration and Doby George, LLC
Nevada Department of Transportation
Nevada Division of Water Resources
Nevada Division of Environmental Protection
Nevada Division of Wildlife
Ellison Ranching Co.
The Nature Conservancy
Great Basin Mine Watch
Robert Thomason
Gary Frost
Suzanne Frost
Charles McAllister
Narayana Sainath
Todd Welty
Kristopher Daniel
Dick Nanna
Tyler Shepherd
Doug Barto
Don Decker
Bill Hall
Charlene Hager
JD Radakovich
Adella Harding
Greg Brasel
Michael Pagel
Ralph Erquiaga

The issues identified from public scoping and internal BLM scoping are listed in Chapter 1.

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6.0 CONSULTATION, COORDINATION, AND CONTACTS

6.1 Public Participation

The public participation program for this SEIS includes the following components.

Two public scoping meetings were held for the SEIS, one on August 14, 2002 in Winnemucca and the second on August 15, 2002 in Battle Mountain. Public scoping comments for the SEIS were received through August 19, 2002. Nine written comment letters were received by the BLM. The public scoping meeting comments were summarized in an SEIS Scoping Document. The following are the key scoping issues for the Millennium Expansion Project at Glamis Marigold Mine:

- <u>Water Resources and Geochemistry</u>
  Impacts to wetland and riparian areas
  Impacts to water quality and quantity (surface and ground water)
  Impacts to existing water rights
  Change in current permitted uses for GMMC
  Mobilization of arsenic
  Pit lake water quality
  Pit backfilling
  Heap leach closure

- <u>Geology and Minerals</u>
  Pit backfill

- <u>Air Quality</u>
  Impacts to air quality
  Fugitive dust – off site from mine vehicles

- <u>Soils</u>
  Impacts to soil quality

- <u>Cultural</u>
  Potential impacts to cultural sites

- <u>Ethnography</u>
  Access to historic hunting/food gathering areas

- <u>Vegetation Resources</u>
  Trace metal impacts to vegetation

- <u>Wildlife and Fisheries Resources</u>
  Impacts to terrestrial and aquatic wildlife and their habitats
  Impacts to migratory birds from land clearing activities and process solutions
  Dermal exposure to burrowing animals from contaminants in reclaimed facilities
  Noise impacts to wildlife
  Impacts to mule deer winter habitat
  Reclamation measures should include vegetation and habitat beneficial to wildlife
  Cumulative impacts to wildlife

- <u>Special Status Species</u>
  Impacts to sage grouse
  Impacts to invertebrates in springs
  Impacts to springsnails
  Impacts to bats

- <u>Range Resources</u>
  Loss of forage during and after mining
  Impacts to sheep movements
  Loss of livestock water sources
  Availability of reclaimed vegetation
  Impacts to amount of land available for shearing areas

- <u>Land Use and Access</u>
  Access to private land and mineral claims
  Water rights impacts
  Impacts to grazing leases

- <u>Social and Economic Values</u>
  Impacts to roads from transportation of mine materials

- <u>Hazardous Materials</u>
  Transportation and storage of hazardous materials

- Cumulative Impacts
  Cumulative impacts from mining and other land uses in the area need to be analyzed

6.2 Native American Consultation

This section summarizes the process to gather information from Native Americans potentially affected by the proposed Millennium Expansion Project.

Native American consultation was conducted to comply with Federal and state laws that apply to resources with traditional and/or religious significance to Native Americans. Consultation was initiated with notification letters outlining the proposed mine expansion. Notification letters and requests for comments were sent by the BLM in August 2002 to various Native American tribal groups.

Following issuance of these letters, the Millennium Expansion Project was placed on the agenda for the monthly Native American-BLM coordination meeting on August 21, 2002. BLM and GMMC presented information on the Proposed Action and fielded questions. Subsequent to the meeting, a tour of the mine site and Proposed Action area was arranged. The tour was conducted on September 17, 2002. A second informational presentation was given to the Battle Mountain Band Council on November 7, 2002.

Specific information regarding the Native American consultation process has been provided in Section 3.15, Cultural Resources and 3.16, Native American Religious Values/Ethnography.

6.3 Draft SEIS Preparation

In preparing the Draft SEIS, the BLM communicated with and received input from many Federal, state, and local agencies, as well as other organizations and individuals. The following is a list of those who provided input:

Federal Government Agencies

U.S. Fish and Wildlife Service (Reno)

State Government Agencies/Universities

Nevada Bureau of Mines and Geology
Nevada Department of Administration
Nevada Department of Conservation and Natural Resources, Nevada Division of Wildlife (Elko)
Nevada Department of Employment, Training, and Rehabilitation-Research and Analysis Bureau and Employment
Nevada Department of Transportation Security Division
Nevada Department of Taxation
Nevada Natural Heritage Program (Carson City)
Nevada State Demographer's Office, Bureau of Business and Economic Research

Local Governments/Agencies

Tri-County Development Authority

6.4 Draft Supplemental Environmental Impact Statement Review

Approximately 400 copies of the Draft SEIS were distributed to various government agencies, organizations, and individuals. A listing of the agencies, organizations, and individuals who were sent copies of the Draft SEIS in March, 2003 is presented below.

Government Agencies

Natural Resource Conservation Service – Winnemucca, NV
U.S. Army Corps of Engineers – San Francisco, CA
U.S. Army Corps of Engineers – Reno, NV
Office of the Deputy A/S of the USAF, Environmental, Safety and Occupational Health – Washington, D.C.
USDA, Forest Service – Winnemucca, NV
USDI, Bureau of Indian Affairs – Elko, NV

USDI, Bureau of Indian Affairs – Carson City, NV
USDI, Bureau of Land Management – Reno, NV; Elko, NV; Carson City, NV; Las Vegas, NV; Ely, NV; Battle Mountain, NV; Tonopah, NV; Denver, CO; Lakewood, CO; Washington, D.C.
USDI, National Park Service - Washington, D.C.
USDI, Minerals Management Service – Washington, D.C.
USDI, Office of Env. Policy & Compliance – Washington, D.C.
USDI, Natural Resources Library – Washington, D.C.
USDI, Office of Public Affairs - Washington, D.C.
USDI, OSM – Washington, D.C.
USDI, Bureau of Reclamation – Denver, CO
USDI, Fish and Wildlife Service – Washington, D.C.
USDI, Fish and Wildlife Service – Portland, OR
USDI, Fish and Wildlife Service – Reno, NV
USDI, Geological Survey – Denver, CO
USDI, Geological Survey – Carson City, NV
USDI, Geological Survey – Reston, VA
U.S. Dept. of Transportation – Washington, D.C.
U.S. Dept. of Energy – Washington, D.C.
U.S. Environmental Protection Agency, Region IX – San Francisco
U.S. Environmental Protection Agency – Washington, D.C.

State Agencies

Nevada Bureau of Mines and Geology, University of Nevada – Reno – Reno, NV
State of Nevada Clearinghouse – Carson City, NV
State of Nevada, Governor's Office – Carson City, NV
Nevada Dept. of Administration – Carson City, NV
Nevada Division of Minerals – Carson City, NV
Nevada Dept. of Conservation & Natural Resources – Carson City, NV
Nevada Div. of Env. Protection, BMRR – Carson City, NV
Nevada Division of State Lands – Carson City, NV
Nevada Division of Water Resources – Carson City, NV
Nevada Division of Wildlife – Reno, NV; Winnemucca, NV; Fallon, NV
Nevada Dept. of Transportation – Elko, NV; Winnemucca, NV
Nevada State Historic Preservation Office – Carson City, NV

Local Agencies

Elko County Commissioners – Elko, NV
Eureka County Commissioners – Eureka, NV
Eureka County Public Works – Eureka, NV
Deputy District Attorney, Eureka County – Eureka, NV
Humboldt County Commissioners – Winnemucca, NV
City of Winnemucca – Winnemucca, NV
Honorable Paul Vesco, Mayor City of Winnemucca – Winnemucca, NV
Winnemucca City Manager – Winnemucca, NV
Lander County Commissioners – Battle Mountain, NV
Lander County District Attorney – Battle Mountain, NV
Humboldt River Basin Water Authority – Winnemucca, NV
Pershing County Commissioners – Lovelock, NV
Lovelock Water District – Lovelock, NV
Washoe County Department of Community Development – Reno, NV
Pershing County Water District – Lovelock, NV
Humboldt County Road Maintenance – Winnemucca, NV

Elected Officials

Honorable Jim Gibbons
Honorable John Marvel, State Assemblyman
Honorable John Carpenter, State Assemblyman
Honorable John Ensign
Honorable Harry Reid
Honorable Dean Rhoads, State Senator

Tribal Organizations

Battle Mountain Band Council – Battle Mountain, NV
Duck Valley Tribal Council – Owyhee, NV
Elko Band, Te-Moak Tribe of Western Shoshone – Elko, NV
Fort McDermitt Tribal Council – McDermitt, NV
Elko Band Council – Elko, NV
Summit Lake Paiute Tribe –Winnemucca, NV
Western Shoshone Defense Project – Crescent Valley, NV
Western Shoshone History Preservation Society – Elko, NV

Winnemucca Colony, Western Band of the Western Shoshone – Winnemucca, NV
South Fork Band of the Te-Moak Tribe Western Shoshone – Lee, NV
Duckwater Tribal Council – Duckwater, NV
Ft. Hall Shoshone-Bannock – Ft. Hall, ID
Yomba Shoshone Tribe – Austin, NV

Organizations

Oregon-California Trails Association - Citrus Heights, CA
Agri Beef Co. - Boise, ID
Audubon Society, Lahontan Chapter - Reno, NV
Natural Resources Defense Council - San Francisco, CA
Santa Clara Valley Gem and Mineral Society - San Jose, CA
JBR Environmental Consultants - Reno, NV
Enviroscientists, Inc. - Reno, NV
Pacific Southwest Bioservices - National City, CA
Holmes, Robert & Owens - Denver, CO
Center for Biological Diversity - Tuscon, AZ
Dames and Moore Inc. - Lompoc, CA
Ballard Spahr Andrews and Ingersoll - Denver, CO
Public Resource Associates - Reno, NV
PTI Environmental Services - Bellevue, WA
Committee for the High Desert - Boise, ID
Citizen Alert, Native American Program - Reno, NV
Great Basin Mine Watch - Reno, NV
Desert Research Institute - Reno, NV
National Wildlife Federation - Washington, DC
Nevada Cattlemen's Association - Elko, NV
Nevada Mining Association - Reno, NV
Nevada Building and Construction Trades Council - Portland, Oregon
Nevada Outdoor Recreation Association - Carson City, NV
Nevada Woolgrower's Association - Elko, NV
Sierra Club, Great Basin Group - Reno, NV
Sierra Club Legal Defense Fund - Denver, CO
Sierra Pacific Power Company - Reno, NV
The Nature Conservancy, Northern Nevada Office - Reno, NV
University of Nevada Cooperative Extension - Elko, NV
Humboldt River Basin Water Auth. - Carson City, NV
Wild Horses Commission - Carson City, NV
Western Shoshone Resources, Inc. - Reno, NV
SW Research - Albuquerque, NM
Agri-Beef Co. - Golconda, NV
Concerned Citizen for Responsible Mining - Ontario, OR
Wild Horse Organization Assistance - Reno, NV
Sierra Club, California/Nevada RCC Mining Committee - Independence, CA
VEK/Andrus Associates - Reno, NV
Western Exploration, Inc. - Reno, NV
Mineral Policy Center - Washington, DC
SWCA Environmental Consultants - Reno, NV
Kautz Environmental Consultants, Inc. - Reno, NV
Western Watershed Project - Hailey, ID
ENSR - Fort Collins, CO

Industries/Businesses

Queenstake Gold Corp. - Elko, NV
Florida Canyon Mining Inc. - Imlay, NV
Barrick Gold Corporation - Toronto, Canada
Barrick Goldstrike Mine Inc. - Elko, NV
Cortez Gold Mine - Beowawe, NV
Coeur Rochester, Inc. - Lovelock, NV
Getchell Gold Company - Golconda, NV
Goldfield Mining Corp. - Golden, CO
Hecla Mining - Couer D'Alene, ID
Newmont Capital - Carlin, NV
Newmont Mining Corp., Lone Tree Complex - Valmy, NV
Newmont Mining Corp. - Carlin, NV
Newmont Gold Company - Reno, NV
Newmont Mining Corp. - Winnemucca, NV
Newmont Mining Corp. - Denver, CO
Newmont Gold Corp., Twin Creeks Mine - Golconda, NV
Echo Bay Minerals Company, McCoy Mine - Battle Mountain, NV
Phelps Dodge Corporation - Lincoln, MO
Nevada Gold Mining Inc., Sleeper Mine - Winnemucca, NV
Western States Mineral Corporation - Reno, NV
University of Nevada, Reno - Reno, Nevada
UNR, Mackey School of Mines - Reno, NV
UNR, Dept. Env. Resource Science - Reno, NV
Battle Mountain Bugle - Battle Mountain,
Elko Daily Free Press - Elko, NV

Humboldt Sun - Winnemucca, NV

Libraries

Elko County Library - Elko, NV
Eureka Branch Library - Eureka, NV
Humboldt County Library - Winnemucca, NV
Lander County Library - Battle Mountain, NV
Pershing County Library - Lovelock, NV
Colorado State University Libraries - Fort Collins, CO
University of Nevada Libraries - Reno, NV
McGill University - Montreal Quebec Canada

Individuals

Fred Leonard - Winnemucca, NV
Mark Baker - Washington, WA
Leah Brashear - Denio,NV
George Brown - Mead, WA
Robert Brown - Manteca, CA
Brian Buck - Sandy, Utah
Tony Damele - Carlin, NV
Donald and Suzanne Decker - Spring Creek, NV
Don and Eddyann Filippini - Battle Mountain, NV
Henry Filippini - Battle Mountain, NV
Jack Fullenwider - Golconda, NV
Corbin Harney - Battle Mountain, NV
Harvey and Charlotte Healy - Wells, NV
Douglas Miller - Carson City, NV
Jeanne King - Battle Mountain, NV
Florine Maine - Battle Mountain, NV
Kenneth Paulsen - Aravada, CO
Joseph A. Laravie - Spring Creek, NV
Gaylyn Springs - Valmy, NV
Debra Struhsacker - Reno, NV
Sharon Sweeney - Winnemucca, NV
Edward Syrjala - Centerville, MA
Greg Taylor - Battle Mountain, NV
Rachel Thomas - Huachuca City, AZ
Roger Johnson - Winnemucca, NV
Tina Nappe - Reno, NV
Deloyd Satterthwaite - Tuscarora, NV
Gregg Bush - Elko, NV
Eugene Haub - Elko, NV
Kenneth Cunningham - Reno, NV
Dave Parker - Reno, NV
Rebecca Sawyer - Battle Mountain, NV
Jacques Etchegoyhen - Minden, NV 89423
Susie Askew- Carson City, NV
Karen Boeger - Reno, NV
Tilman Jones - Austin, NV
Jay C. Winrod - Austin, NV
Joy K. Brandt - Austin, NV
Alan Yoshida - Reno, NV
Jay Callisto - Verdi, NV
Andrea Turman - Virginia City, NV
Joel Casburn - Zephyr Cove, NV
Mike Peterson - Republic, WA
Monica Antonovich - Reno, NV
James Eidel - Carson City, NV
Andy Schumacher - Elko, NV
Merlin McColm - Elko, NV
Gerry Emm - Silver Springs, NV
John Falen - Orovada, NV
Chuck Jeannes - Reno, NV
Dennis Gunn - Reno, NV
Todd Process - Reno, NV
B. Patsch - Reno, NV
Carrie Dann - Crescent Valley, NV
Vic Chevillon - Reno, NV
John and Ralph Bunch - Elko, NV
Mark Bradley - Reno, NV
Terry White - Reno, NV
John Uhalde - Reno, NV
Alan Hitchborn - Elko, NV
Dan Banghart - Elko, NV
Mark Blair - Elko, NV
Terry Munson - Elko, NV
Mark Bennett - Battle Mountain, NV
Mr. and Mrs. Richard Waldemar - Battle Mountain, NV
Cliff Stewart - Battle Mountain, NV
Charles McAllister - Winnemucca, NV
Mr. and Mrs. Ken Carson - Battle Mountain, NV
Ernest Paine - Yerington, NV
Bill Roullier - Reno, NV
Larie Trippet - Incline Village, NV
John Etchegaray - Eureka, NV
Shane Edgar - Battle Mountain, NV

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7.0 LIST OF PREPARERS AND REVIEWERS

7.1 Bureau of Land Management SEIS Team

Discipline	Name	BLM Office Location
Project Manager / NEPA / Air Quality / Social and Economic Values	Jeff Johnson	Winnemucca
Assistant Project Manager / Geology and Minerals	Chuck Johnson	Winnemucca
Project Coordinator	Fred Holzel	Winnemucca
Water Resources / Geochemistry	Craig Drake Tom Olsen	Winnemucca Reno
Soils / Vegetation Resources	Michael Zielinski	Winnemucca
Wildlife and Fisheries Resources / Special Status Species	Duane Crimmins	Battle Mountain
Range Resources	Scott Minnie	Battle Mountain
Land Use and Access	Ken Detweiler	Winnemucca
Recreation	Barb Keleher	Winnemucca
Aesthetics	Barb Keleher	Winnemucca
Hazardous Materials	Rod Herrick	Winnemucca
Cultural Resources / Ethnography / Paleontology	Regina Smith	Winnemucca

7.2 Nevada Division of Wildlife SEIS Cooperating Agency

Discipline	Name	Office Location
Mining Biologist	Rory Lamp	Elko

7.3 SRK SEIS Team

Discipline	Name	Degree(s) and Experience
Project Manager / Vegetation Resources / Range Resources / Special Status / Aesthetics	Gary N. Back	Ph.D. Wildlife Management, M.S. Forestry, B.S. Wildlife & Fisheries Management 25 years experience
Project Principal / Groundwater and Geochemistry / Closure / Geology and Minerals	Jeff Parshley, P.G.	B.A. Geology, Registered Professional Geologist: 21 years experience
Assistant Project Manager / Air Quality	Valerie Sawyer	B.S. Metallurgical Engineering 21 years experience
Groundwater and Geochemistry	Rob Bowell, P.G.	Ph.D. Geochemistry, Bachelor of Science, Geochemistry/Geology 15 years experience
Surface Water / Soils	Lyle Davis, P.E.	M.S., Agricultural Engineering, B.S., Agricultural Engineering 24 years experience
Water Resources / Closure	Maritz Rykaart	Ph.D Geo-environmental, M. Eng. Civil, B. Eng. Civil 9 years experience
Soils/Wildlife and Fisheries Resources / Land Use and Access / Recreation / Socioeconomics	Mark Willow	MS Environmental Science and Engineering, Bachelor of Science in Fisheries and Wildlife Management 15 years experience
Aesthetics (Visual Simulations)	Kristorfer Kvarfordt (Design Workshop)	BS Landscape Architecture 1 year experience
Aesthetics (Visual Simulations)	Dana Dapolito	BA English Literature 4 years experience
Aesthetics (Visual Simulations)	Deana Weber	MS Landscape Architecture, BS Landscape Architecture 9 years experience
Hazardous Materials	Steve Boyce, P.E.	Master of Business Administration, M.S. Civil Engineering, B.A. Civil Engineering 9 years experience
Cultural Resources	Robert Kautz (Kautz Environmental Consultants, Inc.)	Ph.D. Anthropology, B.A. Anthropology 27 years experience
Geology and Minerals / Paleontology	Amy Ott	M.S., Geology, B.S., Geology/Chemistry Minor 6 years experience

SRK SEIS Team (Continued)

Discipline	Name	Degree(s) and Experience
Ethnography / Native American Consultation	Ginny Bengston (SWCA Environmental Consultants, Inc.)	M.A. Applied Anthropology, B.A. Anthropology 12 years experience
AutoCAD / SEIS Maps	Brian Murphy (GMMC)	14 years experience
Document Production / Coordination	Tracey Rozelle	4 years experience

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8.0 GLOSSARY AND LIST OF ACRONYMS

8.1 Glossary

Acid Rock Drainage	Low pH drainage (pH of 2.0 to 4.5) resulting from oxidation of sulfides.
Adsorption-Desorption Recovery Processing Facility (ADR)	The portion of the heap leach facility where gold-bearing solution (pregnant solution) is put through activated carbon to remove the gold from solution. The carbon is then subjected to an acid wash to clean the carbon.
Allochthon	A tectonic process, such as thrust faulting.
Allochthonous	A term applied to a mass of rock that has been moved from its place of origin by tectonic processes (an allochthon), such as thrust faulting.
Alluvium	A general term for all detrital deposits resulting from the operations of modern rivers, including the sediments laid down in riverbeds, floodplains, lakes, and fans at the foot of mountain slopes and estuaries.
Ambient (air)	The surrounding atmospheric conditions.
Animal Unit Month	The amount of forage required to support one animal unit (e.g., cow-calf pair) for one month.
Aquifer	A stratum of permeable rock, sand, etc., which contains water. Water source for a well.
Archaeology	The science that investigates the history of peoples by the remains belonging to the earlier periods of their existence.
Artifact	Any object showing human workmanship or modification especially from a prehistoric or historic culture.
Attenuate	To lessen, decrease, reduce a concentration.
Clean Water Act	Federal Water Pollution Control Act, as amended.
Contrast	The effect of a striking difference in the form, line, color, or texture of an area being viewed.
Cultural Resources	Any site or artifact associated with cultural activities.
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 negligible impact, the combined effect can be significant. Included are activities of the past, present, and

	reasonably foreseeable future; synonymous with cumulative impacts.
Endangered Species	Any species in danger of extinction throughout all or a significant portion of its range. This definition excludes species of insects that the Secretary of the Interior determines to be pests and whose protection under the Endangered Species Act of 1973 would present an overwhelming and overriding risk to man.
Environment	The surrounding conditions, influences, or forces that affect or modify an organism or an ecological community and ultimately determine its form and survival.
Erosion	The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.
ET Basin	A facility designed to receive and hold fluids for passive treatment. The facility is generally filled with gravel to provide a large pore space volume and is overlain by growth media to promote plant growth. The fluids are removed by evapotranspiration.
Fault	A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.
Floodplain	That portion of a river valley, adjacent to the river channel, built of sediments and inundated with water at least once every 100 years.
Fugitive Dust	Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.
Geology	The science that relates to the earth, the rocks of which it is composed, and the changes that the earth has undergone or is undergoing.
Groundwater Table	The surface between the zone of saturation and the zone of aeration; that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.
Habitat	A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.
Heap Leach Pad	A lined facility where run-of-mine ore is stacked in lifts for application of sodium cyanide solution to remove the microscopic gold and other precious metals from the ore.
Historic context	Planning document that is used as a cultural resources management tool. It groups information about related important cultural resources based on a specific theme, geographic limits, and chronology with the purpose of

	providing subsequent identification and framework for evaluation of the eligibility or significance of resources located at a later time in the same area. Historic contexts aid in planning and evaluating future cultural research.
Hydraulic Conductivity	The rate at which a porous medium can transmit water (units of length/time).
Hydrology	The science that relates to the water of the earth.
Impact	A modification in the status of the environment brought about by the Proposed Action.
Intrusive rock	Igneous rock formed within surrounding rock as a result of magma intrusion.
Jurisdictional waters	Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
Key Observation Point	An observer position on a traveled route used to determine visible area.
Landform	A term used to describe the many types of land surfaces that exist as the result of geologic activity and weathering, e.g., plateaus, mountains, plains, and valleys.
Mil	1/1000-inch
Mineralization	Process by which minerals are introduced into a rock, resulting in an economically valuable or potentially valuable deposit.
Mitigation Measure	An action to cause an activity to become less severe or harmful; actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.
Noxious Weeds	A plant that interferes with the management objectives for a given area of land at a given point in time: any species of plant which is, or liable to be, detrimental or destructive and difficult to control or eradicate.
One-hundred-year flood	A flood with a magnitude that may occur once every 100 years. A one-in-100 chance of a certain area being inundated during any year.
Paleontology	The science that deals with the life of past geological ages through the study of the fossil remains of organisms.
Paleozoic	Span of time from end of Precambrian to beginning of Mesozoic ranging from about 570 million to 250 million years ago.

Particulate(s)	Minute, separate particles, such as dust or other air pollutants.
pH	The measure of acidity or basicity of a solution.
Physiographic province	Region in which all parts have similar geologic structure and climate and whose landforms differ significantly from those of other regions.
Project Area	The area in the immediate vicinity of the Marigold Mine Millennium Expansion Project.
Raptor	A bird of prey.
Region	A large tract of land generally recognized as having similar character types and physiographic types.
Right-of-way	Strip of land over which the powerline, access road, or maintenance road would pass.
Riparian area	A form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil.
Sedimentary rock	Rock resulting from consolidation of loose sediment that has accumulated in layers.
Seismicity	The likelihood of an area being subjected to earthquakes. The phenomenon of earth movements.
Species	A group of individuals of common ancestry that closely resemble each other structurally and physiologically and in nature interbreed producing fertile offspring.
Stratigraphy	Form, arrangement, geographic distribution, chronologic succession, classification, and relationships of rock strata.
Tectonics	Large-scale structural features of the upper part of the earth's crust.
Tertiary	Span of time between 65 and 3 to 2 million years ago.
Threatened species	Any species likely to become endangered within the foreseeable future throughout all or a significant part of its range.
Transmission line	An electric power line operating at a voltage of 69 kilovolts or greater.

Transmissivity	A measure of the amount of water that can be transmitted horizontally by a porous medium (expressed in terms of square feet per day).
Uplift	Structurally high area in the crust produced by an upthrust of rocks.
Visual Resource Management	Classification of landscapes according to the kinds of classes of structures and changes that are acceptable to meet established visual goals (BLM designation).
Waste Rock Storage Areas	An above ground facility for placing nongold-bearing rock that is removed from the pit to reach the gold-bearing rock (ore).
Wetlands	Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. BLM Manual 1737, Riparian-Wetland Area Management, includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas as wetlands.
Wind rose	A wind rose is a graphical representation of wind direction and wind speed frequencies.

8.2 Acronyms

µm	micrometers
$\mu g/m^3$	micrograms per cubic meter
ABA	acid-base accounting
ADR	adsorption-desorption recovery
AGP	acid generating potential
AIRFA	American Indian Religious Freedom Act of 1978
amsl	above mean sea level
ANFO	ammonium nitrate/fuel oil
ANP	acid neutralizing potential
APE	Area of Potential Effect
ARPA	Archaeological Resources Protection Act
AUM	animal unit month
BAPC	Bureau of Air Pollution Control
BATF	Bureau of Alcohol, Tobacco, and Firearms
BLM	Bureau of Land Management
BMP	Best Management Practices
BMRR	Bureau of Mining Regulation and Reclamation
BP	before present
BWPC	Bureau of Water Pollution Control
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
ET cover system	evapotranspiration cover system
ET basin	evapotranspiration basin
°F	degrees Fahrenheit
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act of 1976
fps	feet per second
GMMC	Glamis Marigold Mining Company
gpm	gallons per minute
HAP	hazardous air pollutant
HCI	Hydrologic Consultants, Inc.
HDPE	high density polyethylene
Hg^0	elemental metallic mercury
Hg^2	mercury
I-80	Interstate 80
KOP	Key Observation Point
Ma	million years ago

mcl	maximum contaminant level
mgd	million gallons per day
mg/l	milligrams per liter
MFP	Management Framework Plan
MMPA	Mining and Mineral Policy Act
mph	miles per hour
MOU	Memo of Understanding
MSDS	Material Safety Data Sheets
MSHA	Mine Safety and Health Administration
MSHAct	Mine Safety and Health Act
MWMP	Meteoric Water Mobility Procedure
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Grave Protection and Repatriation Act of 1990
NDEP	Nevada Division of Environmental Protection
NDOW	Nevada Division of Wildlife
NDWR	Nevada Division of Water Resources
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMC	Newmont Mining Corporation
NNHP	Nevada Natural Heritage Program
NNNPS	Northern Nevada Native Plant Society
NNP	net neutralizing potential
NOx	oxides of nitrogen
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NP	neutralizing potential
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSO	Nevada State Office
NSPS	New Source Performance Standards
ORV	off road vehicle
pH	Measure of acidity or basicity of a solution; Potential of Hydrogen
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
PMU	Population Management Unit
PoO	Plan of Operations
ppm	parts per million
PSD	Prevention of Significant Deterioration
ROW	right-of-way
SAAQS	State Ambient Air Quality Standards
SAR	sodium absorption ratio
SARA	Superfund Amendments and Reauthorization Act
SCORP	Nevada Statewide Comprehensive Outdoor Recreation Plan
SEIS	Supplemental EIS
SHPO	State Historic Preservation Officer
SO_2	sulfur dioxide
SPCCP	Spill Prevention, Control, and Countermeasures Plan

SPPP	Storm Water Pollution Prevention Plan
TCLP	Toxicity Characterization Leaching Procedure
TDOH	tailings impoundment monitor wells
TDS	total dissolved solids
T/kT	tons/kiloton
TPH	total petroleum hydrocarbons
tpy	tons per year
TSP	total suspended particulate
UBC	Uniform Building Code
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VRM	Visual Resource Management
WAD	weak acid dissociable
WMCI	Water Management Consultants, Inc.
WSA	Wilderness Study Area

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SPPP	Storm Water Pollution Prevention Plan
TCLP	Toxicity Characterization Leaching Procedure
TDOH	tailings impoundment monitor wells
TDS	total dissolved solids
T/kT	tons/kiloton
TPH	total petroleum hydrocarbons
tpy	tons per year
TSP	total suspended particulate
UBC	Uniform Building Code
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
VRM	Visual Resource Management
WAD	weak acid dissociable
WMCI	Water Management Consultants, Inc.
WSA	Wilderness Study Area

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10.0 INDEX

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APPENDIX A

GLAMIS MARIGOLD MINING COMPANY LODE AND MILLSITE CLAIMS

Table A-1
Mining Claims Summary

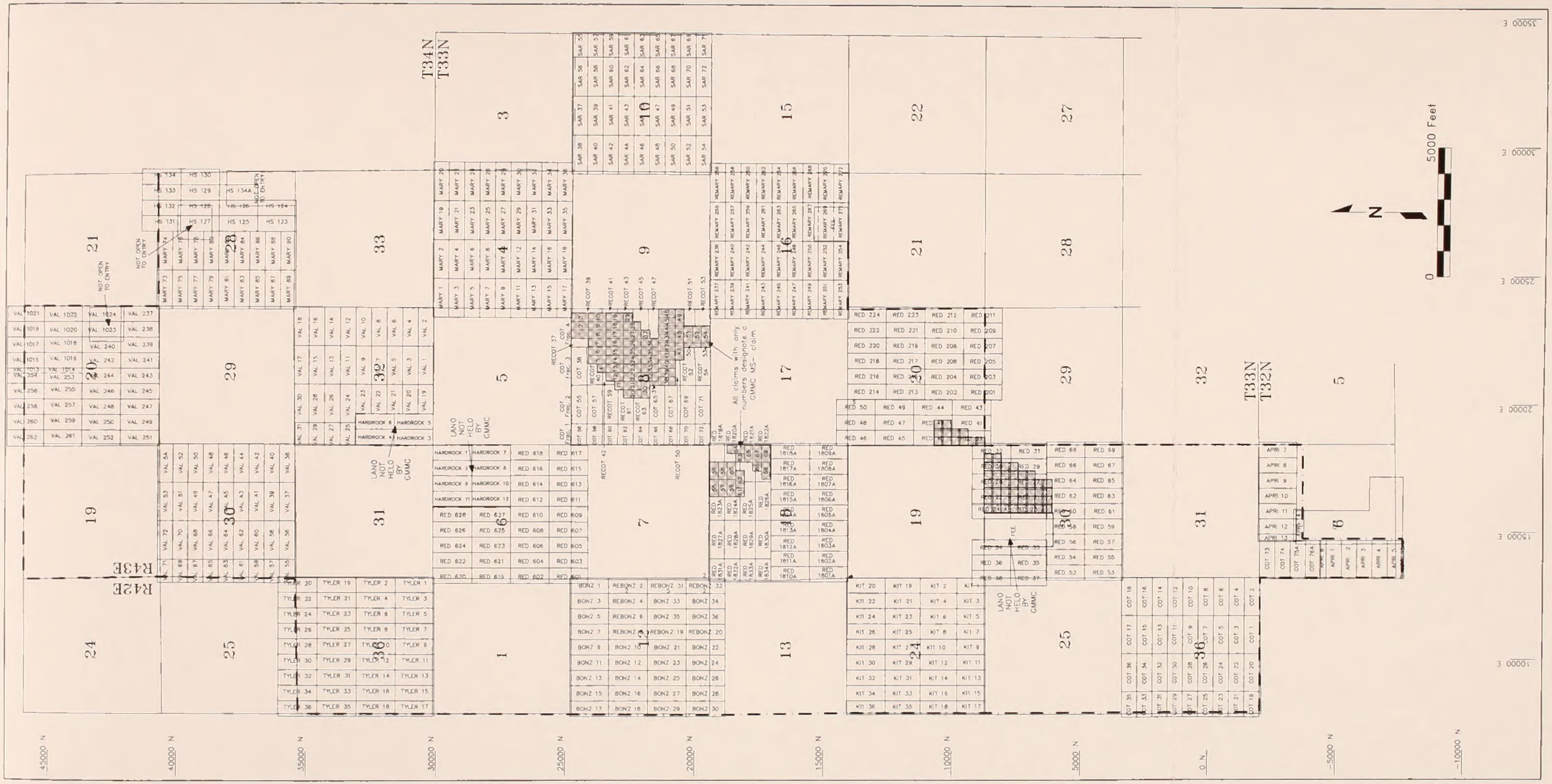
Name Of Claim	BLM Serial Number	Owner	Owned/ Leased	Location
Bonz 1 Bonz 3 Bonz 5 Bonz 7 Bonz 9-18 Bonz 21-30 Rebonz 2 Rebonz 4 Rebonz 6 Rebonz 8 Rebonz 19-20 Rebonz 31 Rebonz 32	371610 371612 371614 371616 371618- 371627 371630- 371639 487422 487423 487424 487425 487426- 487427 487428 524363	Roby Exploration Company	Owned	T33N, R42E, Sec. 12
Mary 1-36[7]	358968- 359003	Roby Exploration Company	Owned	T33N, R43E, Sec. 4
Mary 73-90 HS 123-134, 134A	359040- 359057 400277- 400289	Roby Exploration Company	Owned	T34N, R43E, Sec. 28
Private	N/A	Newmont Gold Corporation	Leased	T33N, R43E, Sec. 5, 6, 7, 13, 25, 31
Private	N/A	Newmont Gold Corporation	Leased	T34N, R43E, Sec. 13, 29, 31, 33
Recot 37[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 38[1]	275733	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 39–43[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 45[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 47[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 50–54[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 55–58[1]	275750 – 275753	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 59[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 60[1]	275755	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 61[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 62[1]	275757	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 63A	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Recot 63[1]	NMC822614 - 822630	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot 64–72[1]	275759 – 275767	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Cot Fractions 1–9	361164 – 361172	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8

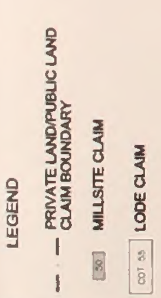
Table A-1 (Continued)

Name Of Claim	BLM Serial Number	Owner	Owned/ Leased	Location
Cot 73-76 Cot 75A-76A	3420680 37420671 3715590 371560	VEK Andrus Associates	Leased	T32N, R43E, Sec. 6
Cot 1-36	271972- 272007	VEK/Andrus Associates	Leased	T33N, R42E, Sec. 36
Private	N/A	Roby Exploration Company	Owned	T33N, R43E, Sec. 9
Remary 237-272 Remary Fraction	454876- 454911 552228	Roby Exploration Company	Owned	T33N, R43E, Sec. 16
Private	N/A	Roby Exploration Company	Owned	T33N, R43E, Sec. 17
Red 1801A-1834A[1]	678030- 678063	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 18
Private	N/A	University of Nevada, Reno	Leased	T33N, R43E, Sec. 19
Red 39-50[1] Red 201-224[1]	56187-56198 271665- 271668	Donald Decker and Suzanne Decker	Leased	T33N,R43E, Sec. 20
Red 21-38 Red 52-69 Red 23A and 24A	48409-48426 56199-56216 552226- 552227	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 30
Red 601-628	271689- 271716	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 6
Kit 1-36	365642- 365677	Donald Decker and Suzanne Decker	Leased	T33N, R42E, Sec. 24
GMMCMS 55-69[2]	NMC822621- 822645	Donald Decker and Suzanne Decker	Leased	T33N, R43E, Sec. 18
GMMCMS 1-54[2]	NMC822560- 822613	VEK/Andrus Associates	Leased	T33N, R43E, Sec. 8
Private	N/A	Roby Exploration Company	Newmont Owned	T33N, R43E, Sec. 31
Apri 1-13 Apri 14 Apri 15	371561- 371573 519580 552229	Roby Exploration Company	Owned	T32N, R43E, Sec. 6
Val 37-72	297572- 297607	VEK/Andrus Associates	Leased	T34N, R43E, Sec. 30
Val 237-262 Val 1013-1024	361136- 361161 600391- 600402	Roby Exploration Company	Owned	T34N, R43E, Sec. 20
Val 1-18 Val 19-31	297554- 297571 347463- 347475	VEK/Andrus Associates	Leased	T34N, R43E, Sec. 32
SAR 37-72	373649- 373684	Euro-Nevada Mining Corporation, Inc.	Leased	T33N, R43E, Sec. 10
Tyler 1-36	371574- 371609	Roby Exploration Company	Owned	T34N, R42E, Sec. 36

[1]Lode claims included in the comparison of the millsite to lode claim ratio (1:1) for existing and proposed operations. All of the lode claims within a lode claim grouping may not be included in this comparison.
[2]Millsite claims.

N/A = Not applicable.





Millennium Expansion Project

Figure A-1

Mining Claims Map

APPENDIX B

BLM'S HEAP LEACH CLOSURE POLICY AND GUIDELINES

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

Nevada State Office
P.O. Box 12000
Reno, Nevada 89520-0006

IN REPLY REFER TO:
3000 (NV-920) P

August 3, 2000

EMS Transmission 8/03/00
Instruction Memorandum No. NV-2000-066
Expires 9/30/2001

To: Field Managers, Nevada
Deputy State Directors and Staff Chiefs, NSO

From: Associate State Director, Nevada

Subject: Nevada Bureau of Land Management's Reclamation/Closure Policy for Water Management for Hardrock Mining Activities

ISSUE: A number of mining operations that were originally permitted in the 1980's have or are preparing to cease mining operations. Several Bureau of Land Management (BLM) field offices have raised issues concerning closure or final reclamation procedures under the Surface Management Regulations (43 CFR 3809) for these operations. The issues range from the adequacy of the original National Environmental Policy Act (NEPA) compliance documentation to specific technical issues such as land application of heap drain down.

Under the guidance of the Nevada BLM State Leadership Team, a task force was formed to address these issues, including formulate policy and develop a guidance document. Make up of the task force included field and state office specialists and managers.

The policy and guidance document was prepared in coordination with the Federal and State regulatory and land managing agencies. In addition, input was solicited from interest groups, including mining interests and environmental groups.

POLICY: It is the policy of the Nevada BLM that reclamation, including closure, of hardrock mining operations be conducted and completed in a proper manner to ensure the protection of the public lands under BLM jurisdiction. It is the responsibility of the BLM to protect the long-term health of the public lands. Authorization to allow the release of contaminated waters into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Nevada Groundwater Protection Act, Endangered Species Act, other applicable environmental laws, and consistent with BLM's multiple use

and resource protection responsibilities under the Federal Land Policy and Management Act (FLPMA).

It is the policy of the Nevada BLM that all modifications to an approved Plan of Operations regarding closure will be reviewed and approved by the authorized officer under 43 CFR 3809. Any Federal decision to approve a modification to an approved Plan of Operations, including changes to the closure plan, must be in compliance with the requirements of NEPA.

It is the policy of the Nevada BLM to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities. Where appropriate, the BLM will utilize the State environmental regulatory requirements, guidance and standards as the base for its analyses and reviews. The BLM recognizes the State's authority under the Clean Water Act, Safe Drinking Water Act, and Nevada Groundwater Protection Act and in carrying out its responsibilities under FLPMA will rely on the State's decisions pursuant to that authority.

IMPLEMENTATION: The "Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities - Management of Heap Leach Effluents -" (attached) is intended as a guide in meeting the requirements of this policy. Specifically the attached document provides guidance to the BLM in meeting its responsibilities to ensure the evaluation and analysis of potential impacts to surface waters, groundwaters and unsaturated zones. The appropriateness of the individual discussions will depend on the issues being addressed and the decisions being made.

CONTACT PERSON: Questions concerning this policy and the attached guidance document should be directed to Dr. Tom Olsen, BLM Nevada State Office, Division of Minerals Management at 775-861-6451.

Signed by: Jean Rivers-Council Associate State Director	Authenticated by: Pam Collins Staff Assistant

1 Attachment

1 - Nevada Bureau of Land Management's Guidance for Hardrock Mining Reclamation/Closure Activities - Management of Heap Leach Effluents (15 pp)

Nevada Bureau of Land Management's
Guidance for Hardrock Mining Reclamation/Closure Activities
- Management of Heap Leach Effluents -

INTRODUCTION

The Bureau of Land Management (BLM) is responsible for management of public lands and resources for present and future generations under our statutory mandates. BLM is committed to close coordination and working through State and local regulators and their statutory primacy requirements to meet our Federal statutory and resource management objectives. BLM has the responsibility to ensure reclamation, including closure, of hardrock mining operations on BLM-administered lands is conducted and does not result in unnecessary or undue degradation of the public lands. This responsibility includes understanding technical issues associated with the closure of hardrock mining operations and making informed decisions. This guidance document is intended to facilitate Nevada BLM field offices in carrying out their responsibilities, ensuring coordination with the appropriate State regulatory agencies.

There are four main topics covered in this guidance document.

- When faced with hardrock mining reclamation, including closure, the authorized officer must ensure decisions will not result in unnecessary or undue degradation of the public lands. All actions must comply with the appropriate federal and state laws, and consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act (FLPMA).

- Reclamation decisions need to be coordinated and made in collaboration with the State regulatory agencies responsible for the permitting and oversight of mine reclamation, including closure activities.

- The BLM must ensure that adequate financial guarantees are in-place for mining operations on public lands which will include reasonably foreseeable reclamation costs, including closure and monitoring, on BLM-administered lands.

- The BLM field specialists and managers need to understand and consider all the technical issues associated with hardrock mine reclamation, including closure activities and the long-term implications of closure, while ensuring that reclamation, including closure activities, is conducted in a timely and effective manner.

Specific technical issues addressed in this guide are disposal and monitoring of heap detoxification waters, heap drain-down waters and process pond sludge.

CLOSURE

In this guidance document, the term "closure" refers to the act of closing any phase of a mining operation where further operations are not intended. It is the final step of reclamation in closing down a mining operation or any phase of an operation.

It is important to be aware of the different usage of the term "closure" by the Nevada Division of Environmental Protection (NDEP), Bureau of Mining Regulation and Reclamation (BMRR). As used by BMRR, closure is when chemical stabilization of a mine site has been achieved after mining activity ceases. State closure requirements primarily deal with stabilization of process and non-process components, solid and liquid process mine waste, pits, waste rock dumps, ore stockpiles, and any other associated mine components that, if not properly managed during operation and closure, could potentially lead to the degradation of the environment.

AUTHORITY, ANALYSES AND DECISIONS

All surface management activities, including reclamation, must comply with all pertinent Federal laws and regulations, and all applicable State environmental laws and regulations. The fundamental requirement, implemented in 43 CFR 3809, is that all hardrock mining under Plan of Operations or Notice on the public lands must prevent unnecessary or undue degradation. The Plan of Operations and any modifications to the approved Plan of Operations must meet the requirement to prevent unnecessary or undue degradation. Authorization to allow the release of effluents into the environment must be in compliance with the Clean Water Act, Safe Drinking Water Act, Endangered Species Act, other applicable Federal and State environmental laws, consistent with BLM's multiple use responsibilities under the Federal Land Policy and Management Act and fully reviewed in the appropriate National Environmental Policy Act (NEPA) document.

The BLM should ensure reclamation issues, including closure, are adequately addressed as part of the initial Plan of Operations. However, it needs to be recognized that proposed reclamation activities found in the original Plan of Operations are subject to change and are likely to change. With mine development, more detailed hydrologic, geologic and chemical information and actual monitoring data becomes available that may warrant changes to the reclamation, including closure activities, described in the approved Plan of Operations. Where the operator proposes or the BLM requires modification to the proposed reclamation activities, including closure, the Plan of Operations must be modified.

The authorized officer is responsible for ensuring modifications to approved Plans of Operations, including mine closure decisions, are properly reviewed prior to approval. In assessing the need for additional NEPA documentation, the authorized officer should consider the significance of the proposed modification and the adequacy of the original NEPA documentation. Any Federal decision to approve a modification to an approved Plan of Operations must be in compliance with

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The BLM should ensure reclamation issues, including closure, are adequately addressed as part of the initial Plan of Operations. However, it needs to be recognized that proposed reclamation activities found in the original Plan of Operations are subject to change and are likely to change. With mine development, more detailed hydrologic, geologic and chemical information and actual monitoring data becomes available that may warrant changes to the reclamation, including closure activities, described in the approved Plan of Operations. Where the operator proposes or the BLM requires modification to the proposed reclamation activities, including closure, the Plan of Operations must be modified.

The authorized officer is responsible for ensuring modifications to approved Plans of Operations, including mine closure decisions, are properly reviewed prior to approval. In assessing the need for additional NEPA documentation, the authorized officer should consider the significance of the proposed modification and the adequacy of the original NEPA documentation. Any Federal decision to approve a modification to an approved Plan of Operations must be in compliance with the requirements of NEPA. If the modification involves actions that have been evaluated under previous NEPA review, the authorized officer may issue a Documentation of Land Use Plan Conformance and NEPA Adequacy (DNA).

The following actions will usually be considered a significant modification of an approved Plan of Operations. These actions will be analyzed in an appropriate NEPA document.

- The proposed modification involves disturbance or use of public land not covered in an approved Plan of Operations.
- The proposed modification is not fully covered in an existing NEPA document.
- The proposed modification has potential impacts not identified and analyzed during approval of the original Plan of Operations or subsequent modifications.

Any required NEPA document needs to consider the potential environmental impacts of the proposed modification, including impacts to resources associated with the unsaturated zone. For the purpose of this guidance document, the unsaturated zone is the portion of the earth immediately below the land surface and above the water table. Within this zone the pores contain both water and air, but are not totally saturated with water. If a mine closure plan proposes discharge of fluids then zero-discharge and fluid treatment alternatives must be considered in the NEPA document. Environmental analyses will be conducted according to BLM's NEPA guidelines contained in H-1790-1.

COORDINATION

Early, consistent cooperation and participation by all Federal, State, local and Tribal entities with review and approval responsibilities for hardrock mining, including closure decisions, is likely the single most effective way to reduce costs and delays in the current approval process. For hardrock mining on public lands, the BLM is the lead agency and land manager, and as such needs to take the responsibility to ensure the appropriate coordination takes place with all parties. In addition to the need to coordinate with other governmental entities, the BLM needs to ensure it meets its obligations under NEPA to provide the public an opportunity to review and comment on decisions affecting public lands.

The Nevada BLM is specifically committed to coordinate and collaborate to the fullest extent practical with the State regulatory agencies responsible for the permitting and oversight of mine reclamation and closure activities. To aid in the coordination with the State regulatory agencies, BLM personnel need to understand the State permit requirements and approval process. When there is disagreement that cannot be resolved by the BLM field office and the BMRR, the issue

should be forwarded to the State Director through the Deputy State Director, Mineral Resources at the Nevada State Office for resolution.

Bureau of Mining Regulation and Reclamation

In Nevada, the State regulatory agency with primary responsibility for closure decisions is BMRR. For mine closure, BMRR requires the operator to submit several major documents for review and approval. Discussed below are the four BMRR documents required for mine closure: Tentative Permanent Closure Plan, Final Permanent Closure Plan, and Final Closure Report and Request for Final Closure. The description of these documents is intended to aid the BLM's understanding BMRR's closure process and to facilitate BLM in its commitment to coordinate with the State agencies on mine reclamation and closure issues.

Tentative Permanent Closure Plan - Reclamation, including closure, of a mine site is addressed in the Plan of Operations approved by the BLM. At the same time the Tentative Permanent Closure Plan is submitted to the BMRR as part of the Water Pollution Control Permit approval process. BLM and BMRR coordination on the Tentative Permanent Closure Plan should occur as part of the review and approval of the original Plan of Operations and Water Pollution Control Permit. However as these plans are submitted as part of the original mine approval, it may not reflect the reclamation options when a mine nears actual closure. Closure activities being proposed by the operator may represent a modification from what was originally approved. If the proposed closure method is not in the approved Plan of Operations, then the Plan of Operations must be modified.

Final Permanent Closure Plan - The operator is required to submit a Final Permanent Closure Plan to the BMRR two years prior to the anticipated closure of the mine site. (However, it should be noted that Final Permanent Closure Plans are not always submitted two years prior to closure as required.) In order to expedite the NEPA and State permitting processes, the operator should concurrently submit the Final Permanent Closure Plans to BMRR and any proposed modifications to the Plan of Operations to the BLM. Ideally, the process should flow as follows:

- Operator submits a Final Permanent Closure Plan to BMRR and appropriate modifications to the Plan of Operations to BLM.
- BLM, in coordination with BMRR, compares the Final Permanent Closure. Plan/Modification to the Plan of Operations with the approved Plan of Operations to determine whether the modifications are significant, and whether the modifications have been reviewed under previous NEPA analysis.

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- Operator submits a Final Permanent Closure Plan to BMRR and appropriate modifications to the Plan of Operations to BLM.

- BLM, in coordination with BMRR, compares the Final Permanent Closure Plan/modification to the Plan of Operations with the approved Plan of Operations to determine whether the modifications are significant, and whether the modifications have been analyzed under previous NEPA analysis.

- If BLM determines new NEPA documentation is necessary, the BLM will coordinate with BMRR and the operator on project-specific issues, including schedules for review and approval of the plans.

- BLM assessment of potential impacts, including resources associated with the unsaturated zone, should occur at the same time as BMRR is reviewing water quality impacts.

- BLM prepares the appropriate NEPA documentation.

- If required, BLM and BMRR should coordinate public review of the NEPA document and modification to the Water Pollution Control Permit.

To meet BMRR's requirement, the Final Permanent Closure Plan provides closure goals and a detailed methodology of activities necessary to achieve a level of stabilization of all known and potential contaminants at the site. The Final Permanent Closure Plan also includes a detailed description of all proposed monitoring that will be conducted to demonstrate how the closure goals are being met. The operator must receive BMRR approval for the Final Permanent Closure Plan before initiating action. Activities including reshaping and regrading, covering, placing growth medium, applying soil amendments, and revegetation are in many cases major components of the site stabilization and closure process, and will be described or referenced as part of the Final Permanent Closure Plan.

It is in the operator's interest to review and amend the reclamation plan and bond cost calculations as general closure plans become more specific. Failure to properly document closure and reclamation activities may result in additional operator expenditures or project delays.

Final Closure Report/Post-Closure Monitoring - Following the completion of all closure related activities, a Final Closure Report is submitted to the BMRR that summarizes all completed closure related activities. This document should also be concurrently submitted to the BLM. Upon approval of the Final Closure Report, the mine site is considered to be in the "post-closure" period. The Request for Final Closure is made following the completion of the post-closure monitoring period. For BMRR purposes, this period lasts anywhere from five to a maximum of 30 years. The post-closure monitoring period is intended to validate the operators contention that those closure activities completed have indeed stabilized and verify no undue degradation of waters of the State. The request contains all pertinent post-closure monitoring information and clearly demonstrates stabilization. BLM 's post-reclamation responsibilities are defined on a case-by-case basis in the approved plan of operations. As such, the time frames used by BMRR may not be relevant or appropriate to the BLM requirements.

Coordinated Review of Technical Issues

The BLM will cooperatively review and approve methodology and technology necessary to ensure adequate evaluation of water quality issues with BMRR. The agencies should concur on data adequacy and conclusions at the earliest possible time. Where appropriate, the BLM will utilize the State environmental regulatory requirements, guidance, standards and testing methods as the basis for its analyses and reviews. This includes deferring to the State BMRR and U.S. Environmental Protection Agency (EPA) decisions pursuant to their authority under the Clean Water Act, Safe Drinking Water Act, Resource Conservation and Recovery Act, and other applicable Federal and State environmental laws where appropriate. For your reference, attached is an EPA information sheet identifying federal requirements affecting groundwater discharge. Except for point source discharges to waters of the U.S., currently there are no numeric Federal standards for permitting discharges into the environment as part of mine closure. The overriding BLM standard is found in the 43 CFR 3809 regulations, specifically the requirement to prevent unnecessary or undue degradation.

TECHNICAL ISSUES

This section of the guidance covers three technical issues: disposal of heap detoxification waters, disposal of heap drain-down waters, and disposal of process pond sludge. Each issue discussion contains methods and technical alternatives that should be evaluated under best management practices for water and sludge disposal.

General Disposal Criteria - The general criteria for review and decisions regarding disposal are:

- Compliance with all applicable Federal and State Laws
- Reduction and minimization of environmental harmful constituents
- Utilization of a risk management approach, if necessary, to address any remaining constituents or concerns.

Disposal of Heap Detoxification and Heap Drain-Down Waters - The following methods for the disposal of heap detoxification and heap drain-down waters should be evaluated in the Plan of Operations and NEPA document:

- Land application by infiltration, leach field, or injection of treated water
- Land application by infiltration, leach field, or injection of untreated water
- Evaporation (zero discharge)

The following information needs to be collected and evaluated for any proposed method of disposal:

- The locations for the proposed disposal
- Volume of disposal solutions
- Predicted drain-down analysis

In addition, the following information needs to be collected and evaluated for proposed land application methods of disposal:

- Chemical characteristics of the solution to be disposed
- Survey of surface waters (locations of streams, springs, lakes, wetlands)
- Depth of the shallowest water table or ground water aquifer
- Hydrogeological characteristics of the disposal area
- Ground water quality
- Soils and subsurface lithology, including attenuation analysis
- Vegetative survey
- Ecological survey

These analyses would include, but not be limited to, state-required analyses for potential degradation of waters of the State.

When disposing of detoxification and heap drain-down waters utilizing land disposal of any type, the soils and sediments in the subsurface need to be tested for metal content. The test methods for metal content in earth materials should conform to those identified in EPA/SW-846 or ASTM.

Disposal of Process Pond Sludge - Process pond sludge must be tested to determine metal content, pH, and water content prior to evaluating disposal alternatives. The test method utilized to test the sludge should be identified in either EPA/SW-846 or ASTM. In addition, the sludge should be dried to the greatest extent possible before disposal takes place, this can be completed by evaporating the water out of the sludge.

Ways to dispose of sludge:

- Dry the sludge and bury it on-site.
- Treat the sludge and bury it on-site.
- Remove the sludge to an off site facility.

If sludge(s) are disposed of on-site through burial, an appropriate cover and capping system must be designed to:

- Provide optimum evaporation.
- Provide optimum surface water run-off and routing.
- Provide in-place physical stabilization.
- Provide optimum evaporation (use of soil materials, vegetation, engineering design, etc.).
- Minimize infiltration through sludge burial system with geosynthetic liners.

Risk Management - A risk management approach may be initiated when all reasonable technologies have been used to reduce environmentally harmful constituents that may reside in soils, drain-down waters, effluents, and sludge.

When contaminants of concern are identified in either residual waters, soils or sludges during reclamation, and that material is being proposed for land application, a risk-based management process can be utilized if appropriate. The risk management process that must be used is outlined in the Environmental Protection Agency Guidance for Risk Assessment, as well as, other guidance referenced in this policy, such as BLM Management Criteria for Metals at BLM Mining Sites, Technical Note 390, 1996, revised 1999.

The following steps outline the EPA guidance and should be accomplished:

- Identify the type of contaminant(s) present and the threat posed to both human and ecological resources.
- Assess, through screening the waters, soils, and sludges to determine if site-specific contaminant levels are exceeding State, Federal and other appropriate standards.

- If contaminants exceed State, Federal, or other appropriate standards then conduct a risk assessment to determine the associated risk to human and ecological resources.

- The risk assessment will determine land application suitability and any additional treatment, redesign, mitigation necessary to ensure human and ecological health and safety.

- The risk assessment process will allow the BLM to make an informed decision on land application proposals with regard to reclamation plans.

BLM managers should adhere to the principles listed below when making human and ecological risk management decisions:

- The goal is to reduce human and ecological risks to levels that will result in the health and maintenance of the land for multiple use objectives.

- Use site specific human and ecological risk data to make informed decisions.

- Characterize the site risks.

- Communicate the risks to the public.

- Remediate and mitigate unacceptable human and ecological risk.

Monitoring Water Disposal in the Unsaturated and Saturated Zones - When land application is utilized to discharge and dispose of process and drain-down waters through an engineered system, the performance of the system must be monitored. The monitoring can be conducted by a monitoring point or series of monitoring points, specifically wells, piezometers and lysimeters.

The piezometers and lysimeters should be located within the soil or unsaturated lithology zone to collect any discharge and monitor the discharge process for unsaturated zone characteristics. The piezometers and lysimeters should be placed at varying depths and distances around and away from the engineered system.

The well(s) should be located in the saturated zone (water table or aquifer), down-gradient of the engineered system, and have enough coverage to account for both horizontal and vertical spatial movement of contaminants. The well(s) should also be located to show system or natural

conditions down-gradient from the discharge point(s) in distance increments. To observe the performance of the engineered system and confirm efficiency or effectiveness, wells should be placed at incremental distances down-gradient from the discharge point(s).

FINANCIAL GUARANTEES

Adequate financial guarantees have long been recognized as an essential component of the BLM's effort to ensure the protection of the public lands. Specifically, financial guarantees are needed when an operator is unable or unwilling to perform reclamation, including closure activities, and other obligations. Existing guidance, *Nevada BLM Bonding Process for Plans of Operations Authorized by 43 CFR 3802/3809,* details the procedures for calculating, establishing and releasing financial guarantees.

For the BLM, closure does not occur until all obligations have been met. As such, the BLM must require some form of a financial guarantee to cover any long-term obligation, including maintenance of long-term water treatment systems and monitoring, that is identified in the approved Plan of Operations. Final release of the financial guarantee may not occur until all reclamation, including closure requirements, are met. These requirements include the need to maintain a financial guarantee until the operator can demonstrate the ability to discharge any residual effluents into the environment to meet standards approved in the Plan of Operations. BLM has the option of considering a separate financial instrument other than the reclamation bond, specific to long-term closure, water and effluent management or monitoring requirements if agreed to with the operator. The Plan of Operations and associated bond must cover maintenance and monitoring of all fluid disposal systems.

REFERENCES

Soil testing: American Society for Testing and Materials (ASTM), Testing Methods for Earth Materials

Environmental Protection Agency (EPA)/SW-846, Test Methods

ASTM, Guide to Site Characterization for Environmental Purposes with Emphasis on Soil, Rock, and Vadose Zone and Ground Water, D5730, 1997.

Risk Assessment: EPA/625/4-89/024, Risk Assessment, Management and Communication of Drinking Water Contamination, EPA, Office of Research and Development (ORD), June 1990.

ASTM, STP 1218, Environmental Toxicology and Risk Assessment, third volume, 1995.

EPA 540/R-97/006, Ecological Risk Assessment Guidance.

EPA Guidance to Human Health Evaluation Manual, 1991.

EPA 540/1-89/002, Risk Assessment Guidance for Super fund.

Comprehensive, Environmental Response, Compensation and Liability Act (CERCLA) Baseline Risk Assessment: Reference Manual, 1995.

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Risks Posed by Bevill Wastes, EPA, 1997.

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	EPA/600/2-91/002, Compilation of Information on Alternative Barriers for Liners and Cover Systems, 1990.
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	Vadose Zone Monitoring for Hazardous Waste Sites, Everett, Wilson, and Hoylman, Noyes Data Corporation, 1984, 251 p.
Sludges:	EPA/540/288/004, Technology Screening Guide for Treatment of CERCLA Soils and Sludges, 1988.
	Estimation of Infiltration Rate in the 1998. Vadose Zone: Compilation of Simple Mathematical Models, Volume I, EPA/600/R-97/128a.
	Estimation of Infilration Rate in the 1998. Vadose Zone: Application of Selected Mathematical Models, Volume II, EPA/600/R-97/128b.

EPA Information Sheet

The purpose of this information sheet is to summarize Federal requirements affecting groundwater discharges in Nevada. The information sheet is arranged as a series of questions and answers.

1. What Defines an Underground Source of Drinking Water?

The Safe Drinking Water Act defines an Underground Source of Drinking Water (USDW) as and ground water containing 10,000 parts per million (ppm) or less total dissolved solid (TDS). However, EPA or a state can determine that water with less than 10,000 ppm TDS is exempted as an underground source of drinking water because of the factors such as: 1) whether or not it is currently a source of drinking water, 2) the economic and technical feasibility of extracting the water, 3) water quality of the aquifer (is it contaminated already, TDS too high to treat most effectively, or minerals or hydrocarbons naturally occur), or 4) subsidence or collapse likely is likely.

2. Is there Federal authority to protect an Underground Source of Drinking Water?

The Federal Safe Drinking Water Act (SDWA) Section 1431 gives EPA the authority to protect underground sources of drinking water. SDWA Section 1431 states that EPA can stop any activity which may cause an imminent and substantial endangerment to an underground source of drinking water.

3. Does the Underground Injection Control Program Apply to the Groundwater Infiltration Basin or Leach Field?

The Underground Injection Control (UIC) program was established under the Safe Drinking Water Act to protect ground water supplies. UIC program regulates the subsurface injection of waste fluids below, into and above underground sources of drinking water. Injection includes seeping, flowing, leaching and pumping with or without pressure. An injection well is a bored, drilled or driven shaft whose depth is greater than the largest surface dimension; or, a dug hole whose depth is greater than the largest surface dimension; or, an improved sinkhole; or subsurface fluid distribution system (an assemblage of perforated pipes, drain tiles, or other similar mechanisms intended to distribute fluids below the surface of the ground). These are the new rules, effective April, 2000. Nevada regulations currently do not include the subsurface fluid distribution system part, although leach fields, per NDEA policy, are considered injection wells.

The federal regulations are located at 40 CFR Part 144-147. There are five well classes:

- Class I: Deep wells injecting below the lowermost USDW. Permit required.
- Class II: Wells used for oil and gas production. Permit required.
- Class III: Wells which inject fluids used mineral extraction. Permit required.
- Class IV: Wells which inject hazardous or radioactive waste into or above a USDW. Prohibited except as a part of a CERCLA or RCRA clean-up action.
- Class V: Shallow wells that discharge into or above a USDW. These wells are currently authorized by real, however all wells must 1) be inventoried and 2) cannot endanger a USDW. examples of Class V wells: dry wells collecting surface water runoff, automotive disposal wells, and septic tanks which accept industrial waste. A new Class V Rule was promulgated in December 1999, but only affects cesspools and automotive waste disposal wells. This rule added the new definition, and ties these well types to SWAP areas and sensitive ground water protection areas.

Percolation ponds are not covered by the federal UTC program because they do not fit the definition of injection well. Leach fields for drainage from a closed heap leach facility are currently not regulated under any of the five classes in the UIC program. However a facility would be covered under SDWA 1421 if it is endangering an underground source of drinking water.

What will EPA look for in NEPA reviews for Closing Gold Heap Leach Facilities?

Post-closure toxins mobility and acid generation may remain a problem for years the heap and subsequently in the heap drainage going out to an underground leach field. Some of the questions to ask when evaluating the chemical constituents of the water that will be discharged are:

- Look at the sulfide content of ore and spent ore. How was the geochemistry done? Were static or kinetic tests conducted?

- What are the performance standards for closure? What would be the requirements if the heap leach pile drainage were placed in percolation ponds if it is toxic?

- What is the geochemistry, structure, and hyrogeology of the substrate/rock under the heap leach pile drainage leach field?

- What is the fate and transport capability of each contaminant in the drainage water?

- What is the chemical composition of the solution remaining in the heap leach pile after the rinsing process to get below 0.2 mg/l CN in the residual solution? Will metals and other harmful contaminants become more concentrated in heaps over time?

Over what period of time will salts in the heap leach pile be discharged to the leach field? How does the chemical composition of heap leach pile drainage vary over time? Do salts and metals accumulate in perc ponds and move down through substrate in increasing amounts?

Look at heap cover design, vegetation, and climatic factors. Does it preclude meteoric water from moving down through closed heap?

Look at the success criteria for reclamation/revegetation. How will integrity of cover be maintained?

Should lime or other neautralizing agent be added to heap cover to neutralize meteoric water?

What is the monitoring program for closure and post-closure leach field discharges to enable close tracking of water chemistry of changes and to evaluate the need for interventions?

Closure monitoring should continue through at least one rest period (or dry season) and wet season after the water meets all standards to check for upward trends or spikes in contaminant concentrations.

Are the leach fields going to receive heap leach pile drainage forever, or is there some period after which the leach fields will not longer be necessary?

Have runon/runoff controls for closed heap piles been evaluated to reduce the infiltration of water into heap and erosion of cover?

Are there contingency plans for large storm events, catastrophic failures of heaps infilitration rates too slow, etc.?

Will post-closure passive or active maintenance be needed?

Are there bonds for closure, reclamation, and post-closure activities for the heap leach piles and the heap leach pile drainage leach field?

Does closure meet post-mining land uses?

Where are drinking water wells, agricultural wells, and surface water bodies in the project vicinity? How could seepage from the project affect these wells and water bodies?

Will seasonal changes affect the heap each drainage capacity or effectiveness?

How are the closed facilities treated by regulatory agencies? Are they industrial facilities?

APPENDIX C

WATER RESOURCES AND GEOCHEMISTRY SUPPLEMENTAL DATA

Table C-1: Millennium ABA Summary

Samples with No Pyritic Sulfur

Sample Number	Pit	Acid Base Potential (ABP) TCaCO3	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	ANP/AGP Ratio	pH Paste	Non-extractable Sulfur	Pyritic Sulfur	Sulfate Sulfur	Total Sulfur
3	Basalt	3.1	<0.3	3.1	10.3 : 1	8.15	<0.01%	0.01%	0.05%	0.05%
4	Basalt	3.6	<0.3	3.6	12 : 1	8.6	<0.01%	0.01%	0.04%	0.04%
5	Basalt	2.6	<0.3	2.6	8.6 : 1	7.72	<0.01%	<0.01%	<0.01%	<0.01%
7	Basalt	246	<0.3	246	820 : 1	8.63	<0.01%	<0.01%	<0.01%	<0.01%
8	Basalt	271	<0.3	271	903 : 1	8.2	<0.01%	<0.01%	<0.01%	<0.01%
11	Basalt	232	<0.3	232	773 : 1	8.32	<0.01%	<0.01%	0.07%	0.11%
12	Basalt	14.1	<0.3	14.1	47 : 1	8.4	<0.01%	<0.01%	<0.01%	<0.01%
13	Target No. 2	39	<0.3	39	130 : 1	8.26	<0.01%	<0.01%	<0.01%	<0.01%
17	Basalt	209	<0.3	209	696 : 1	8.36	<0.01%	<0.01%	<0.01%	<0.01%
18	Basalt	0.5	<0.3	0.5	1.67 : 1	8.1	<0.01%	<0.01%	0.03%	0.03%
19	Basalt	3.6	<0.3	3.6	12 : 1	8.23	<0.01%	<0.01%	0.02%	0.02%
20	Basalt	<0.3	<0.3	<0.3	1 : 1	7.88	<0.01%	<0.01%	<0.01%	<0.01%
21	Basalt	9.8	<0.3	9.8	32.6 : 1	8.4	<0.01%	<0.01%	<0.01%	<0.01%
23	Basalt	2.6	<0.3	2.6	8.6 : 1	8.11	<0.01%	<0.01%	<0.01%	<0.01%
24	Basalt	3.1	<0.3	3.1	10 : 1	8.28	<0.01%	<0.01%	<0.01%	<0.01%
29	Basalt	5.1	<0.3	5.1	17 : 1	8.06	<0.01%	<0.01%	<0.01%	<0.01%
31	Basalt	15.4	<0.3	15.4	51 : 1	8.3	<0.01%	<0.01%	<0.01%	<0.01%
32	Basalt	159	<0.3	159	530 : 1	8.36	<0.01%	<0.01%	<0.01%	<0.01%
33	Basalt	112	<0.3	112	373 : 1	8.54	<0.01%	<0.01%	<0.01%	<0.01%
34	Basalt	174	<0.3	174	580 : 1	8.58	<0.01%	<0.01%	<0.01%	<0.01%
35	Basalt	2.6	<0.3	2.6	8.6 : 1	8.5	<0.01%	<0.01%	<0.01%	<0.01%
36	Basalt	4.1	<0.3	4.1	13.6 : 1	8.28	<0.01%	<0.01%	0.02%	0.02%
42	Basalt	1	<0.3	1	3.33 : 1	8.26	<0.01%	<0.01%	0.02%	0.02%
43	Basalt	16.1	<0.3	16.1	53.6 : 1	8.68	<0.01%	<0.01%	<0.01%	<0.01%
45	Basalt	3.6	<0.3	3.6	12 : 1	8.38	<0.01%	<0.01%	<0.01%	<0.01%
46		<0.3	<0.3	<0.3	1 : 1	8.71	<0.01%	<0.01%	<0.01%	<0.01%

TCaCO3 = Tons of Calcium Carbonate

26 of 44 samples or 59%

Source: Glamis Marigold Mine Millenium Expansion Supplemental Waste Characterization Report, Appendix 1, September, 2002

Note: The Acid-Base Potential is the difference between the ANP and the AGP (ANP-AGP=ABP)

Table C-2: Updated FEIS
March 2003

Sample Identification	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Non-Extractable Sulfur (%)	Total Sulfur (%)	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	Acid Base Potential (ABP) TCaCO3	ANP/AGP Ratio[1]	pH Paste
Top Zone (Terry Zone) Waste									
Top Zone Waste - Valmy (TZ98-1Q-V) 12/21/1998	<0.01	0.02	<0.01	0.02	<0.3	13.8	+13.8	92:1	7.81
Top Zone Waste - Valmy (TZ98-2Q-V) 12/21/1998	<0.01	<0.01	<0.01	<0.01	<0.3	1.2	+1.2	8:1	7.83
Top Zone Waste - Valmy (TZ98-3Q-V) 12/21/1998	<0.01	0.02	<0.01	0.02	<0.3	9.2	+9.2	61:1	8.08
Top Zone Waste - Valmy (TZ98-4Q-V) 12/21/1998	<0.01	0.02	<0.01	0.02	<0.3	<0.5	0	1.67:1	7.92
Top Zone Waste - Valmy (99-95 1st Qtr.) 12/28/99	0.01	0.02	<0.01	0.03	0.3	3.0	+2.7	10:1	7.70
Top Zone Waste - Valmy (99-99 2nd Qtr.) 12/28/99	<0.01	0.01	<0.01	0.01	<0.3	2.0	+2.0	13:1	7.72
Top Zone (Terry Zone) Waste - Valmy (01-50 April 2001) 5/29/01	0.06	0.01	0.01	0.08	1.9	8.7	+6.8	4.5:1	8.49
Top Zone (Terry Zone) Waste - Valmy (01-52 May 2001) 5/21/01	<0.01	<0.01	<0.01	<0.01	<0.3	36.2	+36.2	241:1	8.11
Top Zone (Terry Zone) Waste - Valmy (01-53 June 2001) 6/5/01	<0.01	0.01	<0.01	0.01	<0.3	82.1	+82.1	547:1	8.37
Top Zone (Terry Zone) Waste - Valmy (01-55 July 2001) 7/18/01	<0.01	0.01	<0.01	0.01	<0.3	24.6	+24.6	167:1	8.29
Top Zone (Terry Zone) Waste - Valmy (01-58 August 2001) 8/20/01	0.01	0.01	0.01	0.03	0.3	45.9	+45.6	153:1	8.42
Top Zone (Terry Zone) Waste - Valmy (01-59 Sept. 2001) 9/25/01	0.02	0.01	<0.01	0.03	0.6	13.3	+12.7	22:1	8.11
Top Zone (Terry Zone) Waste - Valmy (01-82 Oct. 2001) 10/2/01	0.04	0.04	<0.01	0.08	1.3	2.0	+0.8	1.5:1	8.20
Top Zone (Terry Zone) Waste - Valmy (01-84 Nov. 2001) 11/1/01	<0.01	0.02	<0.02	0.02	<0.3	20.8	+20.8	138:1	8.47
Top Zone (Terry Zone) Waste - Valmy (01-86 Nov. 2001) 12/1/01	0.02	<0.01	<0.01	0.02	0.6	2.0	+1.4	3:1	8.25
Top Zone (Terry Zone) Waste - Valmy (01-87 Dec. 2001) 12/1/01	<0.01	0.04	<0.01	0.04	<0.3	98.5	+98.5	656:1	8.32
Top Zone (Terry Zone) Waste - Valmy (01-88B 2001 Composite)	0.01	0.03	<0.01	0.04	0.3	17.2	+16.9	5:1	8.38

Table C-2: Updated FEIS
March 2003

Sample Identification	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Non-Extractable Sulfur (%)	Total Sulfur (%)	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	Acid Base Potential (ABP) TCaCO3	ANP/AGP Ratio[1]	pH Paste
East Hill Waste -									
East Hill North Waste - Valmy (EHN98-1Q-V) 12/14/98	<0.01	<0.01	<0.01	<0.01	<0.3	5.1	+5.1	34:1	7.68
East Hill South Waste - Valmy (EHS98-1Q-V) 12/21/98	<0.01	0.08	<0.01	0.08	<0.3	9.2	+9.2	61:1	7.88
East Hill North Waste - Valmy (EHN98-2Q-V) 12/17/98	<0.01	<0.01	<0.01	<0.01	<0.3	13.1	+13.1	87:1	7.55
East Hill South Waste - Valmy (EHS98-2Q-V) 12/21/98	<0.01	0.02	<0.01	0.02	<0.3	5.3	+5.3	35:1	7.97
East Hill North Waste - Valmy (EHN98-3Q-V) 12/16/98	<0.01	<0.01	<0.01	<0.01	<0.3	9.4	+9.4	62:1	7.81
East Hill South Waste - Valmy (EHS98-3Q-V) 12/21/98	<0.01	<0.01	<0.01	<0.01	<0.3	2.5	+2.5	16:1	7.93
East Hill North Waste - Valmy (EHN98-4Q-V) 12/16/98	<0.01	<0.01	<0.01	<0.01	<0.3	8.8	+8.8	58:1	8.01
East Hill South Waste - Valmy (EHS98-4Q-V) 12/21/98	<0.01	0.03	<0.01	0.03	<0.3	32.2	+32.2	214:1	7.92
East Hill South Waste - Valmy (99-91 1st Qtr.) 12/28/99	<0.01	0.01	<0.01	0.01	<0.3	7.5	+7.5	50:1	7.92
East Hill South Waste - Valmy (99-96 2nd Qtr.) 12/28/99	<0.01	0.06	<0.01	0.06	<0.3	12.9	+12.9	86:1	7.99
East Hill South Waste - Valmy (99-100 3rd Qtr.) 12/28/99	0.02	0.01	<0.01	0.03	0.6	1.0	+0.4	1.67:1	8.20
East Hill South Waste - Valmy (99-101 4th Qtr.) 12/28/99	0.02	0.02	<0.01	0.04	0.6	2.5	+1.9	4:1	8.11
East Hill South Waste - Valmy (00-93 1st Qtr.) 3/29/00	<0.01	<0.01	<0.01	<0.01	<0.3	21.6	+21.6	144:1	8.07
East Hill South Waste - Valmy (00-94 2nd Qtr.) 6/28/00	<0.01	<0.01	<0.01	<0.01	<0.3	<0.5	0	0	7.84
East Hill South Waste - Valmy (00-95 3rd Qtr.) 9/27/00	0.01	0.79	<0.01	0.8	0.3	6.4	+6.1	2:1	7.90
East Hill South Waste - Valmy (00-96 4th Qtr.) 11/22/00	0.02	0.01	<0.01	0.03	0.6	1.3	+0.7	2:1	8.23
East Hill South Waste - Valmy (01-46 Jan. 2001) 5/31/01	0.05	<0.01	0.01	0.06	1.6	24.8	+23.2	14:1	8.24
East Hill South Waste - Valmy (01-47 Feb. 2001) 5/30/01	0.01	0.01	0.01	0.03	0.3	1.5	+1.1	5:1	8.26
East Hill South Waste - Valmy (01-48 Mar. 2001) 6/4/01	<0.01	<0.01	<0.01	<0.01	<0.3	0.5	+0.5	3:1	8.25
East Hill South Waste - Valmy (01-49 Apr. 2001) 5/29/01	<0.01	0.01	0.01	0.02	<0.3	42.3	+42.3	282:1	8.13
East Hill South Waste - Valmy (01-51 May 2001) 5/21/01	<0.01	0.01	<0.01	0.01	<0.3	1.0	+1.0	6:1	7.72
East Hill South Waste - Valmy (01-54 June 2001) 6/25/01	0.01	0.01	0.01	0.03	0.3	1.0	+0.7	3:1	7.76
East Hill South Waste - Valmy (01-56 July 2001) 7/18/01	<0.01	<0.01	<0.01	<0.01	<0.3	<0.03	0	0	7.96
East Hill South Waste - Valmy (01-57 Aug. 2001) 8/20/01	<0.01	0.01	<0.01	0.01	<0.3	10.9	+10.9	72:1	7.75
East Hill South Waste - Valmy (01-60 Sept. 2001) 9/25/01	<0.01	<0.01	<0.01	<0.01	<0.3	5.8	+5.8	38:1	7.76
East Hill South Waste - Valmy (01-83 Oct. 2001) 10/2/01	0.01	0.02	<0.01	0.03	0.3	2.5	+2.2	8:1	7.61
East Hill South Waste - Valmy (01-85 Nov. 2001) 11/1/01	<0.01	0.02	<0.01	0.02	<0.3	11.1	+11.1	74:1	7.96

Table C-2: Updated FEIS
March 2003

Sample Identification	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Non-Extractable Sulfur (%)	Total Sulfur (%)	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	Acid Base Potential (ABP) TCaCO3	ANP/AGP Ratio[1]	pH Paste
East Hill South Waste - Valmy (01-88A 2001 Composite)	<0.01	0.02	<0.01	0.02	<0.3	5.8	+5.8	38:1	7.90

Table C-2: Updated FEIS
March 2003

Sample Identification	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Non-Extractable Sulfur (%)	Total Sulfur (%)	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	Acid Base Potential (ABP) TCaCO3	ANP/AGP Ratio[1]	pH Paste
Old Marigold Waste -									
Old Marigold Waste - Havallah (OM98-3Q-H) 12/21/98	<0.01	0.01	0.02	0.03	<0.3	24.4	+24.4	162:1	8.13
Old Marigold Waste - Havallah (OM98-4Q-H) 12/21/98	0.01	0.02	<0.01	0.03	0.3	13.3	+13.0	44:1	8.32
Old Marigold Waste - Valmy (OM98-4Q-V) 12/21/98	<0.01	0.04	<0.01	0.04	<0.3	11.8	+11.8	78:1	8.15
Old Marigold Waste - Edna Mountain (OM98-4Q-EM) 12/21/98	<0.01	0.07	<0.01	0.07	<0.3	390	+390	2,600:1	8.34
Old Marigold Waste - Edna Mountain (99-92 1st Qtr.) 12/28/99	<0.01	0.01	<0.01	0.01	<0.3	128	+128	853:1	7.94
Old Marigold Waste - Havallah (99-93 1st Qtr.) 12/28/99	<0.01	0.02	<0.01	0.02	<0.3	8.0	+8.0	53:1	8.08
Old Marigold Waste - Havallah (99-97 2nd Qtr.) 12/28/99	0.02	0.04	<0.01	0.06	0.6	53.5	+52.9	33:1	8.48
Old Marigold Waste - Valmy (99-94 1st Qtr.) 12/28/99	<0.01	<0.01	<0.01	<0.01	<0.3	2.5	+2.5	16:1	8.07
Old Marigold Waste - Valmy (99-98 2nd Qtr.) 12/28/99	<0.01	0.02	<0.01	0.02	<0.3	2.0	+2.0	13:1	7.67

Table C-2: Updated FEIS
March 2003

Sample Identification	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Non-Extractable Sulfur (%)	Total Sulfur (%)	Acid Generation Potential (AGP) TCaCO3	Acid Neutralizing Potential (ANP) TCaCO3	Acid Base Potential (ABP) TCaCO3	ANP/AGP Ratio[1]	pH Paste
Pond Zone Waste-									
Pond Zone - Alluvium (PZ98-3Q-QAL) 12/16/98	0.01	0.02	<0.01	0.03	0.3	7.4	+7.0	24:1	7.89
Pond Zone - Edna Mountain (PZ98-3Q-EM) 12/16/98	0.04	0.07	<0.01	0.11	1.3	203	+202	156:1	8.12
Pond Zone - Edna Mountain (PZ98-4Q-EM) 12/16/98	<0.01	0.13	<0.01	0.13	<0.3	354	+354	2,360:1	8.24
Pond Zone - Valmy (PZ98-3Q-V) 12/16/98	0.03	0.11	<0.01	0.14	0.9	1.5	+0.5	1.6:1	7.64
Pond Zone - Valmy (PZ98-4Q-V) 12/16/98	<0.01	0.01	<0.01	0.01	<0.3	26.6	+26.6	177:1	8.14
Resort Waste -									
Resort Waste - Valmy (RES98-1Q-V) 3/25/98	<0.01	0.02	<0.01	0.02	<0.3	3.1	+3.1	20:1	7.50
Resort Waste - Valmy (RES98-2Q-V) 6/23/98	<0.01	0.01	<0.01	0.03	<0.3	2.1	+2.1	14:1	8.48
Resort Waste - Antler Peak (RES98-1Q-AP) 3/25/98	<0.01	0.02	<0.01	0.06	<0.3	684	+684	4,560:1	8.48
Resort Waste - Antler Peak (RES98-2Q-AP) 6/23/98	<0.01	0.06	<0.01	0.03	<0.3	519	+519	3,460:1	8.48
Red Rock Waste -									
Red Rock Waste - Antler Peak (RR98-4Q-AP) 12/22/98	0.06	0.02	<0.01	0.08	1.9	302	+300	157:1	8.43

[1] When the value is < one half the value is used in the calculations; i.e., <0.3 is adjusted to 0.15.

Table C-3: Millennium Expansion Project Waste Characterization

Sample Location	Terry Zone	Terry Zone	Target 2	Target 2	Target 2	Target 2	Target 2 Pit
Sample Type	Valmy - Waste	Edna Mtn. - Waste	Alluvium - Waste	Antler Peak - Waste	Antler Peak - Waste	Valmy - Waste	Valmy - Waste
Sample No.	Terry Zone 1	Terry Zone 2	Target 2 Pit 3	Target 2 Pit 4	Target 2 Pit 5	Target 2 Pit 6	Target 2 Pit 7
Date	8/15/02	8/15/02	8/15/02	8/15/02	8/15/02	8/15/02	8/15/02
pH ** (+/- 0.1 units)	8.41	8.52	8.81	8.41	8.64	8.4	8.16
Total Dissolved Solids	200	456	508	284	332	276	264
Sulfate	40	191	106	40.5	56.7	43	66.7
Alkalinity (Total CaCO3)	78.4	122	209	98.9	136	78.8	47.7
Chloride	6.6	18.4	8.2	8.2	13.8	6.0	6.2
Nitrate (as N)	1.12	0.69	0.33	0.37	0.82	0.42	0.53
Phosphorus	0.24	0.24	0.51	0.91	1.4	0.47	0.47
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	0.26	0.04	1.53	0.08	0.44	3.52	3.85
Antimony	0.015	0.008	0.011	0.012	0.01	0.006	0.01
Arsenic	0.23	0.04	0.15	0.05	0.09	0.08	0.11
Barium	0.287	0.046	0.246	0.441	0.359	0.352	0.174
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.006	<0.006	<0.006	<0.006	0.014	0.006	<0.006
Cobalt	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	0.013	0.008	0.011	0.007	0.009	0.014	0.012
Fluoride	1.8	1.2	5.6	0.9	2.6	1.8	2.8
Iron	0.05	0.04	0.86	0.09	0.17	1.27	1.35
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.004	0.01	0.019	0.01	0.009	0.026	0.016
Mercury	0.0004	0.0006	0.0002	0.0003	0.0008	0.0006	0.0005
Molybdenum	0.116	0.104	0.132	0.071	0.143	0.055	0.06
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	<0.005	<0.005	0.095	0.013	0.006	0.031	0.023
Zinc	0.006	0.005	0.03	0.008	0.011	0.013	0.016

Table C-3: Millennium Expansion Project Waste Characterization (Cont.)

Sample Location	Basalt Pit	Basalt Pit	Basalt Pit	Basalt Pit	Basalt Pit	Basalt Pit	Basalt Pit
Sample Type	**Alluvium - Waste**	**Tert. Tuff - Waste**	**Valmy - Waste**	**Valmy - Ore**	**Valmy - Waste**	**Metabasalt - Waste**	**Chert - Waste**
Sample No.	Basalt Pit 8	Basalt Pit 9	Basalt Pit 10	Basalt Pit 11	Basalt Pit 12	Basalt Pit 13	Basalt Pit 14
Date	8/14/02	8/14/02	8/14/02	8/14/02	8/14/02	8/14/02	8/14/02
pH ** (+/- 0.1 units)	8.58	8.34	8.46	8.10	8.44	8.10	8.33
Total Dissolved Solids	520	664	268	258	332	276	250
Sulfate	117	210	93.7	60.9	61.7	64.2	55.1
Alkalinity (Total CaCO3)	109	89.2	72.0	29.9	77.3	29.8	77.8
Chloride	37.7	99.2	15.8	17.7	23.1	28.0	5.6
Nitrate (as N)	1.0	1.98	0.83	0.66	0.75	0.73	0.54
Phosphorus	0.20	0.13	0.21	0.09	0.12	0.18	0.22
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	9.13	0.41	0.27	4.17	4.22	6.29	0.24
Antimony	0.015	0.013	<0.005	0.019	<0.005	0.024	0.007
Arsenic	0.11	0.05	0.05	0.02	0.05	0.07	0.03
Barium	0.236	0.162	0.04	0.235	0.260	0.258	0.248
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	0.011	<0.006	<0.006	<0.006	0.006	0.008	<0.006
Cobalt	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	0.018	0.006	0.003	0.006	0.007	0.016	0.004
Fluoride	2.2	2.4	1.5	1.3	2.2	1.3	2.0
Iron	2.15	0.07	0.26	0.82	1.09	2.50	0.07
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.044	0.01	0.01	0.045	0.016	0.075	0.026
Mercury	0.0003	<0.0002	<0.0002	0.0005	<0.0002	0.0003	<0.0002
Molybdenum	0.139	0.181	0.101	0.08	0.094	0.08	0.102
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	0.078	0.054	0.013	0.007	0.028	0.015	0.006
Zinc	0.045	0.02	<0.005	0.014	0.016	0.042	0.01

Table C-3: Millennium Expansion Project Waste Characterization (Cont.)

Sample Loc.	Basalt Pit	Basalt Pit	Antler Pit	Antler Pit	Antler Pit	Antler Pit
Sample Type	Shale - Waste	Valmy - Waste	Alluvium - Waste	Battle Mtn - Waste	Antler Peak - Waste	Edna Mtn. - Waste
Sample No.	Basalt Pit 15	Basalt Pit 16	Antler Pit 17	Antler Pit 18	Antler Pit 19	Antler Pit 20
Date	8/14/02	8/14/02	8/16/02	8/16/02	8/16/02	8/14/02
pH ** (+/- 0.1 units)	8.31	8.35	8.16	8.47	8.34	8.56
Total Dissolved Solids	334	258	214	152	166	210
Sulfate	84.6	70.8	63.9	41.6	22.0	19.5
Alkalinity (Total CaCO3)	80.0	41.6	51.3	79.7	66.1	69.7
Chloride	42.1	24.0	7.8	9.9	5.1	2.1
Nitrate (as N)	0.94	0.87	0.05	0.22	0.38	0.25
Phosphorus	0.17	0.10	0.31	1.12	0.37	0.81
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	0.29	0.34	0.73	0.33	0.66	0.36
Antimony	<0.005	0.006	0.007	0.01	0.007	0.015
Arsenic	0.03	0.03	0.10	0.08	0.07	0.20
Barium	0.160	0.170	0.149	0.244	0.165	0.284
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.006	<0.006	<0.006	<0.006	0.031	<0.006
Cobalt	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	0.004	0.005	0.008	0.006	0.005	0.008
Fluoride	2.3	1.8	2.1	1.5	1.1	0.5
Iron	0.07	0.13	0.48	0.15	0.11	0.12
Lead	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Manganese	0.016	0.006	0.026	0.011	0.008	0.003
Mercury	<0.0002	<0.0002	0.0003	0.0007	0.0013	0.0002
Molybdenum	0.154	0.105	0.153	0.078	0.162	0.064
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	0.013	<0.005	0.018	<0.005	<0.005	<0.005
Zinc	0.012	0.014	0.015	0.006	<0.005	<0.005

Table C-3: Marigold Existing Pit Waste Characterization Updated 1998

Sample Location	Top Zone Waste	Top Zone Waste	Top Zone Waste	Top Zone Waste	East Hill North - Waste	East Hill North - Waste
Sample Type	Valmy	Valmy	Valmy	Valmy	Valmy	Valmy
Sample No.	TZ98-1Q-V	TZ98-2Q-V	TZ98-3Q-V	TZ98-4Q-V	EHN98-1Q-V	EHN98-2Q-V
Date	12/21/1998	12/21/1998	12/21/1998	12/17/1998	12/17/98	12/17/98
pH ** (+/- 0.1 units)	7.55	7.47	7.81	7.51	7.73	7.36
Total Dissolved Solids	105	70	140	195	289	152
Sulfate	17.7	6.1	60.6	12.7	15.0	7.0
Alkalinity (Total CaCO3)	24.1	19.7	47.2	35.0	40.8	20.4
Chloride	7.8	4.0	4.5	11.5	33.2	46.9
Nitrate (as N)	1.64	2.82	0.98	3.01	21.6	2.55
Phosphorus	-	-	-	-	-	-
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	-	-	-	-	-	-
Antimony	-	-	-	-	-	-
Arsenic	0.283	0.173	0.120	0.316	0.089	0.054
Barium	0.296	0.239	0.028	0.046	0.223	0.240
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.008	<0.008	<0.008	<0.008	<0.008	<0.008
Cobalt	-	-	-	-	-	-
Copper	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	1.1	0.9	0.4	2.6	0.4	0.3
Iron	0.02	<0.019	<0.019	0.022	0.021	<0.019
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.001	0.002	<0.001	0.002	<0.001	0.005
Mercury	0.0003	<0.0002	0.0006	<0.0002	0.0008	<0.0002
Molybdenum	-	-	-	-	-	-
Nickel	-	-	-	-	-	-
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	-	-	-	-	-	-
Tin	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	0.006	0.012	<0.004	<0.004	0.013	0.021

Table C-3: Marigold Existing Pit Waste Characterization Updated -1998 (Cont.)

Sample Location	East Hill North - Waste	East Hill North - Waste	East Hill South - Waste	East Hill South - Waste	East Hill South - Waste
Sample Type	Valmy	Valmy	Valmy	Valmy	Valmy
Sample No.	EHN98-3Q-V	EHN98-4Q-V	EHS98-1Q-V	EHS98-2Q-V	EHS98-3Q-V
Date	12/16/98	12/16/98	12/21/98	12/21/98	12/21/98
pH ** (+/- 0.1 units)	7.54	7.82	7.91	8.04	7.83
Total Dissolved Solids	87	37	225	825	261
Sulfate	7.5	3.0	37.4	108	22.1
Alkalinity (Total CaCO3)	28.2	50.2	51.1	66.7	47.8
Chloride	8.3	3.0	45.7	370	31.9
Nitrate (as N)	2.83	0.4	4.41	1.52	0.88
Phosphorus	-	-	-	-	-
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	-	-	-	-	-
Antimony	-	-	-	-	-
Arsenic	0.148	0.09	0.243	0.112	0.128
Barium	0.342	0.208	0.119	0.138	0.089
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.008	<0.008	<0.008	<0.008	<0.008
Cobalt	-	-	-	-	-
Copper	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	0.3	<0.1	1.0	0.9	1.2
Iron	<0.019	<0.019	0.027	0.023	0.041
Lead	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	0.003	<0.001	<0.001	0.005	<0.001
Mercury	<0.0002	<0.0002	0.0008	<0.0002	<0.0002
Molybdenum	-	-	-	-	-
Nickel	-	-	-	-	-
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	-	-	-	-	-
Tin	-	-	-	-	-
Vanadium	-	-	-	-	-
Zinc	0.021	<0.004	0.013	0.005	0.005

Table C-3: Marigold Existing Pit Waste Characterization Updated 1998 (Cont.)

Sample Location	East Hill South - Waste	Old Marigold - Waste	Old Marigold - Waste	Old Marigold - Waste	Old Marigold - Waste
Sample Type	Valmy	Havallah	Havallah	Valmy	Edna Mtn.
Sample No.	EHS98-4Q-V	OM98-3Q-H	OM98-4Q-H	OPM98-4Q-V	OM98-4Q-EM
Date	12/21/98	12/21/98	12/21/98	12/21/98	12/21/98
pH ** (+/- 0.1 units)	7.90	7.91	7.83	8.13	8.68
Total Dissolved Solids	193	98	58	215	513
Sulfate	21.5	9.0	4.5	29.4	136
Alkalinity (Total CaCO3)	54.7	49.7	40.9	50.6	80.5
Chloride	41.4	1.6	2.3	65.8	153
Nitrate (as N)	0.75	0.53	0.22	0.79	0.46
Phosphorus	-	-	-	-	-
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	-	-	-	-	-
Antimony	-	-	-	-	-
Arsenic	0.066	0.127	0.05	0.052	0.260
Barium	0.107	0.174	0.250	0.204	0.016
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.008	<0.008	<0.008	<0.008	<0.008
Cobalt	-	-	-	-	-
Copper	<0.004	<0.004	<0.004	<0.004	<0.004
Fluoride	0.5	0.4	0.2	0.6	0.9
Iron	<0.019	0.032	<0.019	<0.019	<0.019
Lead	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	0.0003	<0.0002	0.0003	0.0005	<0.0002
Molybdenum	-	-	-	-	-
Nickel	-	-	-	-	-
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	-	-	-	-	-
Tin	-	-	-	-	-
Vanadium	-	-	-	-	-
Zinc	<0.004	0.007	0.009	<0.004	<0.004

Top Zone was renamed the Terry Zone Pit in 2001.

Table C-3: Marigold Existing Pit Waste Characterization Updated 1999

Sample Location	East Hill South - Waste	Old Marigold - Waste	Old Marigold - Waste	Old Marigold - Waste	Top Zone - Waste	East Hill South - Waste
Sample Type	**Valmy**	**Edna Mtn.**	**Havallah**	**Valmy**	**Valmy**	**Valmy**
Sample No.	99-91	99-92	99-93	99-94	99-95	99-96
Date	12/28/99	12/28/99	12/28/99	12/28/99	12/28/99	12/28/99
pH ** (+/- 0.1 units)	7.54	7.90	7.37	7.65	7.46	8.27
Total Dissolved Solids	320	427	103	53	135	917
Sulfate	62.8	112	6.3	3.7	14	286
Alkalinity (Total CaCO3)	33.1	55.1	17.7	29.7	22.9	112
Chloride	102	108	32.0	0.7	31.5	196
Nitrate (as N)	2.49	1.68	0.18	0.17	1.26	2.24
Phosphorus	-	-	-	-	-	-
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	1.07	<0.024	0.071	0.136	0.426	0.05
Antimony	<0.001	0.002	<0.001	<0.001	0.001	0.003
Arsenic	0.097	0.098	0.046	0.109	0.094	0.256
Barium	0.192	0.038	0.019	0.265	0.081	0.093
Cadmium	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	-	-	-	-	-	-
Copper	<0.003	<0.003	<0.003	<0.003	<0.003	0.014
Fluoride	0.7	0.8	<0.1	<0.1	0.5	2.2
Iron	0.07	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	<0.001	<0.001	<0.001	0.001	0.001	<0.001
Manganese	0.002	<0.002	<0.002	0.003	<0.002	0.008
Mercury	0.0059	0.0038	0.0023	0.0034	0.032	0.0007
Molybdenum	-	-	-	-	-	-
Nickel	<0.023	<0.023	<0.023	<0.023	<0.023	0.027
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	0.007	<0.006	<0.006	<0.006	<0.006	<0.006
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-
Zinc	0.034	<0.003	<0.003	0.024	<0.003	0.011

Top Zone was renamed the Terry Zone Pit in 2001.

Table C-3: Marigold Existing Pit Waste Characterization Updated 1999 (Cont.)

Sample Location	Old Marigold - Waste	Old Marigold - Waste	Top Zone - Waste	East Hill South - Waste	East Hill South - Waste
Sample Type	Havallah	Valmy	Valmy	Valmy	Valmy
Sample No.	99-97	99-98	99-99	99-100	99-101
Date	12/28/99	12/28/99	12/28/99	12/28/99	12/28/99
pH ** (+/- 0.1 units)	7.58	7.3	7.67	8.49	7.72
Total Dissolved Solids	68	55	82	208	134
Sulfate	6.2	3.7	11.2	42.5	31.7
Alkalinity (Total CaCO3)	32.5	12.1	36.3	65.4	42.7
Chloride	7.9	5.7	2.8	16.4	10.4
Nitrate (as N)	0.14	0.78	0.76	0.69	0.44
Phosphorus	-	-	-	-	-
WAD Cyanide	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	0.156	0.107	<0.024	0.254	0.938
Antimony	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic	0.037	0.08	0.20	0.192	0.058
Barium	0.021	0.281	0.213	0.180	0.210
Cadmium	<0.0024	<0.0024	<0.0024	<0.0024	<0.0024
Chromium	<0.005	<0.005	<0.005	<0.005	<0.005
Cobalt	-	-	-	-	-
Copper	<0.003	<0.003	<0.003	<0.003	<0.003
Fluoride	<0.1	<0.1	0.9	1.5	0.6
Iron	0.04	<0.02	<0.02	<0.02	0.06
Lead	0.001	<0.001	<0.001	0.028	<0.001
Manganese	<0.002	<0.002	0.002	<0.002	0.002
Mercury	0.0024	0.0059	0.0015	0.0033	0.003
Molybdenum	-	-	-	-	-
Nickel	<0.023	<0.023	<0.023	<0.023	<0.023
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	<0.006	<0.006	<0.006	<0.006	<0.006
Thallium	<0.001	<0.001	<0.001	<0.001	<0.001
Tin	-	-	-	-	-
Vanadium	-	-	-	-	-
Zinc	<0.003	0.032	0.034	<0.003	0.014

Top Zone was renamed the Terry Zone Pit in 2001.

Table C-3: Marigold Existing Pit Waste Characterization Updated 2000

Sample Location	East Hill South - Waste	East Hill South - Waste	East Hill South - Waste	East Hill South - Waste	East Hill - Waste	Top Zone - Waste
Sample Type	Valmy	Valmy	Valmy	Valmy	Valmy	Valmy
Sample No.	00-93	00-94	00-95	00-96	00-88A	00-88B
Date	3/29/00	6/28/00	9/27/00	11/22/00	1/17/02	1/17/02
pH ** (+/- 0.1 units)	7.12	6.74	7.05	7.93	8.05	7.9
Total Dissolved Solids	81	69	66	1230	149	154
Sulfate	6.3	12.5	6.0	389	13.5	23.9
Alkalinity (Total CaCO3)	56.6	29.3	54.9	85.7	81.9	65.4
Chloride	2.1	12.2	4.3	238	6.5	13.7
Nitrate (as N)	0.25	0.39	0.87	11.4	1.9	0.99
Phosphorus	-	-	-	-	0.08	0.15
WAD Cyanide	-	-	-	-	-	-
Aluminum	-	-	-	-	0.5	0.62
Antimony	-	-	-	-	0.001	<0.001
Arsenic	0.179	0.015	0.032	0.592	0.120	0.13
Barium	0.051	0.083	0.087	0.074	0.054	0.069
Cadmium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium	<0.006	<0.006	<0.006	<0.006	0.01	<0.006
Cobalt	-	-	-	-	<0.006	<0.006
Copper	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Fluoride	0.4	<0.1	0.4	1.4	0.9	0.9
Iron	0.12	<0.02	<0.02	0.24	0.06	<0.02
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	0.12
Manganese	0.003	<0.002	<0.002	0.003	0.002	0.003
Mercury	<0.0002	<0.0002	<0.0002	0.0002	0.0022	0.0008
Molybdenum	-	-	-	-	0.016	0.013
Nickel	-	-	-	-	>0.01	<0.01
Selenium	<0.002	<0.002	<0.002	<0.002	<0.01	<0.01
Silver	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Thallium	-	-	-	-	<0.001	<0.001
Tin	-	-	-	-	<0.01	<0.01
Vanadium	-	-	-	-	0.006	0.06
Zinc	<0.005	<0.005	<0.005	<0.005	0.005	0.002

Top Zone was renamed the Terry Zone Pit in 2001.

Table C-4: Long-term heap drainage rates assuming a 12-inch soil cover

Facility	Marigold Heap	5-North Heap	Section 30 Heap	Section 16 Heap
Heap size (Acres)	190	30	155	76
Drainage rate (gpm)	0.99	0.16	0.8	0.4

Note: The Marigold Heap consists of leach pads 1-10 and the SW Pad Extension.

Table C-5: Heap Drainage Chemistry from Marigold Heap Cell 8 (5/13/2002)

Parameter	Total or Dissolved	Value (mg/L)	Nevada Drinking Water Standards (mg/L)
pH (s.u.)	T	8.1	6.5 – 8.5
Total Dissolved Solids	T	***2350***	500 – 1000
WAD Cyanide	T	0.02	0.2
Alkalinity (total)	T	88.8	-
(bicarbonate)	T	88.8	-
(carbonate)	T	<1.0	-
Boron	D	0.85	-
Calcium	D	153	-
Magnesium	D	35.0	125 – 150
Potassium	D	10.4	-
Sodium	D	622	-
Aluminum	D	<0.02	0.05 – 0.2
Antimony	D	<0.001	0.006
Beryllium	D	<0.002	0.004
Chloride	T	**462**	250 – 400
Fluoride	T	0.5	2 – 4
Nickel	D	<0.01	0.1
Nitrate as N	T	-	10
Nitrite as N	T	-	1
Nitrite + Nitrate as N	T	***189***	10
Sulfate	T	***548***	250
Arsenic	D	***0.28***	0.05
Barium	D	0.043	2.0
Cadmium	D	<0.002	0.005
Chromium	D	0.007	0.1
Copper	D	0.010	1.3
Iron	D	0.10	0.3 – 0.6
Lead	D	<0.005	0.015
Manganese	D	<0.002	0.05 – 0.10
Mercury	D	0.0010	0.002
Selenium	D	0.02	0.05
Silver	D	<0.005	0.1
Thallium	D	<0.001	0.002
Zinc	D	<0.005	5.0

Notes: All results in mg/L unless noted
Exceedences shown in ***bold-italic***

Table C-6
Heap Leach Solids
Static Acid-Base Accounting Analyses

SAMPLE	SULFUR CONTENT				AGP (T/kT CaCO3)		ANP (T/kT CaCO3)	NNP (T/kT CaCO3)		ANP/AGP		PASTE pH
	Pyritic Sulfur (%)	Sulfate Sulfur (%)	Unident Sulfur (%)	Total Sulfur (%)	Pyritic Sulfur	Total Sulfur		Pyritic Sulfur	Total Sulfur	Pyritic Sulfur	Total Sulfur	
LEACH SOLIDS												
Top Zone Leach (G071-02B)4/28/92	0.14	-0.01	-0.01	0.14	4.4	4.4	29.7	25.3	25.3	6.75	6.75	
8 South Leach (G071-02B) 4/28/92	0.15	-0.01	1.36	1.51	4.7	47.2	25.4	20.7	-21.8	5.40	0.54	
8-South Leach (G303-04A) 12/2/92	0.01	0.05	1.9	1.96	0.3	61.2	15.3	15	-45.9	51.00	0.25	
Top Zone Leach (G303-04A) 12/2/92	0.01	0.05	-0.01	0.06	0.3	1.8	7.4	7.1	5.6	24.67	4.11	
Top Zone Leach (Monitor Lab 1493) 6/17/92						3.34	10.2		6.86		2.05	8.33
8-South Leach (Monitor Lab 1493) 6/17/92						21.3	127		105.7		4.96	8.27
8-South Leach (H006-04A) 2/11/93	0.03	0.08	-0.01	0.11	0.9	3.3	32.8	31.9	29.5	36.44	9.94	
Top Zone Leach (H006-04A) 2/11/93	0.03	0.04	-0.01	0.07	0.9	2.1	45	44.1	42.9	50.00	21.43	
8-South Leach (1st) (SVL E42464) 7/12/93						0.6	20.1		19.5		32.50	8.15
8-South Leach (2nd) (SVL E42466) 7/12/93						19.2	30		10.8		0.56	7.74
8-South Leach (3rd) (SVL E52340) 12/2/93	0.17	-0.01	2.04	2.21	5.1	66.3	148	142.9	81.7	29.02	2.23	8.17
8-South Leach (4th) (SVL E52341) 12/2/93	0.48	-0.01	1.25	1.73	14.4	51.9	204	189.6	152.1	14.17	3.93	8
Top Zone Leach (1st) (SVL E42470) 7/12/93						0.3	6		5.7		19.00	8.62
Top Zone Leach (2nd) (SVL E42472) 7/12/93						0.8	10.4		9.6		12.00	8.12
Top Zone Leach (4th) (SVL E52346) 12/2/93	0.15	0.03	0.01	0.19	4.5	5.7	18.1	13.6	12.4	4.02	3.18	7.91
East Hill Leach (1st) (SVL E52434) 12/2/93	0.75	0.24	0.59	1.58	22.5	47.4	101	78.5	53.6	4.49	2.13	8.12

Table C-7
Meteoric Water Mobility Procedure Analyses - Leach Solids
Marigold Mine

LEACH SOLIDS										
SAMPLE LOC.	Top Zone	8-South	8-South	Top Zone	8-South	8-South	8-South	8-South	Top Zone	Top Zone
SAMPLE TYPE	Leach	Leach	Leach	Leach	Leach (1st)	Leach (2nd)	Leach (3rd)	Leach (4th)	Leach (1st)	Leach (2nd)
SAMPLE NO.	G071-02	G071-02	G303-04L	G303-04L	E42464	E42466	E52340	E52341	E42470	E42472
DATE	3/27/92	3/27/92	11/23/92	11/23/92	7/12/93	7/12/93	12/2/93	12/2/93	7/12/93	7/12/93
CROSS REF	ABA-4	ABA-6	ABA-10	ABA-12	ABA-34	ABA-35	ABA-36	ABA-37	ABA-38	ABA-39
CONSTITUENT										
pH	7.59	8.01			6.8	6.9	8.2	8.1	7.5	6.9
TDS	163	121			86	106	119	108	215	227
SULFATE	7	6.2			18.3	19.3	24.1	18.3	44.7	28.9
ALKALINITY	23	42			56	62	76	66	62	63
CHLORIDE	36.24	113.4			1.7	1.8	7.5	3.7	26.7	39.7
NITRATE	0.024	0.49			0.47	0.34	1.15	1.33	0.64	2.61
PHOSPHORUS	0.181	<0.1	<0.25	0.125	0.17	0.15	<0.07	<0.07	0.03	0.07
WAD CYANIDE	<0.005	<0.005			<0.01	<0.01	<0.01	<0.01	<0.01	0.06
ALUMINUM	0.678	0.209	0.024	0.754	<0.01	<0.01	<0.02	<0.02	0.02	<0.01
ANTIMONY	<0.05	<0.05	<0.05	<0.05	0.002	<0.001	0.004	0.002	0.01	0.002
ARSENIC	<0.05	<0.05	<0.005	0.973	0.04	<0.04	0.05	0.04	0.26	0.18
BARIUM	0.089	0.15	0.102	0.141	0.19	0.181	0.171	0.184	0.102	0.181
CADMIUM	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
CHROMIUM	0.056	0.052	<0.01	<0.01	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
COBALT	0.022	0.022	<0.015	<0.015	<0.002	<0.002	0.004	<0.003	<0.002	<0.002
COPPER	0.052	0.5	<0.01	<0.01	0.003	0.004	<0.005	<0.005	0.003	0.003
FLUORIDE	<0.2	<0.2			0.6	0.4	0.6	0.5	1.2	1.7
IRON	0.227	0.152	<0.05	0.11	<0.02	<0.02	<0.01	<0.01	<0.02	<0.02
LEAD	<0.025	<0.025	<0.01	0.017	<0.001	<0.001	0.001	<0.001	0.002	0.001
MANGANESE	0.095	0.09	<0.005	0.059	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
MERCURY	0.0018	0.0051	0.0084	0.0406	<0.0002	0.0011	<0.0002	<0.0002	0.01	0.23
MOLYBDENUM	<0.005	<0.008	0.048	<0.015	0.02	0.012	0.016	0.009	0.015	0.018
NICKEL	0.106	0.111	<0.025	<0.025	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
SELENIUM	<0.005	<0.025	<0.002	<0.002	<0.04	<0.04	0.002	0.002	<0.04	<0.04
SILVER	<0.02	<0.02	<0.05	<0.05	0.002	<0.002	<0.003	<0.003	0.002	0.002
THALLIUM	0.194	0.233	<0.1	<0.1	<0.001	<0.001	0.002	<0.001	<0.001	0.001
TIN	0.027	0.063	<0.05	<0.05	<0.06	<0.06	<0.03	<0.03	<0.06	<0.06
VADADIUM	0.016	0.012	<0.01	<0.01	0.004	<0.003	0.007	0.005	<0.003	0.006
ZINC	0.076	0.062	<0.05	<0.05	0.003	0.003	<0.002	<0.002	0.002	<0.002

Table C-7
Meteoric Water Mobility Procedure Analyses - Leach Solids
Marigold Mine

LEACH SOLIDS				
SAMPLE LOC.	Top Zone	East Hill	Top Zone	8-South
SAMPLE TYPE	Leach (4th)	Leach (4th)	Leach	Leach
SAMPLE NO.	E52346	E52434	Monitor Lab	Monitor Lab
DATE	12/2/93	12/2/93	6/15/92	6/15/92
CROSS REF	ABA-40	ABA-41	ABA-14	ABA-16
CONSTITUENT				
pH	7.9	8.1	7.6	8
TDS	224	1860	82	36
SULFATE	23.4	643	19.9	8.17
ALKALINITY	71	100	57.1	34.4
CHLORIDE	7.6	566	3.04	4.06
NITRATE	15	1.61	0.4	1
PHOSPHORUS	<0.07	<0.07	0.028	1.5
WAD CYANIDE	<0.01	<0.01		
ALUMINUM	0.02	0.02		
ANTIMONY	0.009	0.002		
ARSENIC	0.6	0.8	0.148	0.031
BARIUM	0.167	0.021		
CADMIUM	<0.002	<0.002		
CHROMIUM	<0.004	0.024		
COBALT	0.004	0.004		
COPPER	<0.005	<0.005		
FLUORIDE	1.02	1.8	0.724	0.119
IRON	<0.01	<0.01		
LEAD	<0.001	<0.001		
MANGANESE	<0.002	<0.002		
MERCURY	0.0023	0.0005	<0.0005	0.0137
MOLYBDENUM	0.016	0.227		
NICKEL	<0.01	0.01	<0.04	<0.04
SELENIUM	0.002	0.003	<0.005	<0.005
SILVER	<0.003	<0.003		
THALLIUM	0.001	0.002		
TIN	<0.03	<0.03		
VADADIUM	0.004	<0.003		
ZINC	<0.002	<0.002		

APPENDIX D

VISUAL SIMULATIONS AND BLM VISUAL CONTRAST RATING WORKSHEETS

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 08/28/02

District Winnemucca F.O.

Resource Area

Activity (program) Minerals

SECTION A. PROJECT INFORMATION

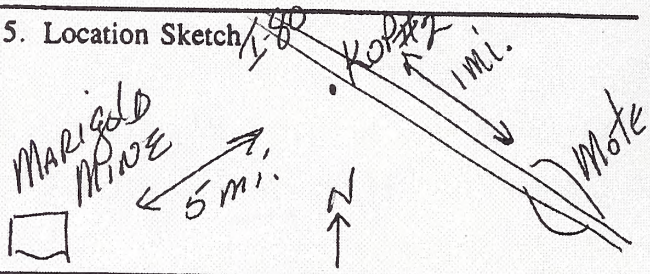
1. Project Name
Millennium Expansion SEIS

2. Key Observation Point #2
Mote, mile marke 221

3. VRM Class
III & IV

4. Location of KOP
Township 33N
Range 44E
Section 7

5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	B - Pyramidal-rolling M Flat F Flat	uniform	B None M Regular F None
LINE	B Convex & Rolling M Horizontal F Horizontal	Discontinuous Discontinuous Discontinuous	None horizontal & vertical None
COLOR	B Dark grey M Tan F Tan	grey green Tan Tan	None Tan None
TEXTURE	B Coarse M Medium F Fine	Fine Fine Fine	None Coarse None

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	M - stair step	M - None	M - None visible
LINE	M - strong linear horizontal	M - None	M - None
COLOR	M - light tan	M - None	M - None
TEXTURE	M - medium	M - None	M - None

SECTION D. CONTRAST RATING ☐ SHORT TERM ☐ LONG TERM

1. DEGREE OF CONTRAST

ELEMENTS	Land/Water Body (1) Strong	Moderate	Weak	None	Vegetation (2) Strong	Moderate	Weak	None	Structures (3) Strong	Moderate	Weak	None
Form		✓					✓					✓
Line		✓					✓					✓
Color			✓				✓					✓
Texture			✓				✓					✓

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: Gary Back

Date: 8-28-02

Form 8400-4
(September 1985)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VISUAL CONTRAST RATING WORKSHEET

Date 08-25-02

District WINNEMUCCA F.O.

Resource Area

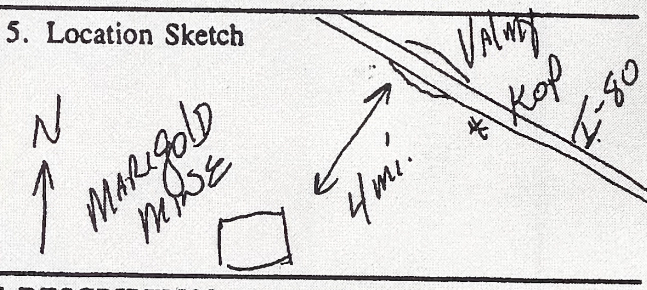
Activity (program) MINERALS

SECTION A. PROJECT INFORMATION

1. Project Name, MILLENNIUM EXPANSION SEIS
2. Key Observation Point #1 MILE MARKER 215.5, I-80
3. VRM Class III & IV

4. Location of KOP
Township 34N
Range 43E
Section 27

5. Location Sketch



SECTION B. CHARACTERISTIC LANDSCAPE DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	Mtn - PYRAMIDAL - B.ackgr. ALLUVIAL FAN - MIDGR. Valley floor - FLAT - F.gr.	UNIFORM	BGR - MINE BLDG. - REGULAR MGR - NONE FGR - REST STOP - REGULAR
LINE	BGR - ANGULAR TO ROLLING MGR - FLAT to sloping FGR - FLAT	BGR - IRREGULAR, DISCONTIN. MGR - FIRELINE - LINEAR FGR - DISCONTINUOUS	BGR - MINE - ANGULAR MGR - POWERLINE - LINEAR FGR - BLDGS. - ANGULAR
COLOR	GREY TAN/GREY TAN	GREY-GREEN TAN TAN	TAN NONE BROWN
TEXTURE	COARSE FINE FINE	FINE FINE FINE	MEDIUM NONE COARSE

SECTION C. PROPOSED ACTIVITY DESCRIPTION

	1. LAND/WATER	2. VEGETATION	3. STRUCTURES
FORM	MGR ANGULAR, REGULAR	NONE, EXCEPT RECLAMATION	NONE VISIBLE
LINE	MGR - horizontal (benches)	Similar to existing	NONE VISIBLE
COLOR	REDDISH BROWN -	TAN, GRAY-GREEN	NONE VISIBLE
TEXTURE	COARSE	NONE, FINE FOR RECLAM.	NONE VISIBLE

SECTION D. CONTRAST RATING ☒ SHORT TERM ☐ LONG TERM

1\. DEGREE OF CONTRAST

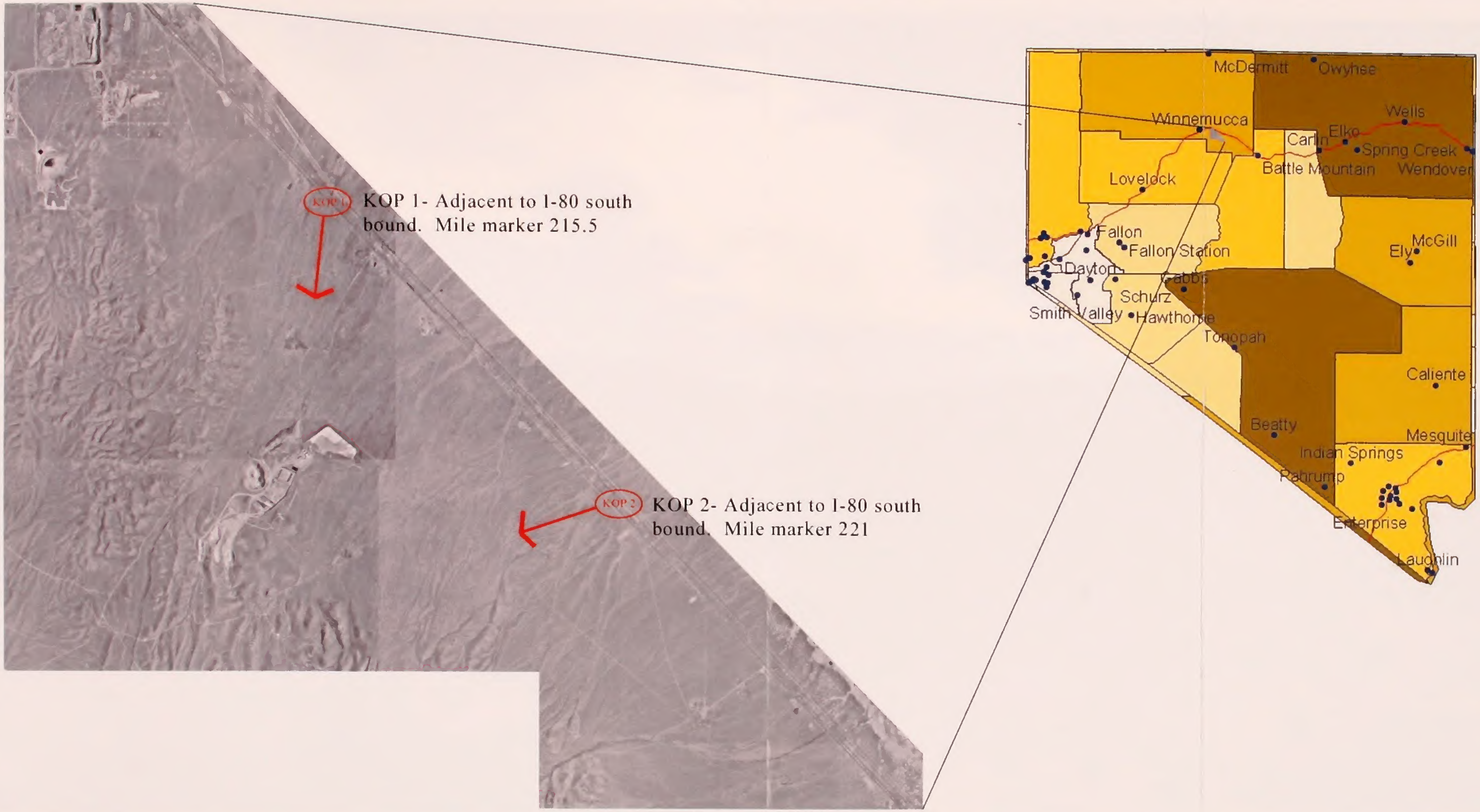
ELEMENTS	LAND/WATER BODY (1) Strong	Moderate	Weak	None	VEGETATION (2) Strong	Moderate	Weak	None	STRUCTURES (3) Strong	Moderate	Weak	None
Form			✓				✓					✓
Line			✓				✓					✓
Color			✓				✓					✓
Texture			✓				✓					✓

2. Does project design meet visual resource management objectives? ☒ Yes ☐ No (Explain on reverse side)

3. Additional mitigating measures recommended ☐ Yes ☒ No (Explain on reverse side)

Evaluator's Names: GARY BACK

Date: 8-28-02



DW Visual Simulation

DESIGNWORKSHOP

Title:	Date:	Client:		
Key Observation Points & Vicinity Orientation	September 20, 2002	Glamis Marigold Mine		
	Drawing: Sheet 1			Page D-1

DW Visual Simulation

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Title: KOP 1 I-80 Mile Marker 215.5 Existing Conditions	Date: September 20, 2002 Drawing: Sheet 2	Client: Glamis Marigold Mine	Reproduction of this document beyond that permitted by Section 107 or 108 of the United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to Design Workshop, PO Box 5666, Stateline, NV 89449. © 2002 DESIGNWORKSHOP, Inc.	Page D-2

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Title:	Date:	Client:		
KOP 1 I-80 Mile Marker 215.5 Proposed Action	September 20, 2002 Drawing: Sheet 3	Glamis Marigold Mine	Reproduction of this document beyond that permitted by Section 107 or 108 of the United States Copyright Act without the permission of the copyright owner is unlawful. Requests for permission or further information should be addressed to Design Workshop. PO Box 5666, Stateline, NV 89449. © 2002 DESIGNWORKSHOP, Inc.	Page D-3

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KOP 1 I-80 Mile Marker 215.5 Post Reclamation	September 20, 2002	Glamis Marigold Mine		
	Drawing: Sheet 4			

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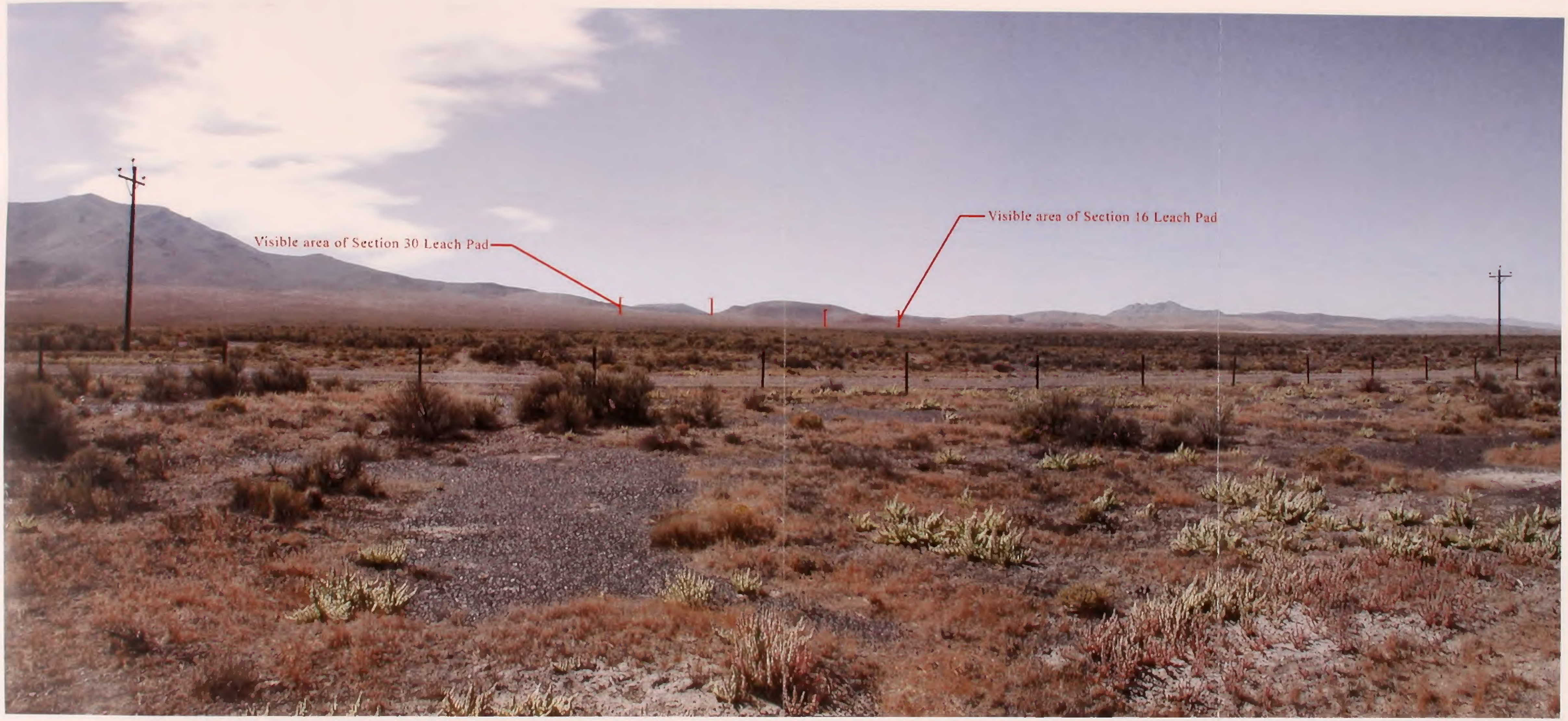
KOP 2 I-80 Mile Marker 221 Existing Conditions	September 20, 2002 Drawing: Sheet 5	Glamis Marigold Mine		



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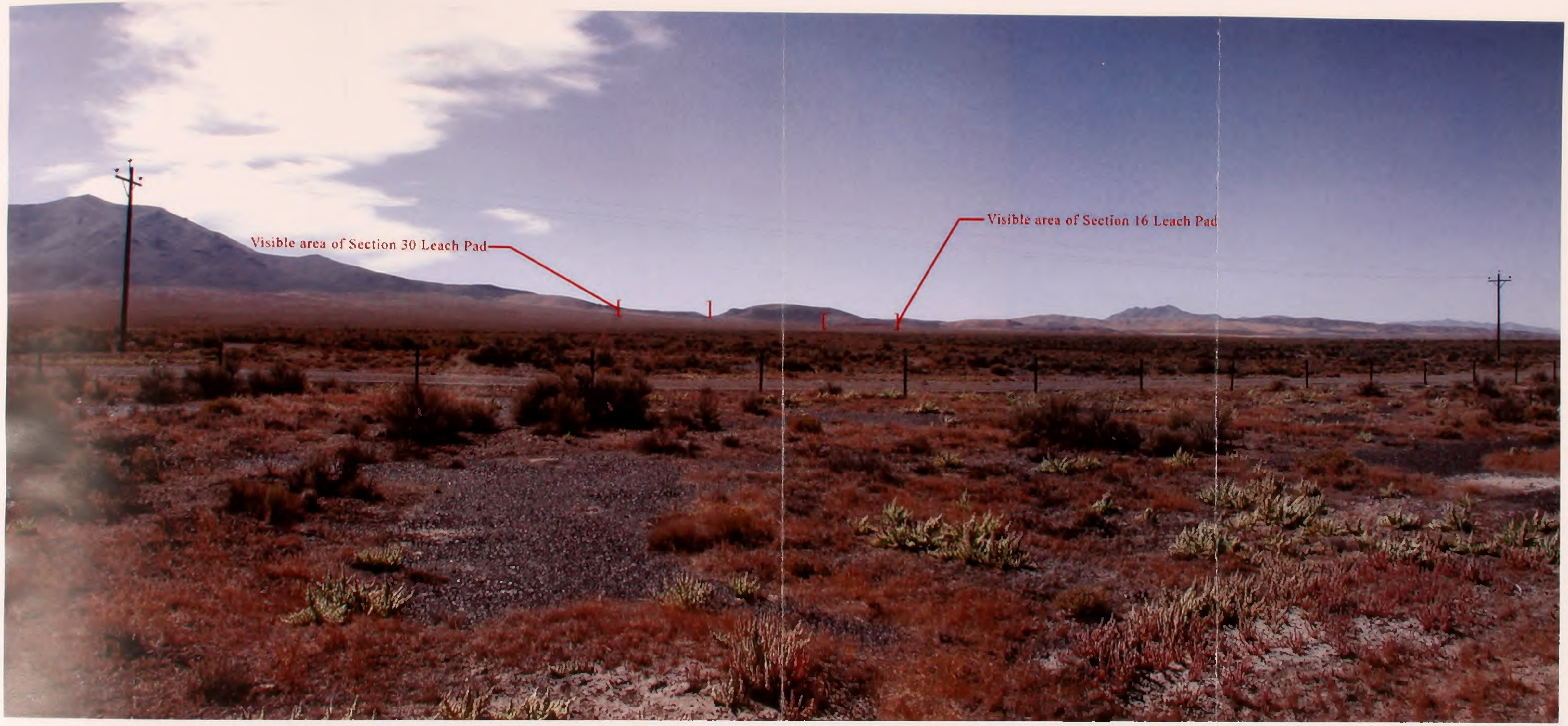

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THE TITLE IS: DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT GLAMIS MARIGOLD MINING COMPANY'S MILLENNIUM EXPANSION PROJECT WINNEMUCCA FIELD OFFICE APRIL 2003

Thank you,

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