CHAPTER 3

AFFECTED ENVIRONMENT FOR PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

Existing resources in the Leeville Project area are described in this chapter. The Project area is located in the Boulder Creek drainage in northern Eureka County, northeastern Nevada (**Figure 3-1**). Elevations range from 5,000 feet above mean sea level (AMSL) in the south and west valley bottom areas to over 7,000 feet AMSL in the Tuscorora Range along the east side of the Project area.

Figure 3-1 shows the general study area for geology and minerals, paleontology, soil, vegetation, invasive nonnative species, and cultural resources. The study area boundaries for air quality; water quantity and quality; wetlands/riparian zones; fisheries and aquatic resources; terrestrial wildlife; threatened, endangered, candidate and sensitive species; grazing management; recreation and wilderness; noise; extend beyond the boundaries depicted on **Figure 3-1** and are described in the respective resource discussions in this chapter. Study areas for each environmental resource are based on the predicted locations of direct and indirect impacts from the Proposed Action.

Appendix 5 of BLM NEPA Handbook (H-1790-1) identifies Critical Elements of the Human Environment. The appendix is a list of elements of the human environment that are subject to requirements specified in statutes or executive orders and must be considered in all BLM environmental assessments (EAs) and environmental impact statements (EISs). The following Critical Elements of the human environment and other resources are potentially affected by the Proposed Action and Alternatives:

- Air Quality
- Cultural Resources
- Environmental Justice
- Invasive, Nonnative Species
- Migratory Birds
- Native American Religious Concerns
- Paleontology
- Threatened, Endangered, Candidate, and Sensitive Species
- Wastes (hazardous or solid)
- Water Quality (Surface/Ground)
- Wetlands/Riparian Zones
- Wilderness

The following Critical Elements of the Human Environment have been analyzed by BLM and would not be affected by the Proposed Action or alternatives or are not present in the proposed Project area:

- Areas of Critical Environmental Concern
- Floodplains
- Wild and Scenic Rivers
- Farmland (prime or unique)

This chapter provides a summary of environmental baseline information. In the following sections, "Project area" and "study area" refer to the Proposed Action and land surrounding the proposed mine, respectively. The "area of potential effect" as used in the *Cultural Resources* section is synonymous with the Project area.

GEOLOGY AND MINERALS

A description of regional geology and gold mineralization in northern Nevada is presented in Chapter 2, *History of Exploration and Mining*. This section of Chapter 3 provides a detailed description of geology in the Leeville Project area.

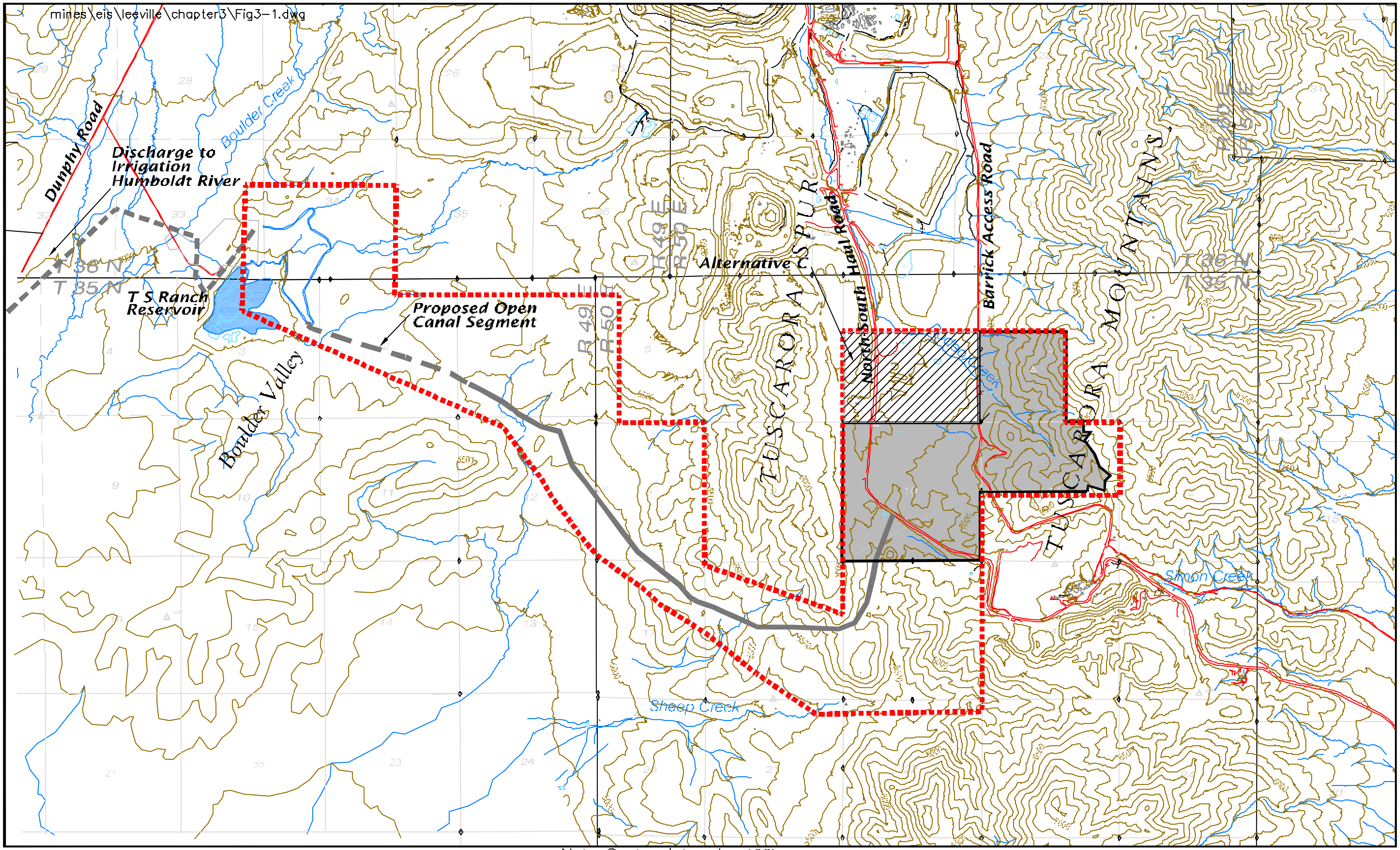
The Leeville Project area is located within the Basin and Range Physiographic Province, a region that extends over most of Nevada and parts of adjoining states. Range-front faulting in the province has created north-south trending fault-block mountain ranges separated by broad valleys filled with alluvium. The geologic history of the study area is summarized in **Table 3-1**.

The Leeville Project area extends from the crest of the Tuscarora Mountains westward across a portion of the Little Boulder Basin to the east edge of the Tuscarora Spur. Valley fill in the Little Boulder Basin consists of poorly-indurated Tertiary-age volcanoclastic sand, tuff, and gravel of the Carlin Formation overlain by Quaternary-age alluvium (**Figures 3-2** and **3-3**). Depth to Paleozoic bedrock in the basin ranges from 0 to 350 feet.

Bedrock in the Tuscarora Mountains is comprised primarily of early Paleozoic-age (505 to 360 million years before present) limestone, silty limestone, dolomite, silty mudstone, chert, and quartzite. Paleozoic-age rocks include the Ordovician-age Vinini Formation (western siliceous assemblage), which was thrust over the Devonian-age Rodeo Creek, Popovich, and the Silurian to Devonian-age Roberts Mountains Formation (eastern carbonate assemblage) along the Roberts Mountains Thrust (**Figures 3-2** and **3-3)**. The upper plate Vinini Formation is comprised of 900 to 1,200 feet of chert, mudstone, greenstone, and silty limestone that was deposited in a deep marine environment. Lower plate rocks are composed of: siliceous mudstone and siltstone of the Rodeo Creek unit (300 feet thick); thin to medium bedded limestone and silty limestone of the Popovich Formation (150 to 250 feet thick); and thin to medium bedded limestone and silty limestone of the Roberts Mountains Formation (1100 to 1550 feet thick) (Jackson et al. 1997). Paleozoic rocks of Ordovician age underly the Roberts Mountains Formation and include dolomite of the Hanson Creek Formation, the Eureka Quartzite, and dolomite and limestone of the Pogonip Group (**Figure 3-2**). The eastern assemblage carbonate rocks of the lower plate were deposited on the western edge of the continental shelf of the North American craton (McFarlane 1991b).

During the middle Paleozoic (360 to 300 million years before present), an island arc collided with the edge of the continent causing an upwarp known as the Antler Orogeny. This collision resulted in the Roberts Mountains Thrust. Erosion of the highland resulted in deposition of sediments to the east and west during late Paleozoic time (300 to 245 million years before present). During the Mesozoic Era (65 to 225 million years before present), granitic stocks and dikes intruded the area along pre-existing high angle faults. During the Cenozoic Era (66 million years ago to present), active tectonics including volcanism, crustal extension, and high-angle faulting affected the area and shaped the existing topography. Faulting and folding are widespread, particularly in the flanks of the Tuscarora Mountains and Tuscarora Spur. Regional folding and localized drag folding are present with one of the more prominent folds, the Tuscarora Anticline, forming the Tuscarora Spur. Paleozoic-age rocks and faults are offset by Tertiary-age high-angle faults (**Figure 3-3**).

Ore in the Leeville Project area occurs in two strata-bound zones located in the upper 350 feet of the Roberts Mountains Formation. Ore grade mineralization is located in the footwall of the West Bounding Fault, which trends northeast, dips 60 degrees west, and has approximately 150 feet of apparent normal displacement. The thickest and highest-grade portion of the deposit is located where the northwest-striking Rodeo Creek Fault intersects the footwall of the West Bounding Fault. Ore occurs in grey to black, decalcified (calcite removed) and weakly to moderately silicified rocks composed of 60 to 70 percent quartz, 10 to 30 percent dolomite, 7 to 16 percent kaolinite and illite, and 2 to 4 percent pyrite (Jackson et al. 1997). Mineralized zones of the ore body occur at depths of 1,500 to 2,000 feet below ground surface.



Note: Contour interval = 100'

Legend

General Study Area Boundary (Geology and Minerals, Paleontology, Soil, Vegetation, Invasive Nonnative Species and Cultural Resources)

Leeville Project Area

Alternative C Project Area

Pipeline Route

Main Access Road

Discharge/Existing Pipeline

N

0 Mile 1

General Study Area

Leeville Project

FIGURE 3-1

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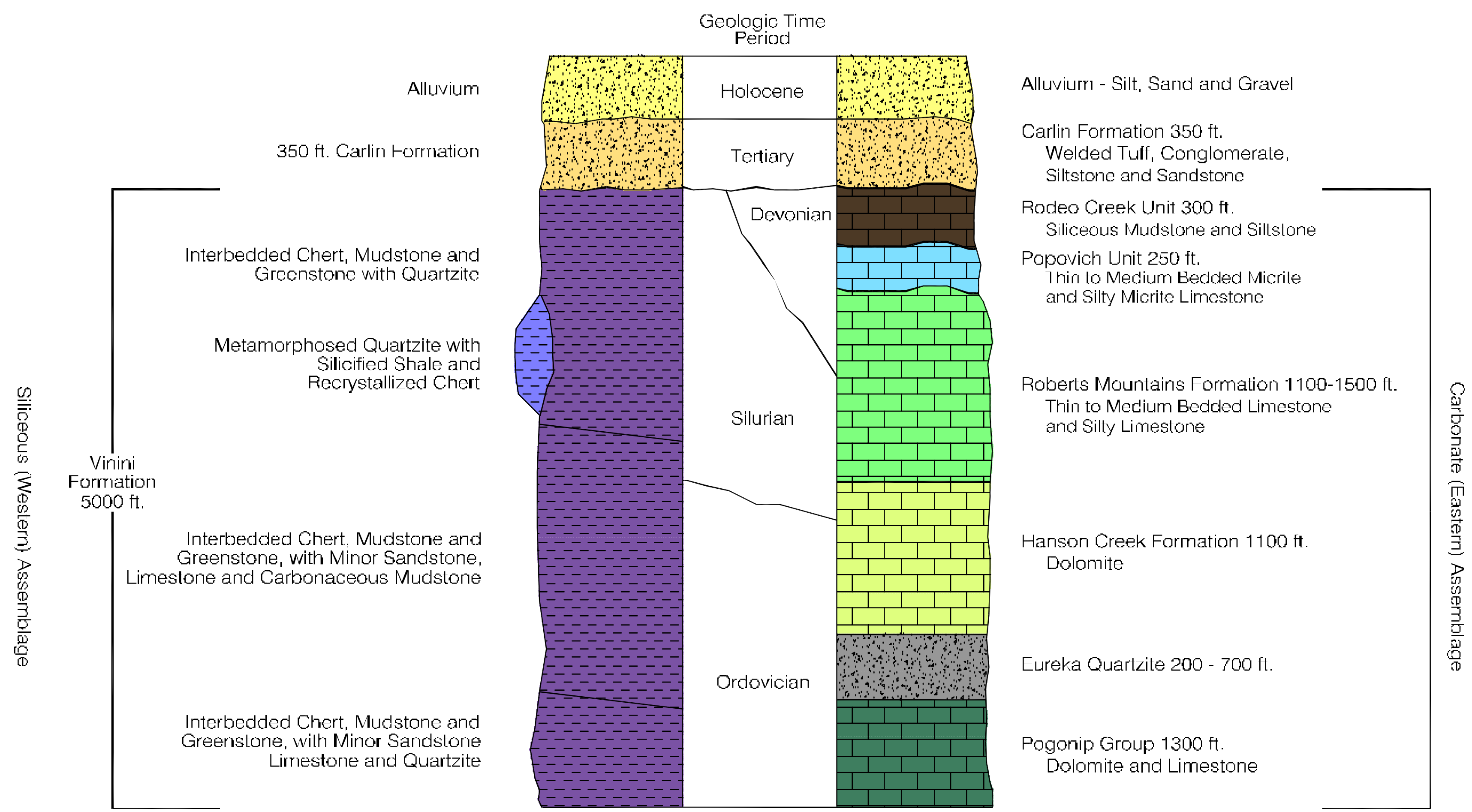

Source: Jackson, et al. 1997; Radtke 1985

General Stratigraphic Section
Leeville Project
FIGURE 3-2

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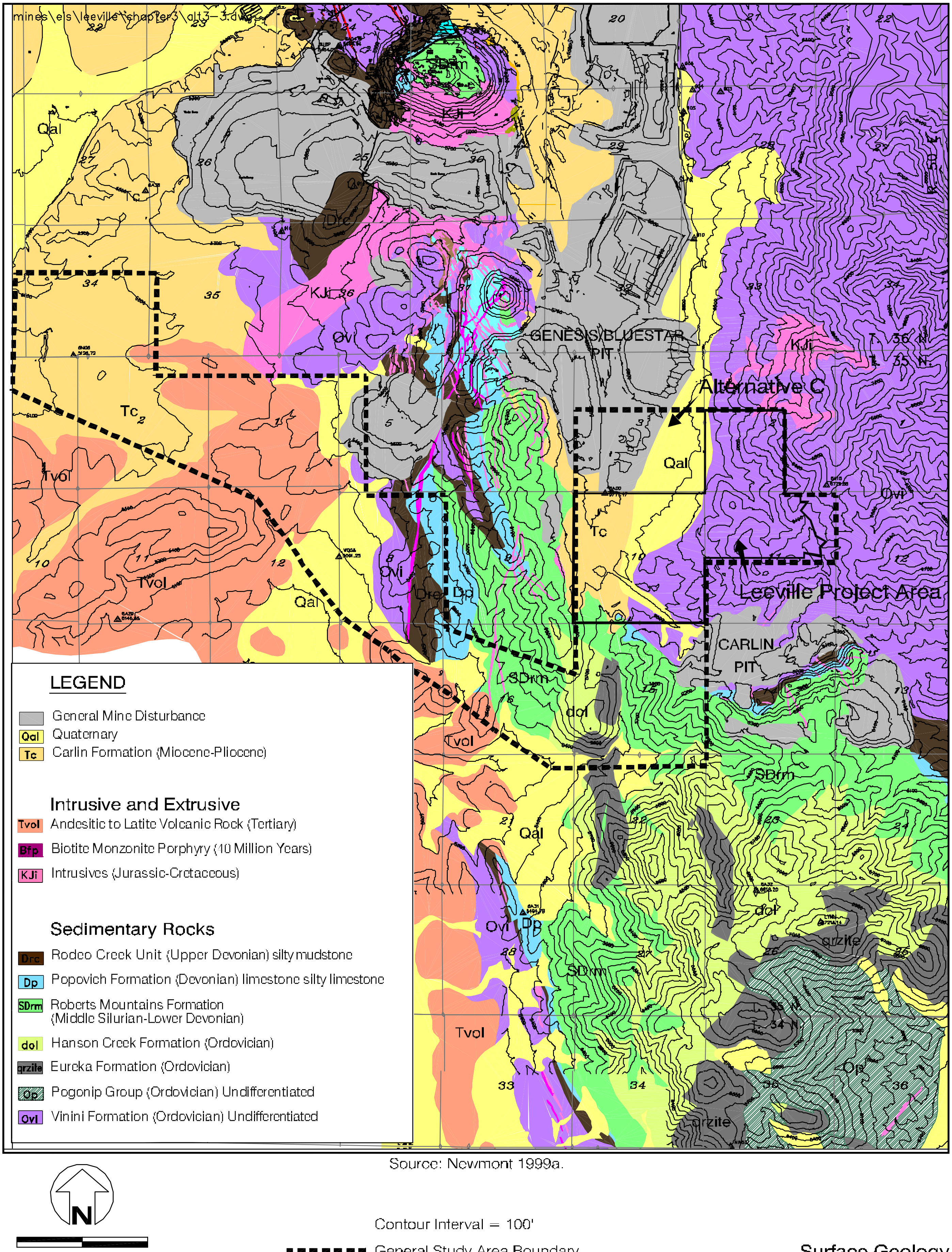

Source: Newmont 1999a.

Surface Geology
Leeville Project
FIGURE 3-3

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TABLE 3-1
Geologic History of the Leeville Project Area

	Geologic Time[1]	Geologic Occurrence	Relationship to Mineralization
Cenozoic Era (0-65)	Quaternary Period (0-3)	Recent localized erosion, deposition, and circulation of groundwater.	Mineralized host rocks are unaffected by local erosion and deposition of surface rocks. Groundwater circulation does not oxidize mineral deposit.
		Regional extension, high-angle faulting, shallow intrusion, and volcanism followed by fluvial and lacustrine deposition (Tertiary-age sediments of the Carlin Formation).	Mineralizing fluids associated with the igneous activity deposit gold and associated sulfides in two strata bound areas in the Roberts Mountains Formation. Carlin Formation sediments are deposited after gold mineralization.
	Tertiary Period (3-65)	High-angle faulting along NW and NE trends. Local emplacement of igneous dikes along high-angle fault zones.	Structural movements prepare rock for mineralization. Hydrothermal solutions migrate along high-angle structures and sedimentary bedding planes depositing minerals.
Mesozoic Era (65-225)	Mesozoic Era (65-225)	Regional emplacement of granitic and dioritic intrusive rocks. Dikes are intruded along previously existing high angle faults which offset rocks of both the upper and lower Roberts Mountains Thrust plates.	Lamprophyre and quartz monzonite dikes are intruded. These dikes may be the source of base metal mineralization in the Carlin Trend and also may have caused silicification of the Popovich Formation, which appears to have controlled later gold bearing mineralization.
Paleozoic Era (225-590)	Late Devonian and Early Mississippian Period (325-360)	Antler Orogeny occurs pushing deeper water marine sedimentary rocks (western assemblage chert and mudstone of the Vinini Formation) eastward along the Roberts Mountains thrust over shallower water marine sedimentary rocks (eastern assemblage silty limestones and calcareous siltstones of the Roberts Mountains Formation, Popovich, and Rodeo Creek units).	Structural compression and thrust faulting in the deposit area.
	Devonian Period (345-395) Silurian Period (395-430) Ordovician Period (430-500)	Deposition of marine sedimentary rocks. Roberts Mountains Formation sediments (thin to medium bedded limestone and silty limestone) grade upwards into Devonian-age Popovich unit fossiliferous limestone. Upper Devonian-age siliceous mudstones and calcareous siltstones of the Rodeo Creek unit overlie Popovich unit limestones. Deposition in the deeper westward ocean of chert, mudstone, greenstone, and limestone of the Vinini Formation.	Upper portion of the Roberts Mountains Formation is later the host to the Leeville Project ore deposits.

Note: [1]Geologic time presented with names of geologic time periods and millions of years before present in parentheses.

Source: Jackson et al. 1997; Radtke 1985; and McFarlane 1991b.

AREA SEISMICITY

The Leeville Project area is located in the Great Basin seismic zone, a region characterized by moderately high rates of seismic activity (Algermissen et al. 1982). To identify historic earthquakes in the project vicinity, two radial searches extending approximately 30 miles and 90 miles from the site (latitude 40 degrees 56 minutes and longitude 116 degrees 20 minutes) were conducted using the U.S. Geological Survey (USGS) and University of Nevada - Reno Seismology Laboratory databases for the time period of 1872 to 1997. Historic earthquakes (post-1872) within 30 miles of the site have ranged from barely detectable to magnitude 5.1. Two magnitude 5.1 earthquakes have occurred: one on September 18, 1945, 24 miles south-southwest of the site, and the other on October 22, 1966, 22 miles south from the site. Within a 90-mile radius of the Project, only one earthquake event was recorded greater than magnitude 5.9. This event occurred in Pleasant Valley on October 15, 1915 with a magnitude of 7.8 (dePolo and dePolo 1999). The epicenter of this earthquake was located approximately 68 miles southwest of the Project site in Pleasant Valley, Nevada. As recently as August 25, 2001, an earthquake with a magnitude of 3.4 occurred about 43 miles northwest of Elko, Nevada (41.19 N Lat., 116.43 W. Long.). The epicenter was located 20 miles west of Tuscarora, Nevada and 50 miles northwest of the Project site.

The closest evidence of historic (post-1872) surface faulting is approximately 68 miles from the Project site at the location of the October 15, 1915, Pleasant Valley earthquake (Chen-Northern 1988). The nearest surface-rupture faults with prehistoric Holocene-age displacement (active faulting between 12,000 years ago and 1870), as mapped by Slemmons (1983), are located in Boulder Valley, approximately 8 miles west-south-west of the Project. Boulder Valley faults were estimated to have had displacement within the last 2,000 years (Slemmons 1983). No active faults (faults with Holocene-age surface offset) have been detected within the Leeville Project area.

During project design, potential effect of earthquake shaking on project facilities was assessed. Parameters typically used to characterize seismicity are: 1) magnitude of the controlling earthquake; 2) maximum horizontal acceleration induced in bedrock at the site by the controlling earthquake; and 3) probability of occurrence of the controlling earthquake.

The maximum predicted earthquake magnitude (M) for the area, as determined by several researchers, is shown in **Table 3-2**. Researchers used two separate methods to assess seismicity in the region: 1) estimation of the maximum credible earthquake based on determination of active faults in the area, and, 2) probabilistic estimation of the risk of earthquake occurrence based on regional seismic modeling. The maximum credible earthquake is the largest earthquake that can be reasonably expected to occur on a fault or over an area. Using the probabilistic approach, Algermissen et al. (1982) estimated that the probability of not exceeding bedrock acceleration of 0.17 gravity (g) in any given 50-year period would be 90 percent, and the probability of not exceeding 0.35g in 250 years would also be 90 percent (**Table 3-2**).

GEOLOGIC RESOURCES

Gold mining has been the primary activity within the vicinity of the Leeville Project area since 1907, when placer gold deposits were discovered along Lynn, Sheep, and Rodeo creeks (BLM 1992). More recently, disseminated gold deposits have become the focus of mining and exploration projects. Prior to initiation of the exploration projects in 1973, mining-related disturbance within the Leeville Project was limited to shallow surface exploration activities consisting of “glory holes” or excavation of placer deposits. These exploration activities tend to be concentrated in the eastern portion of the Project area, on the west slope of the Tuscarora Mountains.

TABLE 3-2
Seismic Characterization for the Leeville Project Area

Assessment Method	Maximum Earthquake Magnitude (M)	Maximum Horizontal Acceleration (g)	Probability of Occurrence
Regional probabilistic assessment	7.3	0.17	90% probability of not being exceeded in 50 years
	7.3	0.35	90% probability of not being exceeded in 250 years

Note: gravity (g) = 9.81 meters per second^2

Source: Algermissen et al. 1982; 1990.

Since 1992, Newmont has been exploring for deep mineralization north of the Carlin Mine. Newmont's efforts from exploration projects at the High Desert and Chevas sites have resulted in discovery of the Leeville deposits. The proposed operations area of the Leeville Project encompasses portions of these exploration projects. Delineated mineralization consists of the West Leeville, Four Corners, and Turf ore deposits present at depths of 1,000 to 2,500 feet below the existing ground surface. The Leeville Project would produce approximately 3,984,000 tons of waste rock and 14,081,000 tons of ore during development of these deposits.

MINE ROCK CHARACTERIZATION

Three deeply buried gold bearing deposits occur in the Leeville Project area: 1) West Leeville; 2) Four Corners; and 3) Turf. Two distinct tectonic units, the upper plate and the lower plate, are present in the area of the deposit. These two units are separated by a thrust fault. All three ore deposits are located within the lower plate.

The upper plate is comprised of a single geologic formation known as the Vinini Formation (Ovi), consisting of siliceous mudstones, siltstones, cherts, silty limestones and their metamorphosed equivalents. The lower plate is comprised of three geologic formations: Rodeo Creek Formation (Drc), consisting of siliceous mudstones, siltstones and sandstones; and the Popovich (Dp) and Roberts Mountains (SDrm) formations, consisting of silty limestones. Three types of mine rock have been identified for the three deposits: 1) unoxidized carbonate rock, 2) carbon sulfide refractory rock, and 3) unoxidized intrusive rock. Ten geochemical rock classifications (**Table 3-3**), which have variable acid-generation and metal release potential, are defined based on grade, lithology, mineralogy, and thrust plate location.

A suite of 966 representative samples were collected from drill cuttings and evaluated for acid-generation potential using the Net Carbonate Value (NCV) static test method. Of the 966 samples submitted, 44 percent were Turf waste rock, 30 percent West Leeville waste rock, 14 percent Four Corners waste rock, 7 percent West Leeville ore, and the remaining 5 percent Four Corners ore.

Results of NCV tests indicate that of 966 samples analyzed, 61 percent are in the range of neutral to highly basic, with the greatest pop-ulation (24 percent) occurring in the highly basic category. The remaining 39 percent of samples are in the range of slightly acidic to highly acidic, although only a small portion fall in the highly acidic category (3 percent). NCV data suggest that West Leeville and Turf deposits are gen-erally basic, and Four Corners deposits are gen-erally acidic or potentially acid-generating (PAG).

This information was used to develop com-posites that represent bulk composition for each of the ten identified geochemical rock types. The number and length of composited intervals varied between materials, as summarized by Coxon (1997). In addition, two master composite samples were prepared to represent run-of-mine ore and waste material from the West Leeville, Four Corners, and Turf deposits over the duration of the Project (Coxon 1997). The master ore and waste composite samples were analyzed for whole rock geochemistry by SVL Analytical, Inc. of Kellogg, Idaho. Results of these analyses (summarized in **Table 3-4**) indicate compositions of ore and waste rock are very similar, and that the rocks are composed primarily of silicates followed by carbon (loss on ignition or LOI), aluminum, magnesium, calcium, iron, and trace amounts of titanium, potassium, manganese, phosphorus, and barium.

The acid-generating potential of waste rock associated with the Proposed Action was reported in a memorandum by Coxon (1997). This study included static geochemical testing of individual drill hole assay samples. The waste lithology composites were also analyzed for acid- generation potential. The number of samples included in each composite is summarized in **Table 3-5** with the Net Neutralization Potential (NNP), which is equal to Acid Neutralization Potential (ANP), less the Acid Generation Potential (AGP) and the Neutralization Potential Ratio (NPR), which is equal to ANP/AGP.

The NPR values confirm that Four Corners waste rock is PAG (i.e., NPR less than the BLM standard 3:1 and the NDEP standard 1.2:1). The majority of the waste is non-PAG. Meteoric Water Mobility Procedure (MWMP) tests were conducted on 15 composite samples including 10 waste rock lithology composites, 3 ore rock lithology composites, and 2 master waste rock and ore rock composites.

TABLE 3-3
Mine Rock Classification
Leeville Mine Project

Rock Type	Deposit	Domain	Formation	Lithology
WLW1	West Leeville	Upper Plate	Ovi	Unoxidized Carbonate
WLW2	West Leeville	Upper Plate	Ovi	Carbon Sulfide Refractory
WLW3	West Leeville	Lower Plate	SDrm, Dp	Unoxidized Carbonate
FCW1	Four Corners	Lower Plate	Drc, Dp, SDrm	Carbon Sulfide Refractory, Unoxidized Carbonate, Unoxidized Intrusive
TW1	Turf	Upper Plate	Ovi	Unoxidized Carbonate
TW2	Turf	Upper Plate	Ovi	Carbon Sulfide Refractory
TW3	Turf	Lower Plate	Dp	Unoxidized Carbonate
TW4	Turf	Lower Plate	SDrm HW	Unknown
TW5	Turf	Lower Plate	SDrm FW	Unknown
TW6	Turf	Lower Plate	SDrm	Unoxidized Carbonate

WLW = West Leeville Waste; FCW = Four Corners Waste; TW = Turf Waste; Ovi = Vinini Formation; SDrm = Roberts Mountains Formation; Dp = Popovich Formation; Drc = Rodeo Creek Formation; HW = Hanging Wall; FW = Foot Wall.
Source: Coxon 1997.

TABLE 3-4
Whole Rock Analytical Results
Leeville Mine Project

Master Composite	Major Elements (percent by weight)											
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	BaO	LOI[1]
Ore	65.57	0.275	5.693	2.402	3.279	5.296	<0.27	0.705	0.014	0.133	0.044	8.50
Waste	65.96	0.256	5.404	1.853	2.847	5.894	<0.27	0.622	0.015	0.167	0.134	9.00

SiO_2 = silica; TiO_2 = titanium oxide; Al_2O_3 = aluminum oxide; Fe_2O_3 = iron oxide; MgO = magnesium oxide; CaO = calcium oxide; Na_2O = sodium oxide; K_2O = potassium oxide; MnO = manganese oxide: P_2O_5 = phosphate; BaO = barium oxide; LOI: Loss on ignition, surrogate for carbon.
Source: Coxon 1997.

TABLE 3-5
Waste Rock Tonnage (ABA Data from Laboratory Analyses)
Leeville Mine Project

Waste Rock					ABA Values	
Deposit and Lab No.	n	Domain	Formation	Lithology	NNP	NPR
WLW1 - West Leeville 99624	139	UP	Ovi	UC	10.2	1.3
WLW2 - West Leeville 99623	113	UP	Ovi	CSR	106	4.1
WLW3 - West Leeville 104992	59	LP	Unk	UC	152	15.7
FCW1 - Four Corners 112948	167	LP	Unk	CSR	-27.1	0.4
TW1 - Turf 143586	105	UP	Drc	CSR	9.5	1.4
TW2 - Turf 143587	205	UP	Dp	UC	104	3.2
TW3 - Turf 153007	62	LP	SDrm HW	UC	171	6.5
TW5 - Turf 153009	126	LP	SDrm FW	Unk	137	6.3
TW6 - Turf 153010	213	LP	SDrm	UC	315	26.2
Total	**1189**					

Note: NA = Data not available; ABA = acid-base accounting; NNP = net neutralization potential; NPR = neutralization potential ratio; WLW = West Leeville Waste; FCW = Four Corners Waste; TW = Turf Waste; LP = Lower Plate; Ovi = Vinini Formation; Drc = Rodeo Creek Formation (Turf Deposit); Dp = Popovich Formation; SDrm = Roberts Mountains Formation; HW = Hanging Wall; FW = Foot Wall; UC = unoxidized carbonate; CSR = carbon sulfide refractory; Unk-Unknown; n = number of samples included in composite. ABA run for waste rock only. Source: Coxon 1997.

All three deposits tested (i.e., West Leeville, Four Corners, and Turf) exhibit a tendency for leaching most metals tested as shown in **Table 3-6,** in some cases above pertinent standards. The only metals that show no elevated concentrations with respect to standards are barium, lead, mercury, and silver. For beryllium, chromium, selenium and copper, only one ore sample exceeded the respective water quality standards. For non-metal parameters tested, most samples exceeded standards for sulfate and total dissolved solids (TDS). With the exception of a Four Corners ore sample, the pH values are in the range of 6.8 to 8.4 standard units.

TABLE 3-6
Meteoric Water Mobility Procedure Leach Extraction Results for Leeville Mine Project Drill Hole Composite Samples

Sample Type							Metals (mg/L)								
No.	n	Dep	Dom	Fm	Lt	Gd	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb
99624	139	WLW1	UP	Ovi	UC	W	0.043	0.125	0.031	<0.001	<0.002	<0.003	<0.003	<0.017	0.002
99623	113	WLW2	UP	Ovi	CSR	W	0.048	0.082	0.035	<0.001	<0.002	<0.003	0.011	<0.017	<0.001
104992	59	WLW3	LP	Unk	UC	W	1.45	0.067	0.024	<0.001	<0.0024	<0.005	0.004	<0.024	0.002
112946	65	WLO	LP	SDrm	UC	O	1.11	0.118	0.016	<0.001	<0.0024	<0.005	<0.003	<0.024	<0.005
112948	167	FCW	Unk	Unk	Unk	W	1.75	0.843	0.021	<0.001	<0.0024	<0.005	0.006	0.2	<0.005
112947	48	FCO	Unk	Unk	Unk	O	0.656	30.2	0.024	0.017	<0.012	1.85	9.74	668	<0.005
143586	105	TW1	UP	Ovi	UC	W	0.025	0.57	0.155	<0.001	<0.0024	<0.005	0.018	1.52	0.004
143587	205	TW2	UP	Ovi	CSR	W	0.033	0.75	0.215	<0.001	<0.0024	<0.005	0.024	1.21	0.004
153007	62	TW3	LP	Dp	UC	W	0.106	<0.04	0.014	<0.002	0.017	<0.008	<0.004	0.03	<0.004
153008	72	TW4	LP	SDrm HW	Unk	W	0.364	0.41	0.043	<0.002	<0.002	<0.008	<0.004	<0.019	<0.004
153009	126	TW5	LP	SDrm FW	Unk	W	0.143	0.17	0.019	<0.002	0.004	0.016	<0.004	<0.019	<0.004
153010	213	TW6	LP	SDrm	Unk	W	0.302	0.63	0.024	<0.002	<0.002	<0.008	<0.004	<0.019	<0.004
153006	173	TO	Unk	Unk	Unk	O	0.109	<0.04	0.017	<0.02	0.019	<0.008	<0.004	9.39	<0.004
182633	Nd	Master Composite Waste					0.149	<0.04	0.029	<0.002	<0.002	NA	<0.004	0.054	<0.002
182532	Nd	Master Composite Ore					0.096	<0.04	0.034	<0.002	0.035	NA	<0.004	189	0.008
Nevada Water Quality Standards							**0.146**	**0.05**	**2.0**	**0.004***	**0.005**	**0.1**	**1.3***	**0.3*(s)**	**0.05**

	Metals (mg/L)							Non-Metals						
No.	Mn	Hg	Ni	Se	Ag	Tl	Zn	Cl	Fl	NO_3	CN	SO_4	TDS	pH
99623	0.021	<0.0002	<0.021	0.02	<0.002	<0.001	<0.002	3.03	0.68	0.11	<0.01	503	829	8.07
99624	0.031	<0.0002	<0.021	0.031	<0.002	<0.001	0.006	4.19	1.18	0.25	<0.01	555	910	8.22
104992	0.025	<0.0002	0.04	0.021	0.003	0.008	0.007	4.13	0.29	<0.05	<0.01	728	1270	7.84
112946	0.077	0.0003	<0.017	0.008	<0.003	0.033	0.003	7.04	<0.2	<0.1	.0.01	1500	2550	7.91
112948	1.11	0.0005	1.79	0.018	<0.003	0.01	0.119	4.92	1.95	<0.25	<0.01	863	1390	7.68
112947	1.51	<0.0002	7.81	<0.01	0.053	0.798	9.17	8.29	5.54	0.67	<0.01	3660	5570	2.98
143586	0.024	0.0003	0.034	<0.04	0.009	<0.001	0.035	11.2	0.7	<0.02	<0.01	206	684	8.37
143587	0.099	0.0002	0.07	0.05	0.009	<0.01	0.067	6.9	2.0	0.38	<0.01	217	558	8.17
153007	1.53	<0.0002	5.52	<0.048	<0.005	0.028	6.07	21.4	0.7	0.1	<0.01	1980	3230	7.39
153008	0.086	<0.0002	0.135	<0.048	<0.005	0.01	0.024	20.2	1.1	0.18	<0.01	796	1400	7.79
153009	0.398	<0.0002	0.681	<0.048	<0.005	0.014	0.688	17.9	1.1	0.25	<0.01	1470	2380	7.59
153010	0.009	<0.0002	0.021	<0.048	<0.005	0.005	<0.004	22.1	1.2	0.16	<0.01	633	1040	7.79
153006	3.64	0.0003	4.95	<0.048	<0.005	0.061	6.31	14.2	0.8	0.12	<0.01	2730	4500	6.86
182633	0.91	<00002	0.852	0.064	<0.005	0.032	0.472	7.4	0.7	0.1	<0.01	2030	3070	7.56
182532	3.44	0.0007	4.16	<0.048	0.008	0.236	8.85	7.6	1.6	0.15	<0.01	3480	5640	5.75
	0.05*(s)	**0.002**	**0.0134**	**0.05**	**--**	**0.013**	**5.0*(s)**	**250**	**4.0**	**10**	**0.2**	**250**	**500**	**5.0-9.0**

Nevada water quality standards are the "Municipal or Domestic Supply" values listed in **Table 3-13**; if no corresponding standard exists, the federal drinking water standard is used and denoted by an asterisk (*). Values with (s) are secondary drinking water standard.

Shading indicates results exceed Nevada water quality standards.

mg/L = milligrams per liter; n = number samples included in each composite; Nd = No data; Dep = Deposit; WLW = West Leeville Waste; FCW = Four Corners Waste; FCO – Four Corners Ore; TW = Turf Waste; TO = Turf Ore; Dom = Domain; UP = Upper Plate; LP = Lower Plate; Unk = Unknown; Fm = Formation; Ovi = Vinini Fm; SDrm = Roberts Mountains Fm ; Dp = Popovich Fm; HW = Head Wall; FW = Foot Wall; Lt = Lithology; CSR = Carbon Sulfide Refractory; UC = Unoxidized Carbonate; Gd = Grade; W = Waste Rock; O = Ore; Sb = antimony; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Fe = iron; Pb = lead; Mn = manganese; Hg = mercury; Ni = nickel; Se = selenium; Ag = silver; Tl = thallium; Zn = zinc; Cl = chloride; Fl = fluoride; NO_3 = nitrate; CN = cyanide; SO_4 = Sulfate; TDS = Total Dissolved Solids; pH = standard units.

Source: Coxon 1997.

PALEONTOLOGICAL RESOURCES

Fossils in northeastern Nevada include vertebrate animals, invertebrate animals, and plants. Fossils in the study area have a relatively broad regional distribution, and are not restricted to any one area. Most invertebrate fossils found in the region of the Leeville Project are of Paleozoic-age. Mammalian fossils found on BLM land during a survey of the Gold Quarry Mine to the south include remains of Cenozoic-age horses, camels, and rodents (Firby and Schorn 1983).

The majority of invertebrate fossils in the Project area occur in Ordovician, Silurian, and Devonian-age rocks and include:

- Brachiopods and conodonts in the Vinini Formation (Rubens et al. 1967; Stewart and McKee 1977);
- Corals, bryozoa, brachiopods, and crinoid fragments in limestone of the Popovich unit (Baker 1991); and
- Coral, bryozoa, brachiopods, mollusks, trilobites, tenticulitids, graptolites, conodonts, and crinoid fragments in the Roberts Mountains Formation (Firby 1993; Coates 1987).

Although uncommon, invertebrates of Tertiary-age have been found in the Humboldt and Carlin Formations, which are synonymous to some authors (Eaton 1994). Mollusks and leaf floras have been collected from the Carlin Formation (BLM 1992), whereas ostracods occur in the Humboldt Formation (Firby 1992).

Vertebrate fossils are generally found in Tertiary-age sediments, although the Roberts Mountains Formation has some potential for Paleozoic vertebrate fossils. Mammalian fossils of Tertiary-age discovered in Elko and Eureka counties include prehistoric horses, camels, rhinos, and rodents (Firby and Schorn 1983; Regnier 1960). These fossils have been found in the Carlin and Raine Ranch Formations. Devonian-age fish fossils have been recovered in the Roberts Mountains Formation about 70 miles south of the Leeville Project area (Firby 1992).

AIR QUALITY

METEOROLOGY

The Leeville Project area is subject to large daily temperature fluctuations, low relative humidity, and limited cloud cover. Wind data collected at Newmont's North Area Leach Facility, located approximately 1 mile from the Leeville Project, indicate the most common wind direction is from the southeast but is influenced by daily heating and cooling of hills and drainage areas **(Figure 3-4)**. Local topographic features frequently cause wind to flow in the direction of the valley (also known as drainage wind). Average wind speed is 8.4 miles per hour.

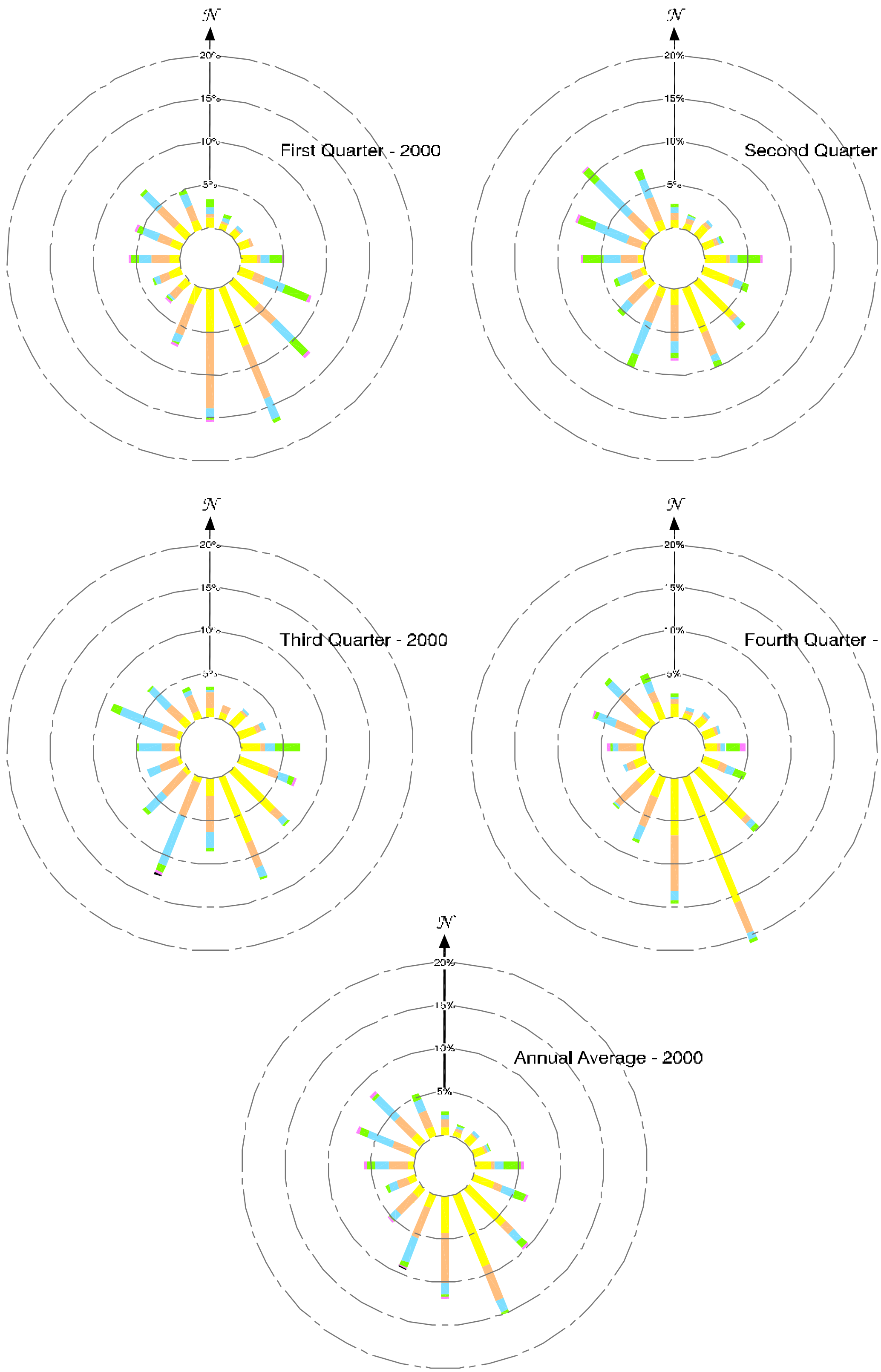
The Tuscarora Mountains rise to approximately 7,000 feet AMSL directly east of the Project area and markedly influence wind, precipitation, and temperature. After sunset, cool mountain air flow is down slope across the Project area. Temperatures increase after sunrise, as warm valley air rises up slope until midday, when ground heating causes instability and variable wind directions.

TEMPERATURE AND PRECIPITATION

The Project area is located approximately 20 miles northwest of Carlin, Nevada. General meteorological conditions in the area are represented by data collected by the National Weather Service at Elko, Beowawe, and Tuscarora. Temperature data are also available from the Carlin Mine, located approximately 1 mile south of the Project area. Average monthly temperature and precipitation data from these sites provide a description of general weather patterns in the region (**Table 3-7**).

Mean monthly temperatures recorded at the Beowawe, Elko, and Tuscarora meteorological stations vary from 67-71^{o} F in July and August to 24-28^{o} F in December and January. The 1966-2000 Carlin Mine temperature data are consistent with those recorded from the three National Weather Service stations. Monthly mean minimum and maximum daily temperature values from the mine site demonstrate that the range of temperatures within a month typically vary by 20^{o} F or more.

mines\eis\leeville\chapter3\windrose.dwg



Source: BLM 2000a

Wind Speed Class

- 0-3 MPH
- 3-7 MPH
- 7-12 MPH
- 12-18 MPH
- 18-24 MPH
- >24 MPH

Wind Rose
Leeville Project
FIGURE 3-4

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Table 3-7 shows mean monthly precipitation and temperature data for the Beowawe, Elko, and Tuscarora meteorological stations. These stations show similar trends, with heaviest precipitation falling from November through January as snow, and in May and June as rain. Summer precipitation occurs mostly as scattered showers and thunderstorms that contribute relatively little to overall precipitation.

AIR QUALITY

The State of Nevada and federal government have established ambient air quality standards for criteria air pollutants. The criteria pollutants are carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2), particulate matter smaller than 10 microns (PM_{10}), ozone, and nitrogen dioxide (NO_2).

Ambient air quality standards must not be exceeded in areas where the general public has access. **Table 3-8** lists the Nevada and federal primary and secondary air quality standards.

National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health. National secondary standards are the levels of air quality necessary to protect the public welfare from known or anticipated adverse effects of a regulated air pollutant.

These standards, other than for ozone and those based on annual averages, must not be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

The attainment status for pollutants within the Project area is determined by monitoring levels of criteria pollutants for which National Ambient Air Quality Standards (NAAQS) and Nevada Ambient Air Quality Standards exist. Air quality in Eureka and Elko counties is classified as attainment or unclassified for all pollutants. Attainment or unclassified designation means no violations of Nevada or national air quality standards have been documented in the region.

TABLE 3-7
Leeville Project Area Temperature and Precipitation

Meteorological Station	Elevation (feet)	Period of Record		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann.
Average Maximum, Average Minimum, and Mean Temperature (degrees F)																
Beowawe	4,684	1949-2000	Max	40	48	53	63	72	82	92	90	81	67	51	41	65
			Min	15	21	25	30	37	44	50	47	39	29	22	15	31
			Mean	27	33	39	46	55	63	71	68	59	48	36	28	48
Newmont's Carlin Mine	6,530	1966-2000	Max	35	39	44	52	62	72	83	83	72	59	43	35	57
			Min	20	23	26	31	40	49	58	58	48	38	27	20	36
			Mean	27	31	35	41	51	61	71	71	60	48	35	27	46
Elko	5,050	1888-2000	Max	37	43	51	60	69	80	91	89	79	66	50	39	63
			Min	11	17	24	29	36	42	48	45	36	28	20	13	29
			Mean	24	30	37	45	52	61	69	67	58	47	35	26	46
Tuscarora	6,170	1957-2000	Max	37	40	45	53	63	73	84	83	73	62	45	38	58
			Min	16	19	23	28	35	42	50	48	40	32	24	18	31
			Mean	27	30	34	41	49	58	67	66	56	47	34	28	45
Mean Monthly Precipitation (inches)																
Beowawe	4,684	1949-2000	Mean	0.82	0.65	0.76	0.80	1.20	0.91	0.27	0.43	0.50	0.60	0.80	0.80	8.54
Carlin Mine	6,530	1966-2000	Mean	1.18	0.97	1.26	1.11	1.30	1.13	0.40	0.46	0.98	0.96	1.13	1.58	12.46
Elko	5,050	1888-2000	Mean	1.20	0.95	0.92	0.80	0.99	0.80	0.36	0.40	0.45	0.71	0.91	1.07	9.55
Tuscarora	6,170	1957-2000	Mean	1.27	0.99	1.11	0.87	1.46	1.21	0.53	0.47	0.79	0.93	1.42	1.47	12.52

Source: Western Regional Climate Center 2001.

In 1997, the United States Environmental Protection Agency (EPA) revised the federal primary and secondary particulate matter standards by establishing annual and 24-hour standards for particles 2.5 micrometers in diameter or smaller ($PM_{2.5}$). States will be required to submit attainment designations for each $PM_{2.5}$ area within one year after receipt of three years of air quality data, expected to be available in the 2002-2003 time frame. Significant technical difficulties still exist with respect to $PM_{2.5}$ monitoring, emission estimation, and modeling. Until these difficulties are resolved, PM_{10} may be used as a surrogate for $PM_{2.5}$ in meeting new source review permitting requirements.

Air Quality Monitoring Data

PM_{10} ambient air quality data have been collected within the towns of Elko and Battle Mountain since 1993. Ambient ozone data were collected at the Saval Ranch along State Route 225 north of Elko from 1989 through 1993. In addition, PM_{10} was measured at the Betze/Post Mine air monitoring station from 1990 through 1992. **Table 3-9** lists available air quality monitoring data for the Leeville Project area and surrounding sites. Ozone monitoring is no longer conducted in north-central Nevada. Ozone monitoring in Nevada is limited to Clark and Washoe Counties.

The PM_{10} data from the Elko and Battle Mountain monitoring stations represent air quality within populated areas. The primary contributors to ambient particulate concentrations in populated areas is road dust and residential wood smoke. Air quality data from the Betze/Post Mine monitoring station are representative of air quality surrounding active mine sites in the area. Air quality violations have not been identified at any of the stations.

TABLE 3-8
State of Nevada and National Ambient Air Quality Standards

Pollutant	Averaging Time	Concentration	Comments
Ozone	1 hour	235 $\mu g/m^3$ (0.12 ppm)	National Primary Standard and Nevada Standard
Carbon Monoxide, below 5,000 ft AMSL	8 hours	10,000 $\mu g/m^3$ (9.0 ppm)	National Primary Standard and Nevada Standard
Carbon Monoxide, at or above 5,000 ft AMSL	8 hours	6,670 $\mu g/m^3$ (6.0 ppm)	Nevada Standard only; National 8-hour Standard is same for all elevations
Carbon Monoxide, all elevations	1 hour	40,000 $\mu g/m^3$ (35 ppm)	National Primary Standard and Nevada Standard
Nitrogen Dioxide	Annual Arithmetic Mean	100 $\mu g/m^3$ (0.053 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	Annual Arithmetic Mean	80 $\mu g/m^3$ (0.03 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	24 hours	365 $\mu g/m^3$ (0.14 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	3 hours	1,300 $\mu g/m^3$ (0.5 ppm)	National Secondary Standard and Nevada Standard
Particulate Matter as PM_{10}	Annual Arithmetic Mean	50 $\mu g/m^3$	National Primary Standard and Nevada Standard
Particulate Matter as PM_{10}	24 hours	150 $\mu g/m^3$	National Primary Standard and Nevada Standard
Lead (Pb)	Quarterly Average	1.5 $\mu g/m^3$	National Primary Standard and Nevada Standard
Visibility	Observation	In sufficient amount to reduce the prevailing visibility to less than 30 miles when humidity is less than 70%	Nevada Standard only
Hydrogen Sulfide	1 hour	112 $\mu g/m^3$ (0.08 ppm)	Nevada Standard only

Note: $\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million; AMSL = above mean sea level.

Source : NDEP 1997

TABLE 3-9
PM_{10} and Ozone Monitoring Data

PM_{10} Monitoring Data				
Site	**Year**	**Annual Mean ($\mu g/m^3$)**	**24-Hour High ($\mu g/m^3$)**	**24-Hour 2nd High ($\mu g/m^3$)**
Betze/Post Mine	1990	18	44	30
	1991	17	74	45
	1992	11	20	20
City of Elko	1993	28.8	79	66
	1994	31.3	87	59
	1995	35.4	75	74
	1996	32.3	119	107
	1997	24.8	49	46
	1998	19.0	91	58
	1999[1]	18.5	48	46
City of Battle Mountain #1	1992	30.5	83	46
	1993	-	-	-
	1994	33.5	95	66
	1995	34.4	95	65
	1996	41.3	244	91
	1997	31.8	83	64
	1998	26.5	149	61
City of Battle Mountain #2	1998	16.4	69	59
	1999[1]	16.0	54	39
Ozone Monitoring Data				
Site	**Year**	**Annual Mean (ppm)**	**1-Hour High (ppm)**	**1-Hour 2nd High (ppm)**
Saval Ranch	1989	0.0532	0.080	0.076
	1990	0.0513	0.078	0.077
	1991	0.0533	0.091	0.088
	1992	0.0513	0.079	0.074
	1993	0.0565	0.084	0.078

Note: PM_{10} = particulate matter smaller than 10 microns; $\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million;
[1] 1999 data collection is not for complete year

Source: EPA 1999.

PSD CLASSIFICATION

The area surrounding the proposed Leeville Project is a designated Class II area as defined by the Federal Prevention of Significant Deterioration of Air Quality (PSD) program. The PSD Class II designation allows moderate growth or degradation of air quality within certain limits above baseline air quality. Industrial sources proposing construction or modifications must demonstrate that proposed emissions would not cause significant deterioration of air quality in all areas. Standards for significant deterioration are stricter for Class I areas than Class II areas. The nearest Class I area is the 64,667 acre Jarbidge Wilderness, located approximately 75 miles northeast of the proposed Leeville Project.

The Jarbidge Wilderness contains rugged, glaciated mountainous terrain. The Jarbidge Mountains form a single crest and maintain elevations between 9,800 and 11,000 feet for approximately 7 miles. Eight peaks exceed 10,000 feet elevation. Scenic views within the Jarbidge Wilderness range from sagebrush flatland to high, rugged, rocky peaks. As a federal mandatory Class I area, the Jarbidge Wilderness receives visibility protection through the PSD air quality permitting process. There are no designated Integral Vistas associated with the Jarbidge Wilderness.

Two other wilderness areas are located in the Humboldt National Forest southeast of the Project area: East Humboldt Wilderness and Ruby Mountain Wilderness. Neither of these wilderness areas are mandatory federal Class I airsheds. The BLM manages 10 Wilderness Study Areas (WSA) in the Elko District, seven of which (all or portions of) have been recommended for wilderness designation. None of these WSAs are mandatory Class 1 airsheds (Hawthorne 2001).

ONGOING OPERATIONS

Existing mining and ore-processing operations in the Leeville Project area produce criteria pollutant emissions, most notably from articulate matter. Particulate matter is emitted from point sources such as crushers and boilers. Fugitive particulate matter emissions are created by drilling, blasting, hauling and crushing rock, and from road dust. Combustion products including carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and hydrocarbons are emitted from boilers, kilns, stationary engines and vehicle engines. Sulfur dioxide, hydrogen sulfide, sulfuric acid mist and particulate sulfur are emitted during ore processing in autoclaves. **Table 3-10** contains a list of existing permitted point source air pollutants in the Boulder Flat air quality management basin.

TABLE 3-10
Existing Permitted Point Sources of Air Pollutants
Boulder Flat Air Quality Management Basin

Dee Gold Mine – Boulder Creek	Jaw crusher, screen, cone crusher Conveyor, ore bin Cargon regeneration kiln Induction furnace Lime storage bin Cyanide storage bin Cement storage bin
Newmont Mill #4	Gyratory crusher, hopper, feeder Cement silo Reclaim tunnel apron feeder Lime bin Secondary cone crusher
Barrick and Newmont Betze/ Post Mine	Mill crusher, reclaim hopper Mill lime silo Heap leach crushing system Carbon reactivation kiln Cement silo Melting furnace (electric) Autoclaves (6) Steam boiler Lime silo ADR furnace (electric) ADR carbon reactivation kiln
Newmont North Area Heap Leach	Gyratory crusher Cone crushers (2) Screens (2) Cement bin
Newmont Carlin and Deep Star Mines	Aggregate hoppers and conveyors Cement silos Metal removal screens and conveyors

Source: McVehil-Monnet Associates, Inc. 1993; 1994.

WATER QUANTITY AND QUALITY

The study area for water resources includes portions of the following hydrographic areas: Boulder Flat (No. 61), Rock Creek Valley (No. 62), Willow Creek Valley (No. 63), Maggie Creek Area (No. 51), Marys Creek Area (No. 52), Susie Creek Area (No. 50), and the adjoining portion of the Humboldt River (**Figure 3-5**).

SURFACE WATER QUANTITY

The Leeville Project area is located on the west slope of the Tuscarora Mountains within the Boulder Flat hydrographic area. Boulder Creek, the primary surface water drainage in this hydrographic area, generally drains southwest toward Rock Creek and the Humboldt River, located approximately 20 miles from the Project site (**Figure 3-5**). Boulder, Bell, Brush, and Rodeo creeks are minor, intermittent drainages and do not support sufficient flows to maintain a defined channel to the Humboldt River. There are no natural ponds or lakes in the vicinity of the Leeville Project. A description of stock ponds in the Project area is in the *Grazing Management* section of this chapter.

The Leeville Project is located on the drainage divide in the headwater of Rodeo Creek and Sheep Creek, both of which are intermittent drainages in the Boulder Creek basin (**Figure 3-1 and Figure 3-5**). The eastern portion of the proposed pipeline route is located in the Sheep Creek drainage, and the western portion of the proposed pipeline route crosses an ephemeral channel that drains to Boulder Creek. The Sheep Creek channel extends to the south-southwest and ends on an alluvial fan approximately 4 miles east of Boulder Creek. Sheep Creek has one short reach of year-round flow approximately 1 mile south of the Leeville Project area (**Figure 3-6**). Rodeo Creek drains to the northwest and joins Boulder Creek approximately 7 miles from the Project site. Rodeo Creek also has a few short channel segments that have flow year-round due to shallow groundwater inflow.

The Tuscarora Mountains extend north-south and separate Boulder, Rock, Antelope, and Willow creeks on the west from Maggie, Marys, and Susie creeks to the east (**Figure 3-5)**. The Leeville Project area is located on the immediate west flank of the mountain divide. The Sheep Creek Range separates Boulder Creek from Rock Creek. Maggie, Susie, and Marys creeks flow southward to the Humboldt River near the town of Carlin, approximately 20 miles southeast of the Leeville Project area (**Figure 3-5**).

All streams in the immediate Project area are ephemeral or intermittent, the former with flow occurring primarily in response to significant precipitation events or snow-melt runoff, and the latter flowing mainly in wetter months when the water table is higher and in contact with the stream. Peak flow typically occurs during March, April, May, or June. Stream segments that typically have year-round measurable baseflow are shown on **Figure 3-6**. Most reaches with perennial flow are located in the upper headwater mountainous areas. Where flow does occur in area streams, baseflow rates are in the range of 1 to 3 cubic feet per second (cfs) or less.

The TS Ranch Reservoir receives mine discharge water from the dewatering system at Barrick's Goldstrike Property. This reservoir is located approximately 5 miles west of the Leeville Project area (**Figure 3-6**) and is at the terminus of the proposed pipeline and canal system for the Leeville dewatering system. The majority of the water in the TS Ranch Reservoir infiltrates to underlying bedrock through a fault/fracture system. Operation of the reservoir is based on an agreement between Newmont and Barrick.

Up to 69,000 gallons per minute (gpm) or 154 cfs (minus process water) have been discharged from the Goldstrike Property dewatering system to an irrigation system, during the irrigation season (i.e., April to early October) using about 75 irrigation pivots and a flood irrigation system (**Figure 3-5**). Most of the pivots are used to irrigate TS Ranch land owned by Newmont in the Boulder Flat area. During the non-irrigation season (i.e., late October through March), excess mine water is discharged to infiltration basins, injection wells, and/or the TS Ranch Reservoir (**Figure 3-5**). Barrick discharged treated water to the Humboldt River from its mine dewatering operations from September 1997 to February 1999. Water was treated to reduce total dissolved solids (TDS) and cooled to meet effluent limitations.

Dewatering for the Goldstrike Property began in 1990 and, under current plans, will continue through 2010. Groundwater pumping rates for the Goldstrike Property, Gold Quarry, and Leeville mines (past and future rates) are shown graphically on **Figure 3-7**. Water management information for these mines is summarized in **Table 3-11**.

Dewatering from the Gold Quarry Mine began in 1992 and has ranged from 4,000 to 20,000 gpm (9 to 45 cfs), with an expected future rate averaging 10,000 gpm (**Figure 3-7**). The rate for fourth quarter 1999, was 7,045 gpm. The discharge water enters lower Maggie Creek and then the Humboldt River after cooling, with some water stored in the Maggie Creek Ranch Reservoir during peak spring runoff. Water in the reservoir is used for crop irrigation in the Maggie Creek Valley or is discharged to Maggie Creek. Dewatering at Gold Quarry is expected to continue through 2011.

Rodeo Creek

Approximately two-thirds of the Leeville Project area shown on **Figure 3-6** is contained in the upper Rodeo Creek drainage; the remaining third of the Project area is in the Sheep Creek drainage. Both Rodeo and Sheep creeks are located in the Boulder Flat Hydrographic Area. Intermittent flow in Rodeo Creek occurs primarily in the middle section of the stream as a result of groundwater discharge from springs and seeps (Welsh Engineering 1989). Newmont and Barrick constructed a diversion on Rodeo Creek in 1993 to allow expansion of the Betze/Post pit. Rodeo Creek is monitored monthly by Barrick at four sites (RC-AA, RC-A, RC-B and RC-C; **Figure 3-6)**.

A surface water flow hydrograph for one of the Rodeo Creek stations (RC-C) is presented on **Figure 3-8**; seasonal variations in flow shown on this hydrograph are similar to the other three monitoring sites on Rodeo Creek. In general, Rodeo Creek is dry except during the spring period of March through June (Barrick 1998). Heavy precipitation in the spring of 1993 and 1996-97 resulted in streamflow rates of up to 1,300 gpm (2.9 cfs) in the upper portion of Rodeo Creek, and up to 12,000 gpm (27 cfs) in lower Rodeo Creek (Barrick 2000). Peak flow rates measured during other years in the period of record are about half the maximum values reported above for Rodeo Creek. The Rodeo Creek channel typically is narrow and entrenched to depths of 4 to 24 feet. The lower reaches of Rodeo Creek show evidence of sedimentation (BLM 1991). This creek drains a total area of approximately 19.4 square miles.

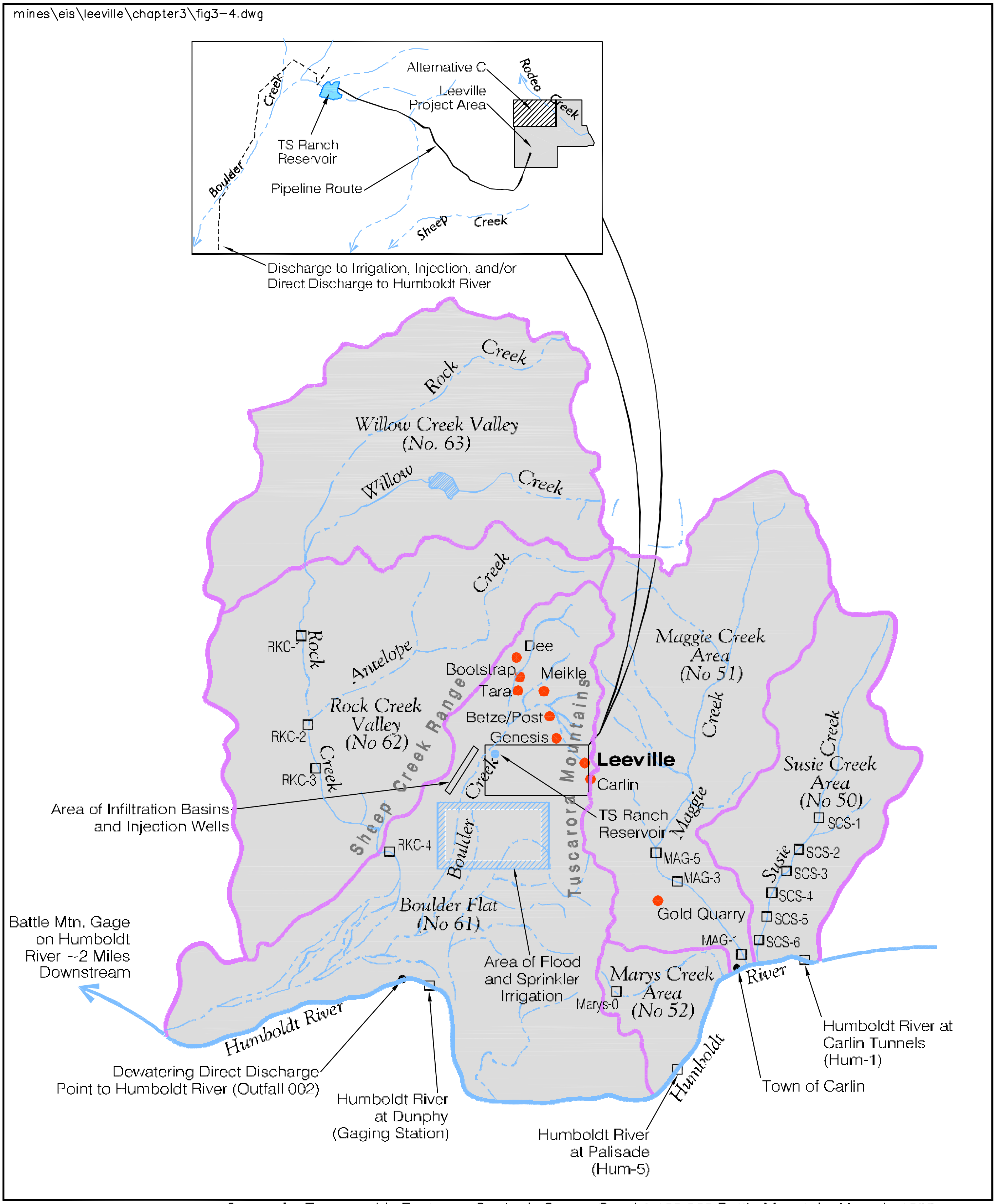
Brush and Bell creeks are two primary tributaries of Rodeo Creek located north of the Leeville Project area (**Figure 3-6**). Bell and Brush creeks have perennial flow in the upper reaches and are intermittent in the lower portion of the drainage. The channels of both creeks are entrenched.

Sheep Creek

The eastern portion of the proposed dewatering discharge pipeline for the Leeville Project would extend along the northern end of the Sheep Creek drainage (**Figures 3-1** and **3-5**). Sheep Creek is an intermittent drainage that extends south-southwest toward Boulder Creek. No flow data are available for Sheep Creek; however, a short perennial reach occurs approximately 1 mile south of the Leeville Project area (**Figure 3-6**). When flow occurs in the Sheep Creek channel from significant precipitation events, water normally infiltrates prior to reaching Boulder Creek.

Boulder Creek

Springs that discharge from the Tuscarora Mountains supply water year-round to upper reaches of Boulder Creek. Boulder Creek becomes intermittent approximately 2 miles above its confluence with Rodeo Creek and remains intermittent until it joins Rock Creek (BLM 1993a). As water moves downstream in Boulder Creek from the mountains, it infiltrates and recharges Boulder Valley alluvium. The Boulder Creek channel is about 3 feet deep and 50 feet wide just downstream of its confluence with Rodeo Creek. The channel consists primarily of cobbles and gravel with minor amounts of silt (BLM 1991).



Source for Topographic Features: Geologic Survey Quad 1:100,000 Battle Mountain, Nevada 1988

N

0 Miles 10

Hydrographic Basin Boundary and Number

Mine / Proposed Mine

Surface Water Monitoring Station

Regional Surface Water Drainages
Leeville Project
FIGURE 3-5

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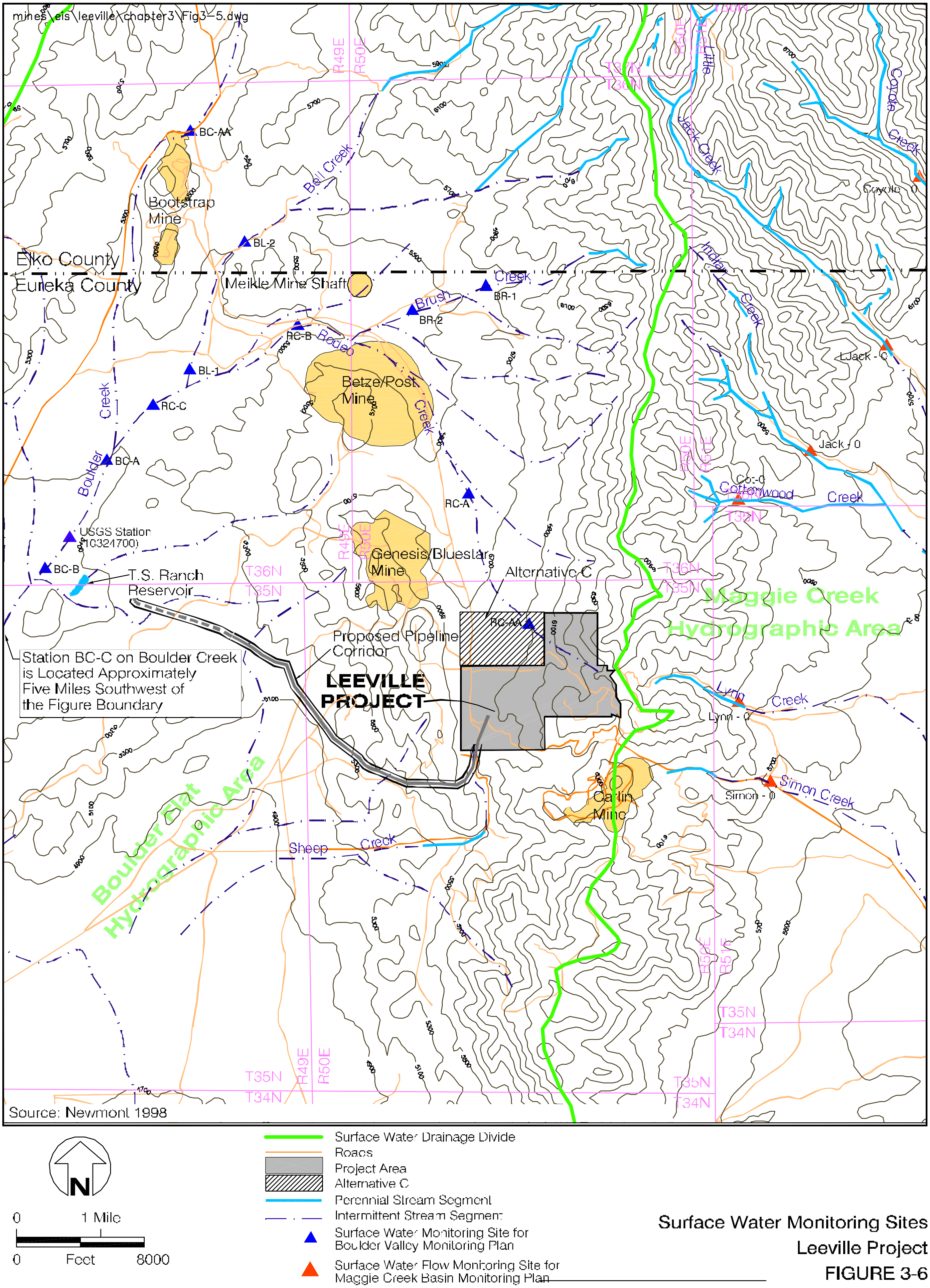

Surface Water Monitoring Sites
Leeville Project
FIGURE 3-6

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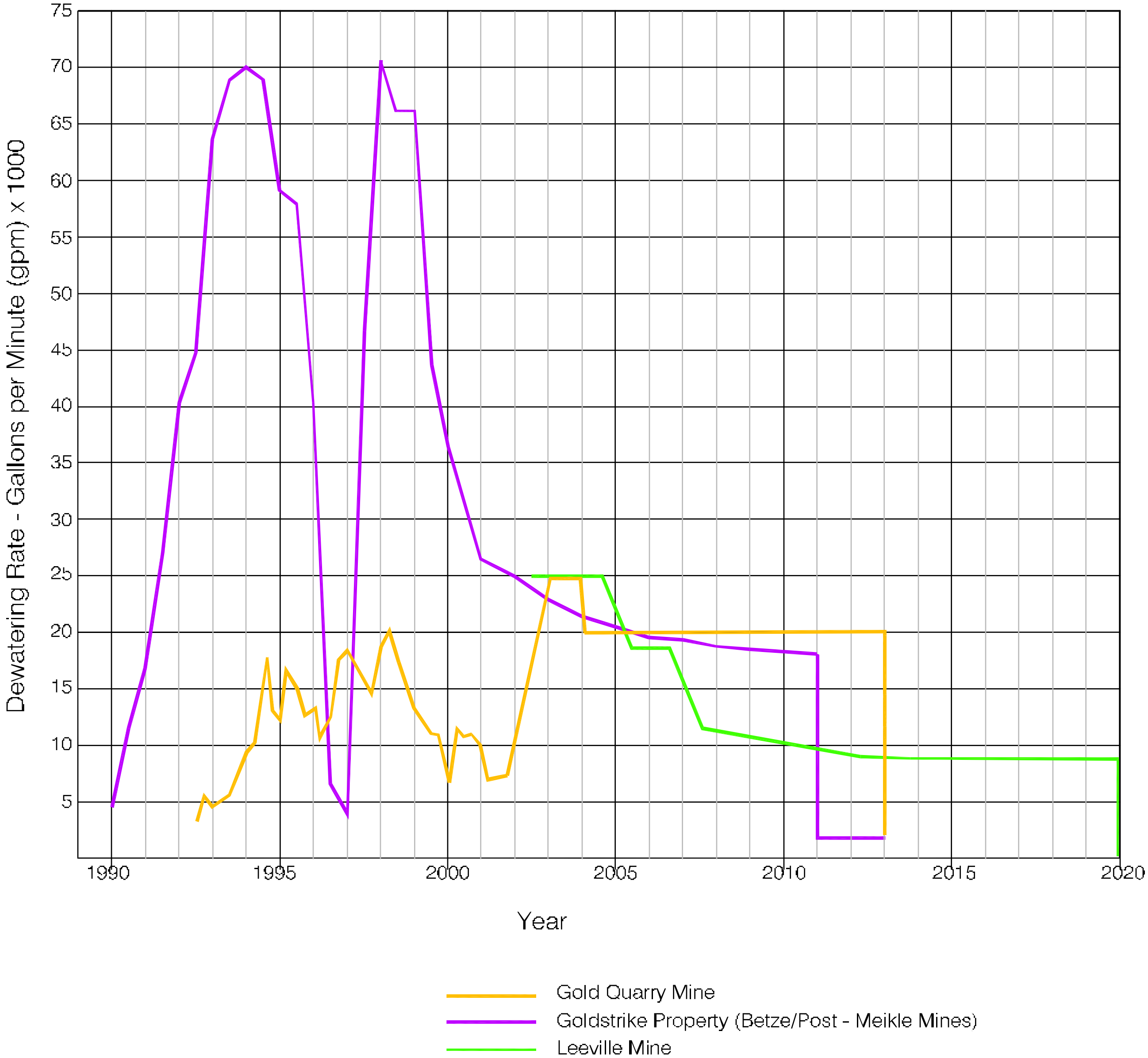

Note: Additional pumping would occur at the end of the dewatering period for each mine (1000-2000 gpm) for several years for mine closure related activities

Source: HCI 1999b; BLM 2000a.; Pettit 2001.

Dewatering Rates for Three Major Mines in Carlin Trend
Leeville Project
FIGURE 3-7

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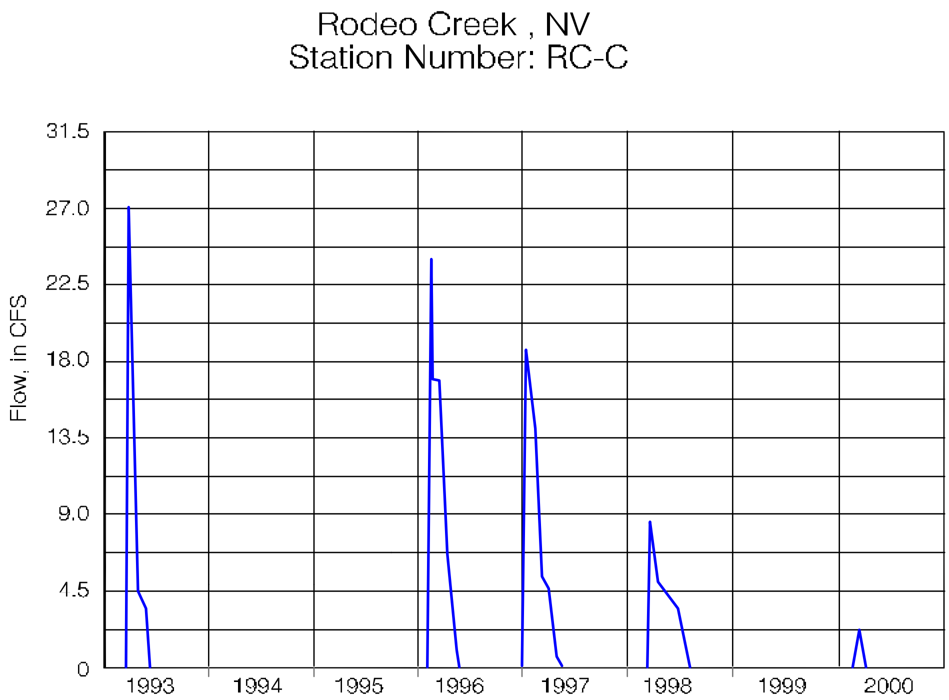
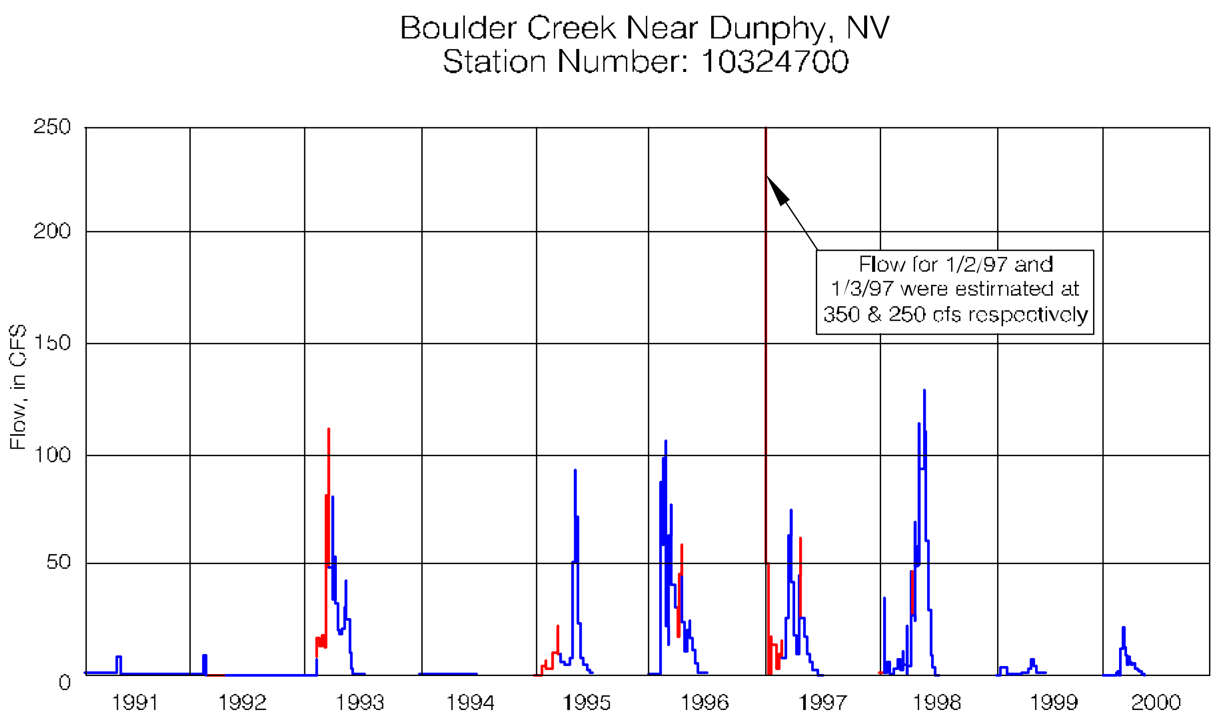


Note: See Figure 3-6 for Station Locations.



Source: USGS Electronic file from Internet (http://nv.usgs.gov/); Barrick 1999

Legend

CFS Cubic Feet per Second

Daily Mean Streamflow (blue line)

Estimated Streamflow (red line)

Hydrographs of Boulder Creek and Rodeo Creek

Leeville Project

FIGURE 3-8

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TABLE 3-11
Water Management for Major Mines in the Carlin Trend, Nevada

Condition	Major Mine Site		
	Goldstrike Property	**Gold Quarry Mine**	**Leeville Mine**
Pumping Periods and Rates			
Start of Active Dewatering (year)	1990	1992	2002[2]
Planned End of Dewatering (year)	2010	2012	2020[2]
Max. Projected Dewatering Rate (gpm)[1]	69,000	25,000	25,000
Note: See **Figure 3-7** for projected pumping rates over time.			
Groundwater Drawdown			
Premining Groundwater Surface at Mine (feet above mean sea level)	5,265	5,100	5,267
Max. Drawdown End of 1998 (feet)	1,527	658[3]	360[4]
Maximum Planned Drawdown (feet)	1,689	1,375[3]	1,467
Pumped and Reinfiltration Volume			
Total Planned Pumped Volume at Closure (acre-feet)	1,085,000	595,000	360,000[6]
Total Planned Reinfiltration Volume at Closure (acre-feet)	564,000	16,700[5]	212,000
Humboldt River Discharge[7]			
Start of Discharge (year)	1997	1994	2002[2]
End of Discharge (year)	1999	2011	2005[2]
Estimated Max. Rate (gpm)	56,810	23,800	25,000
Period of Peak Discharge (year)	1997	2000	2003[2]
Total Discharge Volume End of 1998 (acre-feet)	72,000	77,000	0
Total Planned Discharge Volume at Closure (acre-feet)	81,000	442,000	47,000

1. gpm = gallons per minute
2. Revised date based on personal communication (Pettit 2001).
3. Includes approximately 76 feet of drawdown that occurred from pumping between 1988 and 1992.
4. Drawdown has resulted from pumping at the Goldstrike Property and Gold Quarry mine.
5. Preliminary estimate only.
6. Revised volume of pumped groundwater at Leeville Mine based on average annual rates shown on **Figure 3-7**.
7. Leeville Mine is not expected to discharge excess water to the Humboldt River, but has a contingency to do so with approval from the State Engineer (per Ruling 5011). Discharge to Humboldt River from Gold Quarry Mine is via Maggie Creek.

Source: BLM 2000a.

The USGS operates gaging station No. 10324700 on Boulder Creek approximately 1 mile downstream of the Rodeo Creek confluence (**Figure 3-6**). Drainage area for this Boulder Creek station is 77 square miles (USGS 2000). For the period of record (1991 to 2000), there was no flow at this station from July through December. Mean monthly flow for January, February, March, April, May, and June for the period 1991 to 1999 is 5.2, 7.7, 15.1, 13.9, 18.6, and 2.0 cfs, respectively (USGS 2000). A hydrograph showing flow variations at the Boulder Creek USGS station from 1991 through 2000 is shown on **Figure 3-8**.

Barrick measures flow monthly in Boulder Creek at four stations (BC-AA, BC-A, BC-B, and BC-C), the first three of which are shown on **Figure 3-6.** The fourth station is located about 5 miles downstream from BC-B. The USGS station on Boulder Creek discussed above is located near station BC-B (**Figure 3-6**). Annual peak flow rates for the four Boulder Creek stations range from 62 to 85 cfs (Desert Research Institute 1998). In 1994, flow occurred only at upper station BC-AA (February through June), ranging from 0.2 to 9 cfs. JBR Consultants Group (1990a) calculated peak flow for flood events in Boulder Creek (at Rock Creek) for the following recurrence intervals: 2-year = 1,200 cfs;

5-year = 3,300 cfs; 10-year = 4,400 cfs; 25-year = 7,000 cfs; 50-year = 9,500 cfs; and 100-year = 12,700 cfs. For the period 1991-2000 at USGS gaging station on Boulder Creek, highest daily mean flow was 350 cfs (**Figure 3-8**) and instantaneous peak flow was 440 cfs (USGS 2000).

Rock Creek

Rock Creek flows south from Squaw Valley through the Sheep Creek Range into the Boulder Valley (**Figure 3-5**). Rock Creek drains approximately 864 square miles. The USGS operates a stream gaging station (No. 10324500), which has been in continuous operation since 1946, at the mouth of the canyon where Rock Creek exits the Sheep Creek Range. Mean annual flow in Rock Creek for the period of record is 41.7 cfs at the USGS gaging station (USGS 2000). Maximum and minimum flows at the gaging station were 4,800 cfs (in 1962) and 0 cfs, respectively. Although Rock Creek provides virtually no base flow to the Humboldt River due to infiltration and evapotranspiration, it does contribute significant runoff to the Humboldt River during snowmelt and major precipitation events (HCI 1999b). Barrick (2000) also monitors flow in Rock Creek at three additional stations (RKC-1, RKC-2, and RKC-3) located upstream of the USGS gaging site (RKC-4). Flow at the three upper stations is intermittent, but occurs most of the year at rates typically in the range of 1 to 20 cfs.

Maggie Creek

East of the Tuscarora Mountains, Maggie Creek flows to the south where it enters the Humboldt River near the town of Carlin (**Figure 3-5**). Maggie Creek Basin is divided into upper and lower basins by Maggie Creek Canyon, or “the Narrows.” Baseline flow data show that Maggie Creek is generally perennial above the Narrows and intermittent downstream from the Narrows where surface flow infiltrates into alluvial sediments. Mine dewatering discharge from Newmont’s Gold Quarry Mine is piped to Maggie Creek below the Narrows; this source of water to Maggie Creek has ranged from 4,000 to 20,000 gpm (Newmont 1999b). Total drainage area for Maggie Creek is 396 square miles.

Flow data for Maggie Creek currently are obtained by the USGS at three stations -- two upstream of Gold Quarry discharge just below the Narrows (USGS No. 10321950; Newmont station MAG-3) and above the Narrows (USGS No. 10321940; Newmont station MAG-5), and another near the mouth of the creek (USGS No. 10322000; Newmont station MAG-1) where it joins the Humboldt River. **Table 3-12** summarizes flow data for two of these stations, including mean annual, maximum, minimum, and mean monthly flow. Mean annual natural flow in Maggie Creek at all three gaging stations for individual years in the period of record prior to April 1994 ranges from 1.8 to 47 cfs (USGS 2000). Stream flow at this site has been influenced by mine dewatering discharges from Gold Quarry since April 1994. A hydrograph of Maggie Creek flow at the lower station for the period 1992 through 2000 is included on **Figure 3-9**.

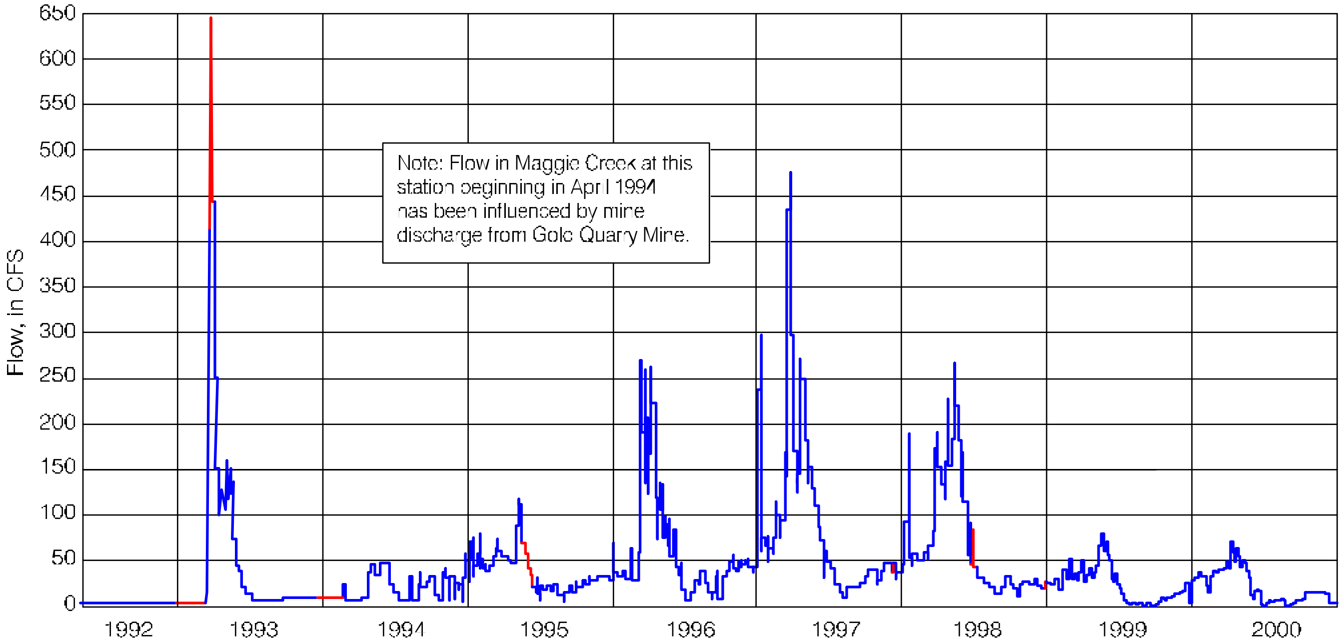
Marys Creek

Marys Creek flows under Interstate 80 and past Carlin Springs before entering the Humboldt River southwest of Carlin. Marys Creek is intermittent above Carlin Springs but flows perennially below the springs to its confluence with the Humboldt River. The USGS has operated a continuous stream gaging station (USGS No. 10322150; Newmont Station Marys-0)) on Mary’s Creek below Carlin Springs since November 1989. Drainage area of Marys Creek above the gaging station (distance of 0.7 mile above confluence with Humboldt River) is 45 square miles (USGS 2000). Maximum flow in Marys Creek at the gaging station was 530 cfs, and lowest daily mean flow was 0.6 cfs (USGS 2000). Mean annual flow ranges from 2.8 to 9.4 cfs for individual years in the period of record 1990 to 1998 (USGS 2000). Flow at the gaging station typically declines sharply in April or May as a result of the end of spring runoff. The town of Carlin also obtains some municipal water from the springs, which affects flow at the gaging station.

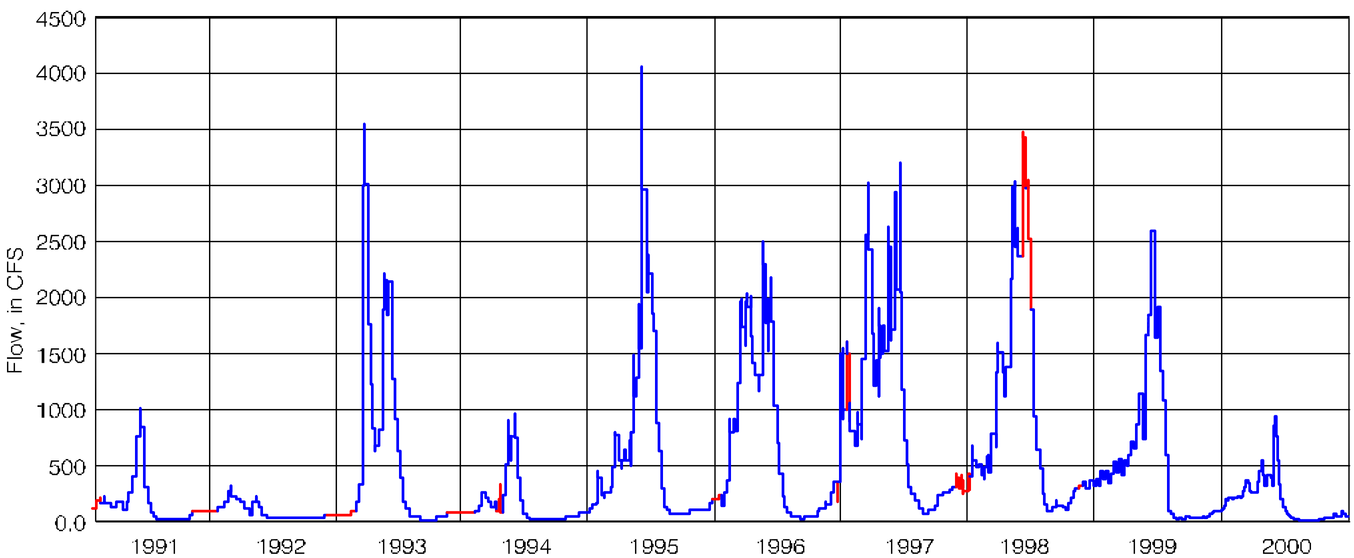
Susie Creek

One USGS gaging station (No. 10321590) is located near the mouth of Susie Creek and has been recording flow data since April 1992. The drainage area above this gage is 194 square miles (USGS 2000). Mean annual flow for individual years in the period of record has ranged from 1.7 to 21 cfs (USGS 2000). A peak mines\eis\leeville\chapter3\hydro2.dwg

Maggie Creek at Carlin, NV
Station Number: 10322000



Humboldt River at Battle Mountain, NV
Station Number: 10325000



Source: USGS electronic file from Internet (http://nv.usgs.gov/)

Legend

CFS Cubic Feet per Second
Daily Mean Streamflow
Estimated Streamflow

Hydrographs of Maggie Creek and Humboldt River
Leeville Project
FIGURE 3-9

blank

flow of 561 cfs was measured at this site on March 16, 1997. Susie Creek periodically becomes dry in the lower section, primarily during the months of July, August, and September. Newmont (2001) also monitors Susie Creek at the USGS gage site (SCS-6), as well as at five more stations farther upstream (SCS-1 through SCS-5).

Humboldt River

Several USGS gaging stations are located along the Humboldt River upstream, downstream, and adjacent to the Carlin Trend area. Humboldt River gaging station No. 10325000 is located near the town of Battle Mountain approximately 2 miles below where Rock Creek joins the Humboldt River. Another USGS gaging station (No. 10321000) is located upstream of the Maggie Creek confluence near the town of Carlin (Newmont station HUM-1). Flow data for these two Humboldt River stations are summarized in **Table 3-12**. Mean annual flow at these upstream and downstream stations for the period of record through 1999 is 385 and 376 cfs, respectively (USGS 2000). **Figure 3-9** presents a hydrograph of flow variations in the Humboldt River at the Battle Mountain station for the period 1991 through 2000.

Two additional USGS gaging stations are located between the Carlin and Battle Mountain stations: No. 10322500 at Palisade and No. 10323425 at Dunphy. Baseflow data (i.e., October mean flow) indicate that flow increases in the Humboldt River between the Carlin and Palisade gaging stations, and decreases between the Palisade and Dunphy gaging stations (BLM 2000a). Estimated baseflow in the Humboldt River is 16.6 cfs at the Carlin gage and 32.3 cfs at Palisade (HCI 1999a).

Gains and losses in river flow in this area are exaggerated by mine discharge water and irrigation withdrawals. Gold Quarry Mine has discharged at a rate of 4,000 to 20,000 gpm to Maggie Creek upstream from Carlin. Discharge to the Humboldt River also occurred periodically from the Goldstrike Property at rates of up to 66,000 gpm between 1997 and 1999 (**Table 3-11**).

CHANNEL GEOMETRY AND FLOODPLAINS

In the vicinity of Barrick's permitted discharge outfall, the Humboldt River is a sinuous point-bar channel and has maintained this configuration since 1979 (BLM 2000b). Channel bed slope is approximately 6 feet per mile in this portion of the river. Channel banks typically are steep and consist primarily of very-fine grained sand, silt, and clay. Bed materials consist predominantly of gravel and sand, with a mean grain size of 20 millimeters (BLM 2000b).

The Federal Emergency Management Agency (FEMA 1982) and BLM (1991) have delineated the 100-year floodplain along Boulder Creek below its confluence with Rodeo Creek. West of the Project area, the floodplain for Boulder Creek is relatively narrow, typically less than 500 feet wide. The 100-year floodplain of upper Boulder and Rodeo creeks has not been delineated; however, the floodplain in these areas is generally narrower than the lower reaches. Floodplain width of the Humboldt River is in the range of about 2000 to 4000 feet. Three bridges cross the river in the vicinity of Dunphy.

TABLE 3-12
Flow Data for Maggie Creek and Humboldt River

Time Period	Flow Rates (cubic feet per second)					
	Maggie Creek Upstream (#10321950)	**Maggie Creek Downstream (#10322000)[1]**		**Humboldt River Upstream Near Carlin (#10321000) [2]**	**Humboldt River Midway at Palisade (#10322500) [2]**	**Humboldt River Downstream Near Battle Mountain (#10325000)[2]**
Mean Annual	22.5	23.4	31.6	385	403	376
High Daily Mean	520	750	750	8,090	7,820	5,800
Low Daily Mean	0	0	0	0.2	2.0	0
<u>Mean Monthly</u>						
Jan	12	4.5	18	142	148	189
Feb	14	17	26	272	289	293
Mar	66	64	78	523	596	528
Apr	69	97	101	729	865	778
May	65	87	93	1,011	1,024	924
Jun	22	19	27	1,283	1,215	1,136
Jul	3.4	3.0	6.9	364	353	376
Aug	1.4	2.1	4.9	55	62	51
Sep	1.9	1.9	4.8	27	37	18
Oct	3.7	3.6	8.5	45	60	32
Nov	5.1	3.8	11	76	89	74
Dec	5.9	2.9	11	99	107	110
Period of Record	1989-1999	1913-1993[3]	1913-1999[3]	1943-1999	1903-1999	1897-1999[3]
Number of Years in Record	10	10	16	56	92	48

[1]Maggie Creek downstream station (10322000) has been influenced by mine dewatering discharges 6 miles upstream since April 1994.
[2]The Humboldt River has many diversions for irrigation.
[3]No data available from this station from October 1, 1924 to April 27, 1992.

Source: USGS 2000

WATER QUALITY STANDARDS

Nevada water is regulated for quality standards that have been established by the State of Nevada under Nevada Water Pollution Control regulations and statutes (Nevada Administrative Code [NAC] 445A.070 et seq.; Nevada Revised Statutes [NRS] 445A.300 et seq.). Water quality criteria for designated beneficial uses (i.e., irrigation, livestock watering, aquatic life, recreation, municipal or domestic supply, industrial supply, and propagation of wildlife) are summarized on **Table 3-13**; these standards include those for toxic materials that may be applicable to the Leeville Project. Narrative standards applicable to all water in the state are specified in NAC 445A.121-122. Streams and rivers in Nevada are classified as Class A, B, C, or D with Class A streams of highest quality and Class D streams of lowest quality (NAC 445A.123-127). Tributaries of Maggie Creek are designated Class A and the upper portion of Maggie Creek is Class B. Class C reaches include the lower portion of Maggie Creek and Rock Creek. The Humboldt River in the study area is Class C. Other streams in the study area are not classified. Standards for stream classes A, B, and C are summarized in **Table 3-14**.

TABLE 3-13
Water Quality Criteria and Standards for Nevada

Parameter[1] (mg/L), unless specified otherwise	Federal Drinking Water Standard		Nevada Municipal or Domestic Supply	Aquatic Life[4]		Agriculture		Wildlife Propagation
	Primary MCL[2]	Secondary MCL[2]		1-Hr Average or Propagation	96-Hr Average or Put and Take	Irrigation	Stock Water	
Antimony	0.006		0.146					
Arsenic	0.05	--	0.05	0.342 As(III)	0.18 As(III)	0.1	0.2	--
Barium	2.0	--	2.0	--	--	--	--	--
Beryllium	0.004	--	0	--	--	0.1	--	--
Boron	--	--	--	--	--	0.75	5.0	--
Cadmium	0.005	--	0.005	0.0053[3]	0.0013[3]	0.01	0.05	--
Chromium	0.10	--	0.10	0.015 Cr(VI)	0.01 Cr(VI)	0.1	1.0	--
Copper	1.3	1.0	--	0.0221[3]	0.0142[3]	0.2	0.5	--
Iron	--	0.3[0.6]	--	1.0	1.0	5.0	--	--
Lead	0.015	--	0.05	0.0684[3]	0.0013[3]	5.0	0.1	--
Manganese	--	0.05[0.1]	--	--	--	0.2	--	--
Mercury	0.002	--	0.002	0.002	.000012	--	0.01	--
Molybdenum	--	--	--	0.019	0.019	--	--	--
Nickel	0.1	--	0.0134	1.699[3]	0.189[3]	0.2	--	--
Selenium	0.05	--	0.05	0.020	0.005	0.02	0.05	--
Silver	--	--	--	0.0069[3]	0.0069[3]	--	--	--
Thallium	0.002	--	0.013	--	--	--	--	--
Zinc	--	5.0	--	0.140[3]	0.127[3]	2.0	25.0	--
Cyanide (WAD)	0.2	--	0.2	0.022	0.0052	--	--	--
Alkalinity	--	--	--	less than 25% change		--	--	30-130
Chloride	--	250[400]	250[400]	--	--	--	1,500	1,500
Color (PCU)	--	15	75	--	--	--	--	--
Dissolved Oxygen	--	--	Aerobic	5.0	5.0	--	Aerobic	Aerobic
Fluoride	4.0	2.0	--	--	--	1.0	2.0	--
Nitrate as N	10	--	10	90(w)	90(w)	--	100	100
pH (SU)	--	6.5-8.5	5.0-9.0	6.5-9.0	6.5-9.0	4.5-9.0	5.0-9.0	7.0-9.2
Sulfate	--	250[500]	250[500]	--	--	--	--	--
Temp° C	--	--	--	Site specific determination		--	--	--
TDS	--	500[1000]	500[1,000]	--	--	--	3,000	--
TSS	--	--	--	25-80	25-80	--	--	--
Turbidity (NTU)	1.0	--	--	50(w);10(c)	50(w);10(c)	--	--	--

[1]mg/L = milligrams per liter; PCU = photoelectric color units; SU = standard pH units; NTU = nephelometric turbidity units; TDS = total dissolved solids; TSS = total suspended solids; °C = degrees Celsius. WAD = weak acid dissociable. Standards for metals are expressed as total recoverable, except those metals that are hardness-dependent where the standard applies to the dissolved fraction (see note #3 below).

[2] MCL = Maximum Contaminant Level. Numbers in brackets [ ] are mandatory secondary standards for public water systems.

[3]Parameter dependent on hardness; see NAC 445A.144 for equations to determine concentration; values in this table calculated assuming a hardness of 150 mg/L as $CaCO_3$. Example: Cadmium 1-hour average = 0.85 exp {1.128 in (hardness) – 3.828} = 0.85 exp {1.824} = 0.85 (6.2) = 5.3 µg/L = 0.0053 mg/L.

[4](w) = warm water; (c) = cold water; no letter designation indicates criteria are common to both warm and cold water.

Source: Nevada Administrative Code 445A.119 and 144.

TABLE 3-14
Water Quality Standards for Class A, B, and C Streams in Nevada

Item	Class A Specification	Class B Specification	Class C Specification
Floating Solids or Sludge Deposits	None attributed to human activities	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
Odor-Producing Substances	None attributed to human activities	See Nevada Administrative Code 445A.125	Not Specified
Sewage, Industrial Wastes, or Other Wastes	None allowed	None that are not effectively treated to the satisfaction of the NDCNR	None that are not effectively treated to the satisfaction of the NDCNR
Toxic Materials, Oil, Deleterious Substances, Colored or Other Wastes	None allowed	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
Settleable Solids	See Nevada Administrative Code 445A.124	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
pH	Range between 6.5 and 8.5	Range between 6.5 and 8.5	Range between 6.5 and 8.
Dissolved Oxygen	Must not be less than 6.0 milligrams per liter (mg/L)	For trout water, not less than 6.0 mg/L; for nontrout water, not less than 5.0 mg/L	For water with trout, not less than 6.0 mg/L; for water without trout, not less than 5.0 mg/L
Temperature	Must not exceed 20° C; allowable temperature increase above natural receiving water temperature: None	Must not exceed 20° C for trout water or 24° C for nontrout water; allowable temperature increase above natural receiving water temperatures: None	Must not exceed 20° C for trout water or 34° C for nontrout water; allowable temperature increase above normal receiving water temperatures: 3° C
Total Phosphates	Must not exceed 0.15 mg/L in any stream at the point where it enters any reservoir or lake, nor 0.075 mg/L in any reservoir or lake, nor 0.30 mg/L in streams and other flowing water	Must not exceed 0.3 mg/L	Must not exceed 1.0 mg/L
Total Dissolved Solids	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)

NDCNR = Nevada Department of Conservation and Natural Resources

Source: Nevada Administrative Code 445A.124-205.

Water quality standards for Humboldt River control points at the Palisade Gage and Battle Mountain Gage are presented in **Table 3-15**. Standards assigned to the Humboldt River apply to all surface water in the watershed upstream from the control point or to the next upstream control point; these standards consist of selected nonmetal parameters such as temperature, pH, chloride, nitrate, total dissolved solids, and total suspended solids. Groundwater quality may not be lowered below state or federal standards for drinking water (NAC 445A.424).

Nevada's Section 303(d) list (Clean Water Act) for development of "total maximum daily loads" (TMDLs) includes the Humboldt River. In general, a waterbody was included on the 303(d) list if the beneficial use standards were not met more than 25 percent of the time. There are existing TMDLs for total phosphorous and total suspended solids on the Humboldt River from Palisade to Battle Mountain (NDEP 1998). There is a high priority of TMDL development assigned by NDEP to the Humboldt River.

TABLE 3-15
Beneficial Use Water Quality Standards for Humboldt River at Palisade Gage and Battle Mountain Gage Control Points

Parameter[1] (mg/L, unless specified otherwise)	Water Quality Standards for Beneficial Uses[2]	Most Restrictive Beneficial Use
Temp (ºC)	ΔT ≤ 2º C [3]	Aquatic life (warm water fishery)
pH (standard units)	6.5 – 9.0 ΔpH ∀ 0.5	Water contact recreation; wildlife propagation
Dissolved Oxygen	≥ 5.0	Aquatic life (warm water fishery)
Chlorides	≤ 250	Municipal or domestic supply
Total Phosphorus (as P)	≤ 0.1	Aquatic life (warm water fishery)
Nitrate	≤ 1.0	
Nitrite	≤ 10	Municipal or domestic supply
Ammonia (un-ionized)	≤ 0.02	
TDS	≤ 500	Municipal or domestic supply
TSS	≤ 80	Aquatic life (warm water fishery)
Sulfate	≤ 250	Municipal or domestic supply
Sodium (SAR)	≤ 8	Irrigation
Color (PCU)	No adverse effects	Municipal or domestic supply
Turbidity (NTU)	≤ 50	Aquatic life (warm water fishery)

[1] mg/L = milligrams per liter; ºC = degrees Celsius; P = phosphorous; TDS = total dissolved solids; TSS = total suspended solids; SAR = sodium adsorption ratio; PCU = photoelectric color units; NTU = nephelometric turbidity units. Limits apply from the control point upstream to the next control point.

[2] Δ = change; all values are single-value measurements, except total phosphorus as seasonal average, TDS and SAR as annual averages, and TSS as annual median. ≤ = less than or equal to; ≥ = greater than or equal to

[3] Maximum allowable increase in temperature at the boundary of an approved mixing zone.

Source: Nevada Administrative Code 445A.204-205

Waste discharges to any state water must be such that no impairment of beneficial use occurs as a result of the discharge (NAC 445A.120[2]). Permits are required from the Nevada Department of Conservation and Natural Resources (NDCNR) for anyone intending to discharge to state water (NAC 445A.228-263; NRS 445.221). Limits on certain quality parameters of the water are established for a discharge permit.

SURFACE WATER QUALITY

Barrick currently collects water samples from four surface water stations on Rodeo Creek (RC-AA, RC-A, RC-B, and RC-C) and four stations on Boulder Creek (BC-AA, BC-A, BC-B, and BC-C) on a monthly basis (**Figure 3-6**). These data are reported semi-annually in the Boulder Valley Monitoring Plan reports (Barrick 2000). Newmont also samples five Rodeo Creek sites on a quarterly basis as part of its Water Pollution Control Permit in the North Operations Area. Newmont's analytical data have been submitted to NDEP on a quarterly basis since 1997. In addition, the USGS collects water quality data at its station on Boulder Creek located approximately one mile downstream of the Rodeo Creek confluence near station BC-B (**Figure 3-6**).

Surface water near the Leeville Project area generally is a calcium-bicarbonate type with pH in the range of 7.5 to 8.5 standard units. With the exception of a few parameters (e.g., chloride and arsenic), surface water in Rodeo Creek and Boulder Creek is similar in quality (**Table 3-16**). Quality of water in Rock Creek has been monitored periodically since 1995 at the four stations established by Barrick (2000). Rock Creek has chemical characteristics similar to Rodeo and Boulder creeks. Sulfate in Rock Creek generally is in the range of 20 to 40 milligrams per liter (mg/L).

A review of surface water quality data in the Leeville area shows that arsenic is elevated throughout Rodeo Creek, but is relatively low in the tributaries of Brush and Bell creeks. The elevated arsenic concentrations in Rodeo Creek probably are due to a combination of natural arsenic in the mineralized areas and increases from exposure and weathering of rock from mining-related disturbed areas. Concentrations of arsenic in the uppermost Rodeo Creek Station (RC-AA), which is located above most mining-related disturbance, are similar to concentrations measured at other Rodeo Creek stations located farther downstream.

Surface water quality is also monitored periodically by Newmont, Barrick, USGS, and NDEP in Maggie Creek, Marys Creek, Susie Creek, and the Humboldt River in the Carlin Trend area. Samples generally are collected on a quarterly basis and reported quarterly by Newmont (2001) in the Maggie Creek Basin Monitoring Plan reports, and annually by the USGS (2000) in the Water Resources Data - Nevada Water Year Reports. Data obtained by NDEP are reported in STORET (STORET numbers for NDEP stations are: Maggie Creek station HS14 = 310583; Humboldt River near Palisade station HS6 = 310082; Humboldt River at Battle Mountain station HS7 = 310083) (NDEP 1998). STORET is an EPA database of chemical and physical water quality parameters at over 750,000 locations across the United States. The Maggie Creek sample sites are located upgradient and downgradient of the Maggie Creek Canyon, and near the creek's confluence with the Humboldt River. Stations on Marys Creek and Susie Creek monitored by Newmont are located near the mouth of these drainages.

Newmont's Humboldt River sample sites are located at Carlin, Palisade, and Battle Mountain gages. The Humboldt River station near Carlin (No. 10321000) is sampled by the USGS six times per year as part of its National Stream Quality Accounting Network (NASQAN) and National Water Quality Assessment (NAWQA) program. The program established specifically for the Carlin Trend includes seven stream gaging stations, 15 sites for miscellaneous streamflow measurements, one site for surface water quality, and 25 wells for water level measurements as required by the Nevada State Engineer.

Water quality characteristics of Boulder, Rodeo, and Maggie creeks, and the Humboldt River are summarized below because they are primary drainages near the Project. Other streams in the study area (i.e., Rock, Marys, and Susie creeks) have similar quality characteristics that are reported by Newmont (2001) and Barrick (2000).

Boulder Creek

Representative water quality data collected from Boulder Creek at stations BC-AA (upstream) and BC-B (downstream) are presented in **Table 3-16**. Concentrations of metals (e.g., arsenic, iron, and manganese) are higher at the downstream station (BC-B) on Boulder Creek. Some arsenic concentrations at the lower station do not meet aquatic life and domestic supply standards (**Tables 3-13** and **3-16**).

Rodeo Creek

Table 3-16 contains representative analytical results from surface water in Rodeo Creek at stations RC-AA (immediately downstream of the Leeville Project) and RC-B (approximately 5 miles downstream of the Leeville Project). Average concentrations of arsenic (0.097 and 0.148 mg/L) at both Rodeo Creek stations do not meet standards for aquatic life and domestic water supply. Iron concentrations often exceed the aquatic life standard.

Maggie Creek

Water in Maggie Creek upstream of the Gold Quarry Mine discharge point at Newmont station MAG-3 (USGS No. 10321950) exhibits low concentrations of common ions and metals (Newmont 2000). Arsenic ranges from about <0.005 to 0.03 mg/L. Iron concentrations often exceed the aquatic life standard. At the lower station near the mouth of Maggie Creek (Newmont station MAG-1; USGS No. 10322000), water quality is similar to the upper station (**Table 3-16**). Dissolved oxygen at both Maggie Creek stations is in the range of 8 to 10 mg/L (Newmont 2000).

Humboldt River

Humboldt River water in the study area is consistent in quality (i.e., between upstream Carlin monitoring site and downstream Battle Mountain site). Quality of river water at the middle station (HUM-5 at Palisade) is summarized in **Table 3-16**. This surface water contains low concentrations of most chemical constituents. Arsenic concentrations in the river range from 0.002 to 0.02 mg/L. Dissolved oxygen in the Humboldt River generally is between 4 and 11 mg/L. Sodium adsorption ratios are low (1 to 2) (USGS 2000). Sediment yield in the Humboldt River at Carlin is about 14 and 605 tons per day for flow rates of 100 and 1,000 cfs, respectively (BLM 2000b).

SPRINGS AND SEEPS

Numerous springs and seeps have been identified in the study area, primarily north of the Leeville Project area on the flanks of the Tuscarora Mountains (**Figure 3-10**). On the west side of this mountain range, springs typically form the head-water of Rodeo, Brush, Bell, and Boulder creeks. Most of the springs are small and often flow only part of each year at rates up to 5 gpm. The source for many of these mountain springs, especially above an elevation of about 6,000 feet, is believed to be primarily perched groundwater not connected to the regional water table (Desert Research Institute 1998; BLM 1991, 1993a; Leggette, Brashears & Graham, Inc. 1993). Locations of these springs generally are controlled by topography and/or geologic formation.

A comprehensive spring and seep inventory in the North and South Operations Areas was conducted by Riverside Technology, Inc. (RTI 1994) during September and October 1993. Additional springs/seeps have been identified by the USGS (1968), JBR Consultants Group (in Newmont 1998), and BLM (1997a). **Figure 3-10** shows springs/seeps in the Leeville Project area. Four springs have been identified within the Leeville Project boundary, whereas approximately 75 springs/seeps have been inventoried along the portion of the Tuscaloosa Range shown on **Figure 3-10**.

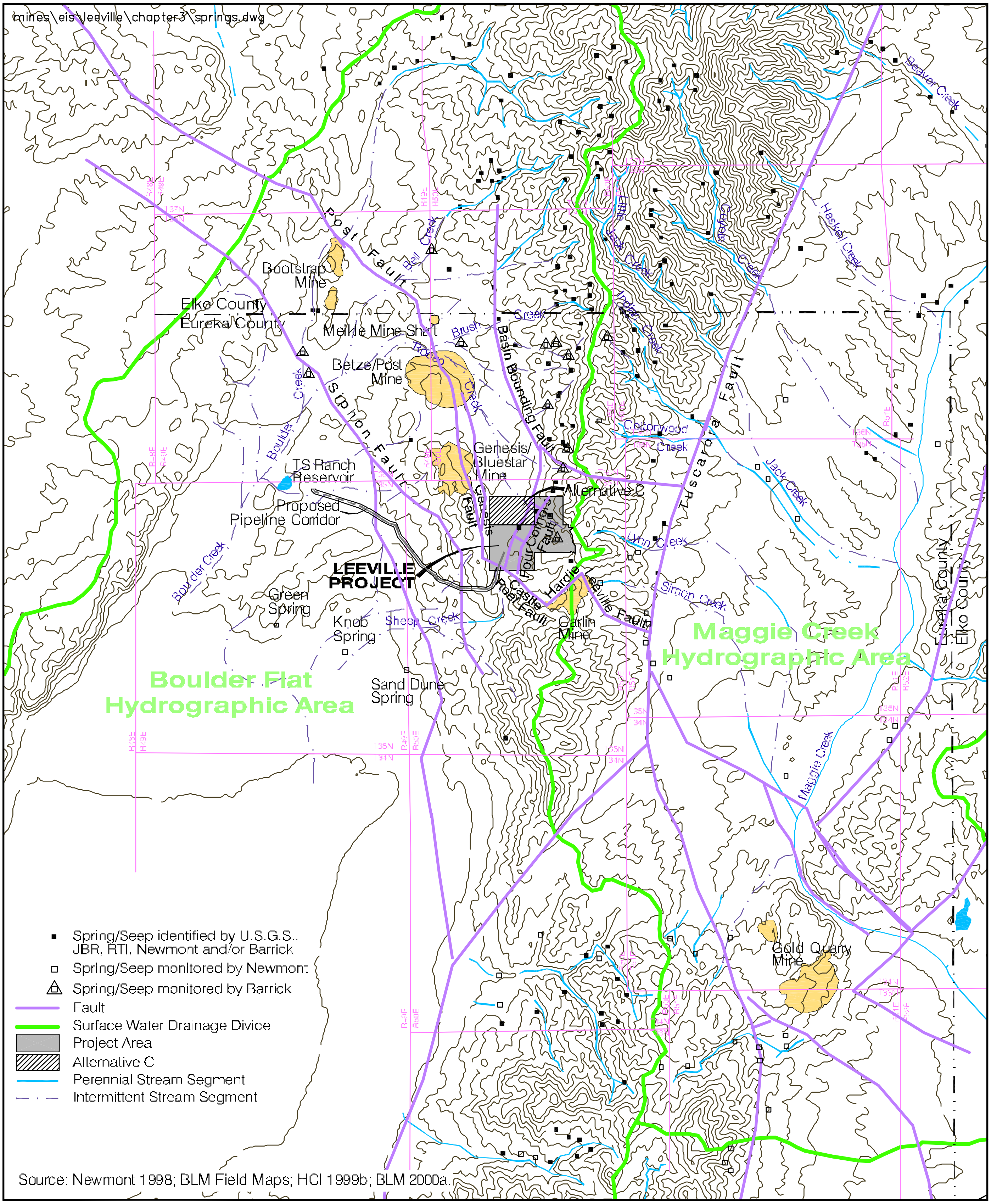
Infiltration of water from the TS Ranch Reservoir resulted in creation of three new springs (Green, Knob, and Sand Dune springs) about 3 to 5 miles south of the reservoir and southwest of the Leeville Project area (**Figure 3-10**). Water discharging from these three springs is collected in the Sand Dune Canal and conveyed to the infiltration and/or irrigation systems.

Selected springs are monitored quarterly or semi-annually by Newmont in the North and South Operations Areas. Results of this monitoring program show springs can be categorized into three basic groups: water of a

TABLE 3-16
Surface Water Quality – Leeville Project Area

Parameter [2]	Boulder Creek (BC-AA)	Boulder Creek (BC-B)	Rodeo Creek (RC-AA)	Rodeo Creek (RC-B)	Maggie Creek at Mouth (MAG-1)	Humboldt River at Palisade (HUM-5)	Standards for Municipal or Domestic Supply[3]
	Sample Sites [1]						
Sample Period	1/93 – 3/99	1/93 – 3/99	3/93 – 6/98	1/93 – 6/98	3/93 – 3/99	3/93 – 3/99	---
No. Samples	41	24	19	15	24	24	---
TDS							
Range	72 – 250	86 – 220	130 – 534	198 – 1090	222 – 410	170 – 372	500 – [1000]
Mean	145	142	208	370	330	293	
TSS							
Range	<0.1 – 323	6 – 460	6 – 1300	14 – 361	1.6 – 1100	3 – 1200	---
Mean	45	87	202	120	101	188	
pH (std units)							
Range	7.1 – 8.4	7.7 – 8.2	7.1 – 9.3	7.7 – 8.7	7.8 – 9.2	7.3 – 8.7	5.0 – 9.0
Mean	7.8	7.9	8.0	8.1	8.5	8.2	
Total Alkalinity							
Range	22 – 100	41 – 76	30 – 160	75 – 180	100 – 253	130 – 220	---
Mean	64	60	66	120	196	197	
Calcium							
Range	9 – 42	10 – 45	11 – 63	27 – 141	36 – 65	32 – 66	---
Mean	20	19	21	49	50	48	
Sodium							
Range	5.2 – 12	4.9 – 13	9.2 – 25	12 – 47	19 – 74	6 – 52	---
Mean	10	8.4	17	21	34	34	
Magnesium							
Range	3.4 – 17	4.0 – 21	3.7 – 78	14 – 40	14 – 32	0.05 – 20	---
Mean	7.6	7.3	21	29	20	13	
Potassium							
Range	<1.5 – 4.3	1.2 – 11	2.9 – 29	2.7 – 12	5.8 – 15	2.4 – 11	---
Mean	2.6	3.1	5.9	5.0	9.1	7.4	
Chloride							
Range	1.9 – 7.0	1.9 – 22	6 – 177	6.8 – 421	10 – 25	6 – 25	250 – [400]
Mean	3.6	5.9	28	75	15	16	
Fluoride							
Range	0.1 – 1.2	0.2 – 0.3	0.1 – 0.4	0.2 – 0.9	<.05 - .08	0.33 – 0.7	---
Mean	0.3	0.3	0.3	0.5	0.6	0.5	
Sulfate							
Range	7 – 100	8.4 – 47	12 – 47	23 – 162	47 – 82	15 – 61	250 – [500]
Mean	29	22	30	75	59	40	
Nitrate							
Range	<.05 – .54	<.05 - .66	<.05 – 1.5	0.33 – .88	<.05 - <.10	<.05 - <.10	10
Mean	0.12	0.21	0.53	0.54	0.05	0.06	
Arsenic							
Range	<.001 - .003	.002 - .505	.037 – 1.38	.024 - .542	<.005 - .033	0.002 - .02	0.05
Mean	0.003	0.028	0.148	0.097	0.015	0.015	
Iron							
Range	0.03 – 23	0.2 – 89	0.12 – 150	0.15 – 30	<.01 – 30	0.04 – 36	0.3 – [0.6] (s)
Mean	1.94	9.2	12.0	4.1	1.4	2.1	
Manganese							
Range	.002 - .282	.002 – 1.06	.008 – 2.81	.002 - .71	<.005 - .93	<.005 - .65	0.05 – [0.10] (s)
Mean	0.041	0.11	0.30	0.13	0.09	0.13	

[1] See **Figure 3-6** for sampling sites on Boulder and Rodeo creeks
[2] All units in milligrams per liter (mg/L) unless otherwise specified; TDS = total dissolved solids; TSS = total suspended solids; NR = no record. Concentrations are total. For statistical purposes, values reported as less than the laboratory detection limit were set equivalent to the value.
[3] Numbers in brackets [ ] are mandatory secondary standards for public water systems; values with an (s) are federal secondary drinking water standards. See **Table 3-13** for a listing of water quality standards.
Source: Barrick (2000); Newmont (2000).



N

0 Miles 3

Spring/Seep Sites
Leeville Project
FIGURE 3-10

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non-thermal origin; thermal water; and anomalous water with elevated major ions and trace metals (Newmont 1997b). Concentrations of trace metals and major ions generally are slightly higher in the thermal springs than the non-thermal springs. Most springs in the vicinity of the Leeville Mine site are non-thermal.

Water from springs in the study area exhibits neutral to basic pH (6.4 to 8.9 standard units), specific conductance (SC) ranging from about 100 to 800 micromhos per centimeter (µmhos/cm), nitrate concentrations of less than 3.2 mg/L, and sulfate ranging from <10 to 230 mg/L (RTI 1994). Total dissolved solids range from 30 to 550 mg/L, with lowest concentrations at higher elevations in the Tuscarora Mountains. Concentrations of metals in spring water throughout the area generally are low. Temperature of springs in the area ranges from 38 to 78° F.

GROUNDWATER QUANTITY

Groundwater in the Project area moves through siltstone and carbonate rocks along the Tuscarora Mountains and then into basin fill deposits and volcanic rocks in the Boulder, Rock, and Willow Creek valleys (west side) and Maggie Creek Valley (on the east side) (Maurer et al.1996). In some areas, the siltstone and carbonate rocks are confined by overlying, older basin fill deposits. Carbonate rocks are unconfined where exposed at land surface. In general, carbonate rocks are the most permeable material in the area. Shallow alluvial deposits of interbedded sand and gravel are found in drainage bottoms at thicknesses of up to 50 feet. Groundwater movement generally is down the valleys; however, mine dewatering and discharge in the Carlin Trend has influenced direction of flow in some areas.

Precipitation in the mountain ranges is the primary source of groundwater recharge in the Project area. The USGS estimates that for an area with 12 to 15 inches per year (in/yr) of precipitation, which is typical for the Leeville area (see **Table 3-7**), approximately 7 percent of total precipitation recharges groundwater from infiltration (Maurer et al. 1996). For areas with 8 to 12 in/yr and 15 to 20 in/yr of precipitation, estimated percentage of precipitation that infiltrates to groundwater is 3 percent and 15 percent, respectively (Maurer et al. 1996).

Evapotranspiration of groundwater is limited to areas where water levels are sufficiently shallow to influence plant water uptake (i.e. phreatophytes) or bare soil. The following evaportranspiration rates for plant types have been used by the USGS in the study area: 3.6 in/yr for greasewood; 6 in/yr for a mixture of shrubs; 7 in/yr for a mixture of shrubs and grasses; and 12 in/yr for grasses and willows in wet meadows and irrigated areas (Maurer et al 1996).

Leeville Project Area

The Leeville Project gold deposits are hosted primarily by Paleozoic-age carbonate rocks. Two primary hydrostratigraphic units occur in the study area: (1) shallow, unconfined siltstone or “upper plate”; and (2) deep, generally confined carbonate system or “lower plate”. The shallow and deep flow systems apparently interact to a limited degree, but do not function as a single hydrogeologic unit. Numerous monitoring wells/ piezometers have been installed in the vicinity of the Leeville Project to obtain information on groundwater conditions (**Figure 3-11**). Nineteen monitoring wells are located within or near the Project boundary (**Figure 3-12**).

A complex system of north-south trending high-angle faults occur in the Leeville Project area (**Figure 3-10**). These faults can act as both conduits and barriers to groundwater flow, depending on the openings and alteration associated with the structures. Based on results of water level monitoring and aquifer testing, some faults in the vicinity of the Leeville Project area appear to act as barriers to groundwater flow; see **Figure 3-10** for locations of selected faults. Drawdown in the carbonate rocks at Leeville has been relatively constant over the past few years due to dewatering at the Goldstrike Property and to a lesser degree, the Gold Quarry Mine, suggesting that the rocks are part of a bounded system created by barrier faults.

A geothermal system is evident in the study area, conceptualized as a very deep groundwater flow system (HCI 1999a). Permeable fractures and faults associated with ore deposits allow upwelling of geothermal water from depth which mixes with shallower groundwater in the vicinity of the mines.

Dewatering at the Goldstrike Property and Gold Quarry mine are described above under the *Surface Water Quantity* section. Groundwater levels have been lowered by over 1,500 feet in the vicinity of the Goldstrike Property (BLM 2000b). The Leeville Project area is located between two cones of depression caused by dewatering at the two mine sites (**Figure 3-11**).

Prior to initiation of mine dewatering, groundwater generally flowed southwest from the west side of the Tuscarora Mountains to Boulder Creek, and then along the Boulder Valley toward the Hum-boldt River (BLM 2000a). On the east side of the mountains, groundwater moved east-southeast toward Maggie Creek and the Humboldt River. Current groundwater flow in the Leeville Project area remains to the southwest (**Figure 3-11**) because of its location between the two major mine drawdown areas.

Figure 3-13 presents a hydrogeologic cross-section through the Leeville Project area that shows approximate water table elevations during first quarter 2000. Completion data for monitoring wells at the Leeville site are presented in **Table 3-17.** At the proposed Leeville Mine shaft site, the water table in the upper plate rocks is approximately 250 to 500 feet below ground surface (elevation of about 5,700 feet), with a vertical downward gradient of about 0.7 foot/foot (HCI 1998). Hydraulic head encountered in the lower plate is at an elevation of about 4,800 to 4,900 feet.

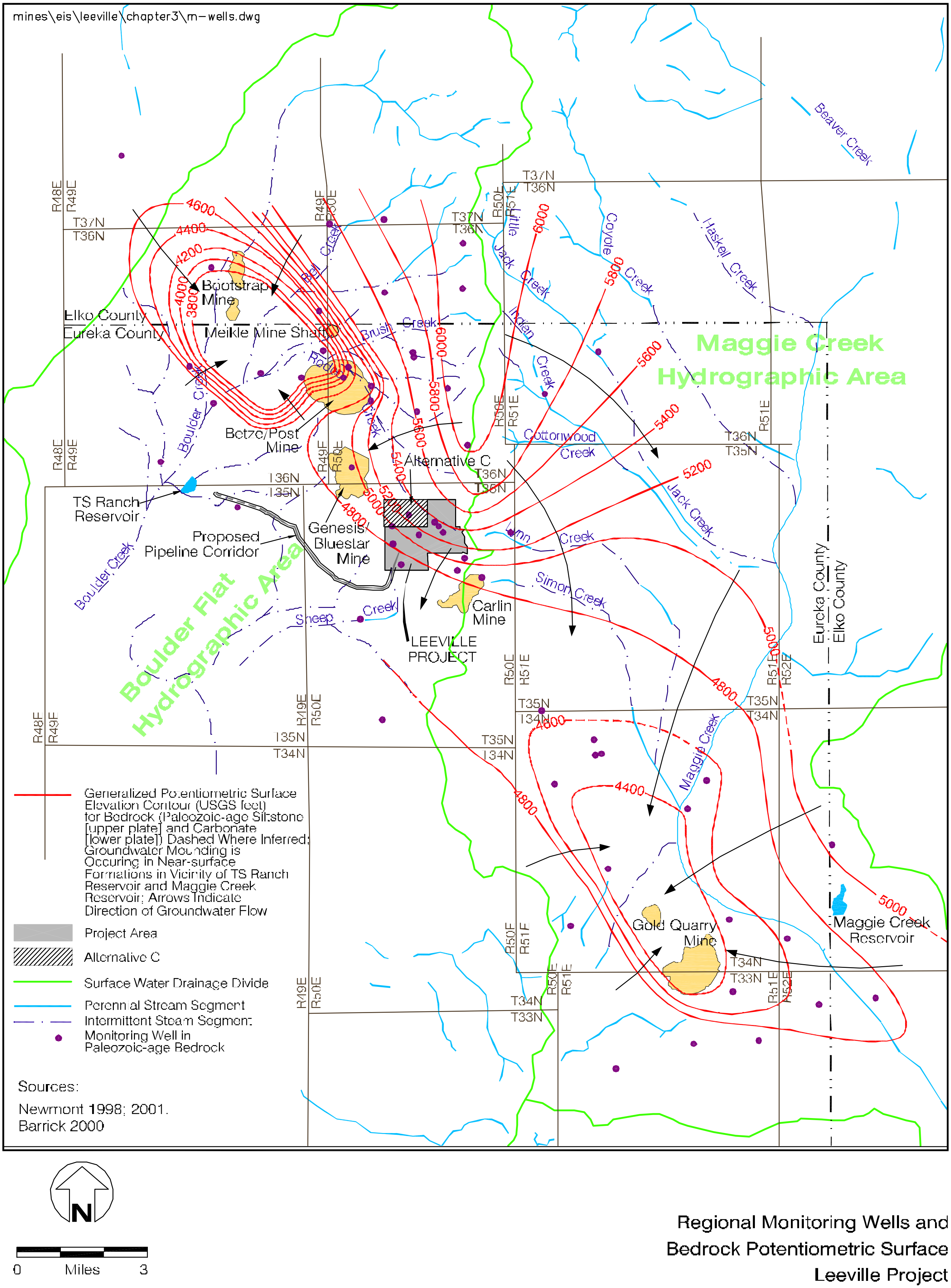
Groundwater in the Leeville Project area has been declining at a relatively constant rate since large-scale dewatering began at the Goldstrike Property and Gold Quarry mine. According to monitoring by Newmont (2001), water levels in wells completed in upper plate rocks near the Leeville Project generally have declined between 60 and 265 feet over the period of record (1993 to 2000), while water levels in lower plate rocks have dropped up to 369 feet during the same time period (**Table 3-17**). As shown on **Figure 3-13**, the hydraulic head in the lower plate in the Leeville Project area has been lowered below the contact between the upper and lower plates, resulting in unconfined conditions.

During 1996, Newmont conducted aquifer tests in some of the wells installed at the Leeville Project area. Testing involved completion of static spinner, dynamic spinner, step drawdown, and constant discharge tests. The spinner tests were employed to document vertical gradients across a formation and identify discrete water-producing zones within a formation, while the step drawdown tests and constant discharge tests were conducted to determine well efficiencies, aquifer parameters, and identify aquifer boundaries. Aquifer test results indicate hydraulic conductivity of the upper plate rocks (siltstone; pumping well HDDW-3) ranging from 0.6 to 5.2 feet/day with a geometric mean of 1.7 feet/day (HCI 1998). Using pumping well HDDW-1A in the lower plate rocks (carbonate), hydraulic conductivity is in the range of 80 to 96 feet/day with a geometric mean of 89 feet/day (HCI 1998).

For Carlin Trend modeling purposes, HCI (1999a) used the following hydraulic conductivity values: 0.025 to 0.5 feet/day for regional siltstone; 50 to 100 feet/day for carbonates in upper Boulder Flat; 0.13 to 0.25 feet/day for Tertiary-age sediment in upper Boulder Flat; and 10 feet/day for alluvium in Boulder Flat.

Boulder Flat and Rock Creek Valley

Five hydrostratigraphic units occur in Boulder Flat and the Rock Creek Valley. The shallowest unit is Quaternary-age basin-fill alluvium. Underlying the alluvium, in descending order, are: Tertiary-age basin-fill sediments known as the Carlin Formation; Tertiary-age volcanic rocks; Paleozoic-age siltstone (upper plate); and Paleozoic-age carbonate rocks (lower plate). Alluvium is limited to areas along stream channels and across the floor of Boulder Flat. Tertiary-age sediment in the Boulder Flat area contains tuffaceous sand and gravel, interbedded with siltstone and claystone. This sediment package is up to 4,000 feet thick and overlies Tertiary-age volcanic and Paleozoic-age siliciclastic rocks (HCI 1999a). In upper Boulder Flat, groundwater flows toward the drawdown area caused by dewatering at the



Regional Monitoring Wells and Bedrock Potentiometric Surface
Leeville Project
FIGURE 3-11

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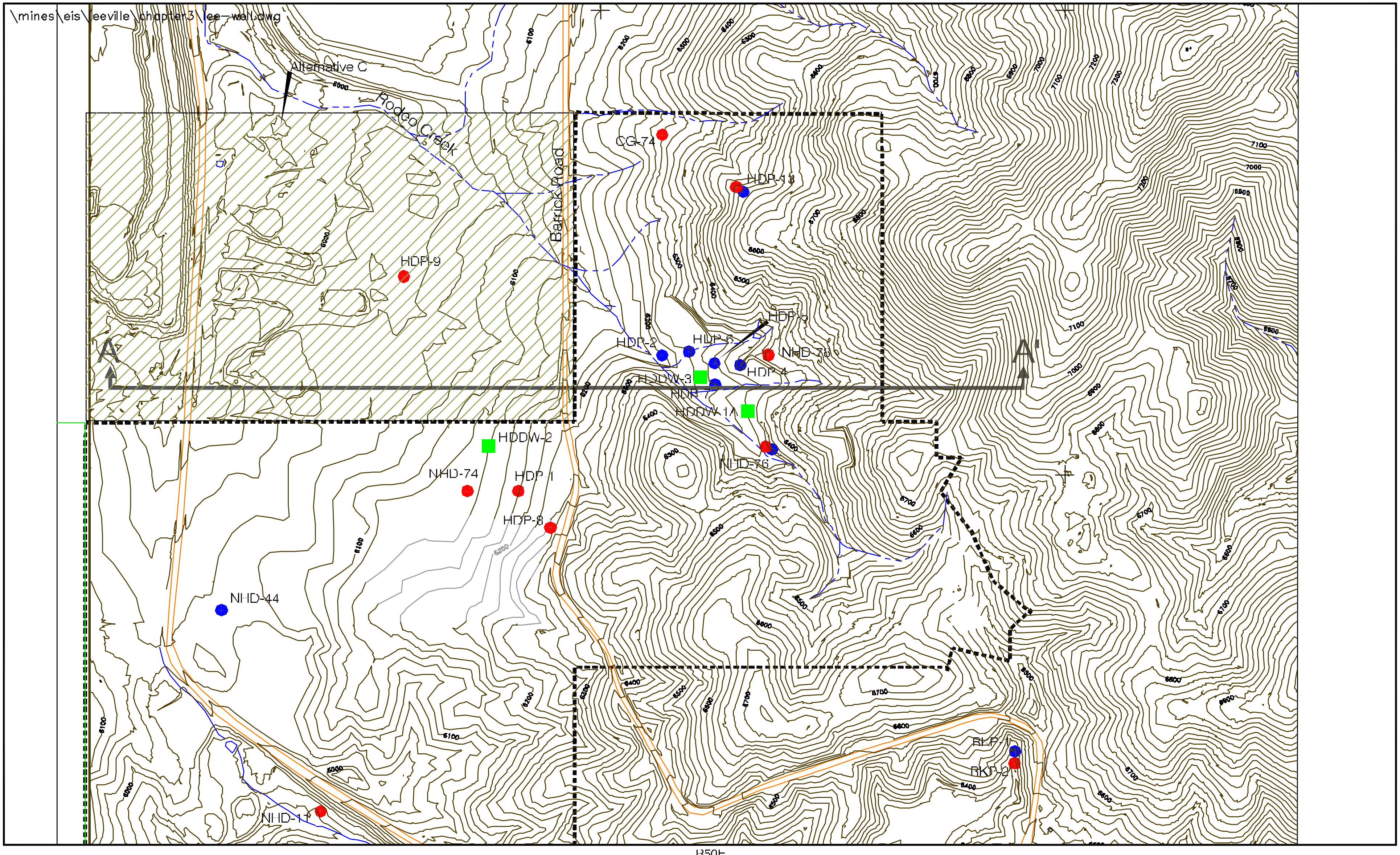

Monitoring Well/Piezometer in Carbonate (lower plate)

Monitoring Well/Piezometer in Siltstone (upper plate)

Dewatering Well in Carbonate

Cross Section Location (See Figure 3-13)

Leeville Project Boundary

Alternative C

N

0 1/4 Mile

0 Feet 1500

Leeville Area Monitoring Wells

Leeville Project

FIGURE 3-12

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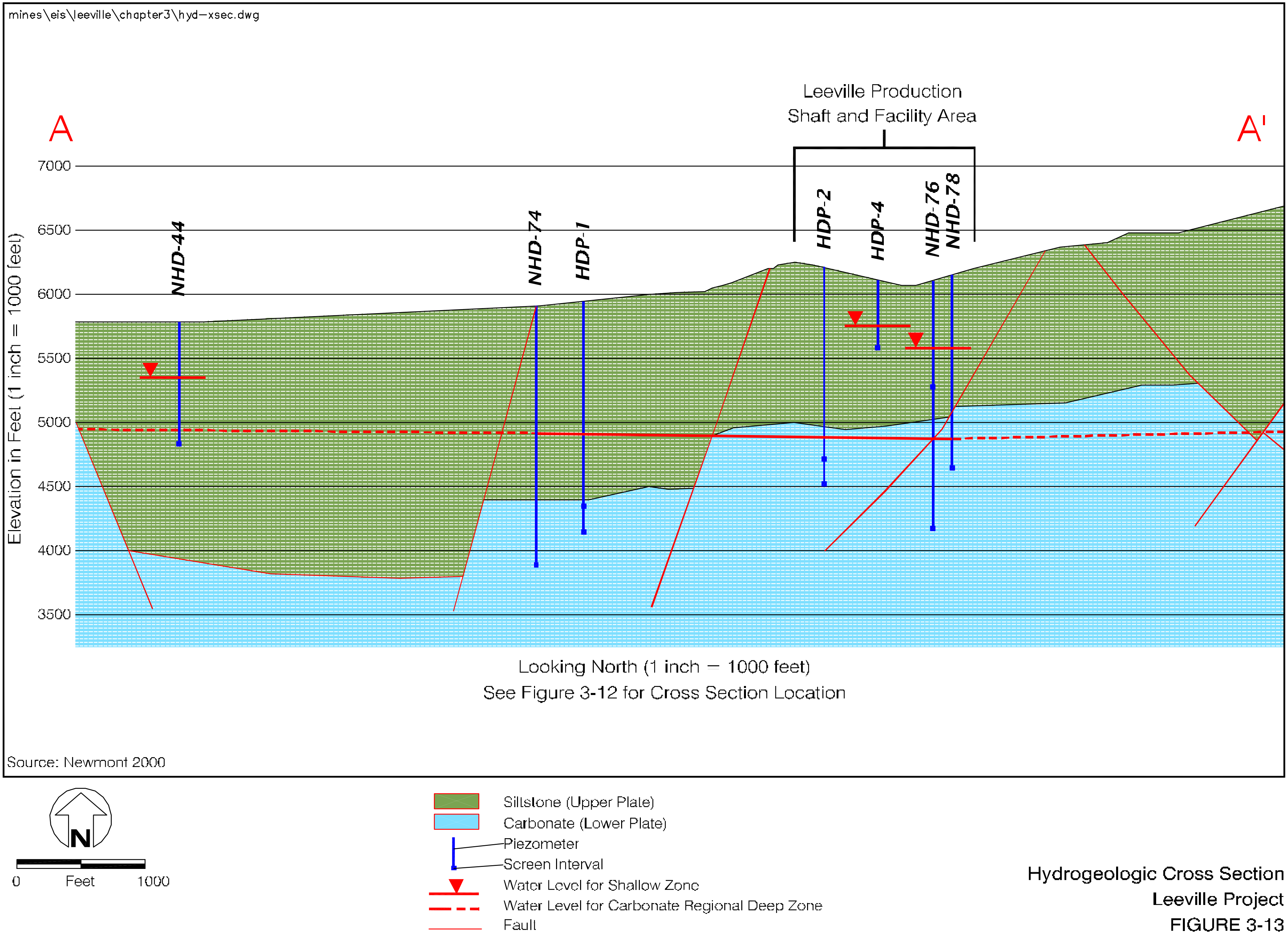

Hydrogeologic Cross Section
Leeville Project
FIGURE 3-13

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TABLE 3-17
Monitoring Well Completion and Water Level Elevation Data at the Leeville Project Site

Well No.	Total Depth (ft)	Screen Interval (ft)	Formation Plate	Initial GW Elev. (ft)	Initial Measure-ment Date	Last Monitored Elev. (ft)	Last Measure-ment Date	Water Level Drawdown to Date (ft)
CG-74	2340	2220-2240	Lower	4961.9	6-20-97	4807.1	9-29-00	154.8
HDP-1D	1830	1800-1820	Lower	5213.7	7-19-95	5111.4	3-31-00	102.3
HDP-2S	1520	1280-1300	Lower	5057.6	6-23-95	4811.2	9-27-00	246.4
HDP-4	500	480-500	Upper	5804.3	8-8-96	5735.4	9-29-00	68.9
HDP-5	1005	980-1000	Upper	5553.7	8-9-96	5289.0	9-29-00	264.7
HDP-6	520	500-520	Upper	5791.8	8-8-96	5732.1	12-22-00	59.7
HDP-7	520	500-520	Upper	5799.0	8-8-96	5727.1	12-22-00	71.9
HDP-8	2100	2030-2050	Lower	5982.4	1-13-97	NA	NA	NA
HDP-9	2940	2890-2930	Lower	4988.6	1-27-97	5006.7	3-30-00	+18.1
HDP-13S	2250	1508-1528	Upper	5789.3	6-23-97	5725.5	9-29-00	63.8
HDP-13D	2250	2220-2240	Lower	4960.1	6-24-97	4812.7	9-29-00	147.4
NHD-11	1363	1319-1359	Lower	5458.9	7-7-92	5212.0	6-8-99	246.9
NHD-44	1015	995-1015	Upper	5422.1	8-30-93	5304.6	12-7-00	117.5
NHD-74	2000	1979-1999	Lower	5196.9	10-13-94	4827.5	12-22-00	369.4
NHD-76D	1869	1849-1869	Lower	5100.4	10-18-94	4816.2	9-29-00	284.2
NHD-76S	1869	830-850	Upper	5789.8	10-13-94	5590.5	9-29-00	199.3
NHD-78	1766	1530-1550	Lower	5079.9	3-8-95	4816.3	9-27-00	263.6
RKP-1S	1762	720-740	Upper	5541.5	7-18-95	5647.6	9-27-00	+106.1
RKP-2	1550	1528-1548	Lower	4987.2	12-27-96	4821.1	9-29-00	166.1

Note: See **Figure 3-12** for well locations. Ft = feet; GW = groundwater; Elev. = elevation; NA = not available.

Source: Newmont 2000, 2001.

Goldstrike Property. Groundwater flow parallels Boulder Creek in lower Boulder Flat except near the TS Ranch Reservoir, where a groundwater mound has developed as a result of seepage from the reservoir.

Maggie Creek Area

The same five hydrostratigraphic units present in Boulder Flat are in the Maggie Creek area. In this area, the uppermost water table system is hosted by sediments of Quaternary-age alluvium, the Carlin Formation, and Tertiary-age volcanics. The groundwater system generally flows to the southeast parallel to Maggie Creek (Plume 1994). Groundwater in deeper siltstone (upper plate) and carbonate (lower plate) rocks flows toward the Gold Quarry pit as a result of mine dewatering.

GROUNDWATER QUALITY

Leeville Project Area

Groundwater quality in the Leeville Project area has been characterized by analysis of water samples from three aquifer test wells installed at the Leeville Project (wells DDW-1A, HDDW-2, and HDDW-3, **Figure 3-12**). Groundwater quality analytical results from the three wells are presented in **Table 3-18.** With the exception of arsenic in the upper and lower plate units, concentrations of all parameters are below Nevada's primary drinking water standards (**Tables 3-13** and **3-18**). Arsenic concentrations exceed the state drinking water standard (0.05 mg/L) in the wells during all sampling events. Highest arsenic concentrations occur in well HDDW-2 (0.508 to 0.726 mg/L), screened in lower plate carbonate rocks. Elevated arsenic concentrations in groundwater in the Leeville area likely represent natural levels in deep mineralized zones.

TABLE 3-18
Groundwater Quality in Vicinity of Leeville Project

Parameter[1]	Well HDDW-1A		Well HDDW-2		Well HDDW-3		Standards for Municipal or Domestic Supply[2]
No. of samples	4		4		4		---
Hydrostratigraphic Unit	Lower Plate (Popovich / Roberts Mtn Formations)		Lower Plate (Rodeo Ck / Popovich / Roberts Mtn Formations)		Upper Plate (Vinini Formation)		---
Statistics	Range	Mean / SD[3]	Range	Mean / SD[3]	Range	Mean / SD[3]	---
TDS	233 – 305	266 / 37.1	233 – 321	275 / 44.1	229 - 241	233 / 5.3	500 – [1000]
SC (μmhos/cm)	367 – 372	369 / 2.6	494	494 / NM	NA	NA / NA	---
pH (std units)	7.20 - 8.17	7.9 / 0.47	8.08 – 8.16	8.15 / 0.07	7.83 - 8.07	7.95 / 0.13	5.0 – 9.0
Temperature (º F)	86 – 87	86.5 / NM	67 – 70	68.5 / NM	59 – 63	61 / NM	---
Alkalinity (as HCO_3)	137 – 146	140 / 4.1	179 – 185	182 / 3.1	109 – 138	118 / 13.9	---
Calcium (Ca)	39.7 – 42.2	40.4 / 1.2	48.6 – 51.9	49.9 / 1.5	33.0 - 39.0	37.3 / 2.9	---
Sodium (Na)	6.5 – 10	7.5 / 1.7	9.0 - 13.1	10.8 / 1.8	9.0 - 10.4	9.6 / 0.71	---
Magnesium (Mg)	19.1 – 19.5	19.2 / 0.2	18.7 – 20.2	19.5 / 0.7	14.0 - 15.6	14.7 / 0.79	125 – [150] (s)
Potassium (K)	2.9 - 3.0	2.95 / 0.06	3.0 - 4.0	3.43 / 0.42	3.0 - 3.4	3.1 / 0.2	---
Chloride (Cl)	6.9 - 7.7	7.2 / 0.35	8.8 - 12.5	10.5 / 1.52	6.1 - 7.7	6.8 / 0.67	250 – [400]
Fluoride (F)	0.32 – 0.33	0.32 / 0.005	0.79 - 0.84	0.81 / 0.026	0.42 - 0.53	0.45 / 0.05	2.0(s) - 4.0
Sulfate (SO_4)	44.6 - 45.5	45 / 0.38	65.0 – 72.2	68.2 / 3.01	62.6 - 70.0	65.8 / 3.2	250 – [500]
Nitrate as NO_3-N	<0.02 - <0.10	0.04 / 0.02	<0.10	0.05 / 0	<0.10	0.05 / 0	10
Antimony (Sb)	0.007	0.007 / NM	0.015 - 0.030	0.023 / 0.006	<0.005	0.0025 / 0	0.146
Arsenic (As)	0.057 - 0.068	0.061 / 0.005	0.508 - 0.726	0.628 / 0.104	0.097 - .572	0.348 / 0.22	0.05
Boron (B)	<0.10	0.05 / 0	<0.10	0.05 / 0	<0.10	0.05 / 0	---
Cadmium (Cd)	<0.005	0.0025 / 0	<0.005 - 0.009	0.004 / 0.003	<0.005	0.0025 / 0	0.005
Chromium (Cr)	<0.05	0.025 / 0	<0.05	0.025 / 0	<0.05	0.025 / 0	0.10
Iron (Fe)	0.14 - 0.32	0.21 / 0.08	0.37 - 0.39	0.38 / 0.008	0.17 – 4.69	2.25 / 2.14	0.3 – [0.6] (s)
Manganese (Mg)	<0.01 - 0.01	0.006 / 0.003	0.06 - 0.08	0.068 / 0.01	0.18 – 0.32	0.395 / 0.08	0.05 – [0.10] (s)
Mercury (Hg)	<0.001	0.0005 / 0	<0.001	0.0005 / 0	<0.001	0.0005 / 0	0.002
Selenium (Se)	<0.001 - .005	.0016 / 0.002	<0.001 - 0.004	0.0018 / 0.002	<.001 - .004	0.0018 / 0.0017	0.05
Zinc (Zn)	<0.01 - 0.01	.0075 / 0.003	<0.01 - 0.06	0.0188 / 0.028	0.03 - 0.09	0.05 / 0.028	5.0 (s)

Note: Samples were collected and analyzed during the period April 1996 – August 1997. See **Figure 3-12** for well locations.

1 All units in milligrams per liter (mg/L) unless otherwise specified. Metals are dissolved concentrations. SC = specific conductance in micromhos per centimeter; TDS = total dissolved solids; NA = not analyzed.

2 Numbers in brackets [ ] are mandatory secondary standards for public water systems. Values with an (s) are federal secondary drinking water standards. See **Table 3-13** for a listing of water quality standards.

3 SD = standard deviation; NM = not measured. For statistical purposes, values reported by the laboratory at less than the detection limit were converted to half the specified limit value.

Source: Newmont 1996, 1997b.

Iron and manganese concentrations were elevated with respect to federal secondary drinking water standards (**Table 3-18**), especially in the upper plate well. Iron and manganese concentrations decreased as aquifer testing progressed, indicating possible influence from steel well casing. Water temperatures range from approximately 60°F in upper plate rocks to 87°F in lower plate rocks.

WATER USE

Water in the study area is used for irrigation, stock watering, mining/milling, and domestic purposes. Irrigation and stock watering uses are scattered throughout the Boulder Valley, whereas mining and milling uses occur primarily in upper reaches of Boulder and Rodeo creeks drainages where most of the active mines are located (e.g., Betze/Post Mine). Other nearby mining and milling water uses are located on the east side of the Tuscarora Mountains in the South Operations Area (i.e., Gold Quarry Mine). Most domestic uses are associated with various mine operations.

Mine-Related Water Use

A summary of groundwater pumping rates for the Goldstrike Property, Gold Quarry, and Leeville mines are presented graphically on **Figure 3-7**. Information relative to water management at these mines is presented in **Table 3-11**. Relatively minor groundwater pumping and consumption (less than 100 gpm) also occurs at several other mines in the north Carlin Trend area (e.g., Genesis and Deepstar mines). Long-term water consumption from evaporation of pit lake water will occur at some of the mine pits; however, this would not occur for the Leeville underground mine.

The proposed Leeville Project is expected to pump groundwater at rates of up to 25,000 gpm for the first 2 years of operation, declining to a rate of about 15,000 gpm in the following 2 years (**Figure 3-7**). Approximately 8,000 to 10,000 gpm would be pumped at the mine site during the final 10 years of operation.

For the Goldstrike Property and Gold Quarry mine, maximum groundwater pumping rates of about 69,000 gpm and 25,000 gpm, respectively, have been used to dewater the mines. Current pumping rates at Goldstrike Property and Gold Quarry mine are approximately 40,000 and 10,000 gpm, respectively. These rates are expected to remain the same or decline for the remaining mine life (**Figure 3-7**). Approximately 2,000 to 2,500 gpm is consumed for mine-related activities at each of the major mine sites. The remainder of water at the Goldstrike Property is discharged to infiltration basins and the TS Ranch Reservoir. Injection wells are occasionally used in the Boulder Valley, but have scaling problems that preclude frequent use.

Excess water at Gold Quarry is discharged to Maggie Creek, including a temporary storage reservoir (Maggie Creek Ranch Reservoir). Barrick maintains a permit to discharge excess water from their dewatering system at Goldstrike Property to the Humboldt River if necessary, but has not done so since February 1999. Active dewatering would continue through year 2010 for the Goldstrike Property and through year 2012 for Gold Quarry. Additional water supply needs of 1,000 to 2,000 gpm would be needed for 5 to 10 years after cessation of mining for post-closure and reclamation activities at each major mine.

Water Rights

Maps and lists of surface water and groundwater rights for the study area are provided in the Cumulative Impact Analysis report (BLM 2000a). Within a 3-mile radius of the Leeville Project site, there are three water supply wells with water rights that are not associated with mining and milling activities: (1) Permit No. 23881; Certificate No. 7642; Newmont Gold Company; T35N, R50E, NW¼ of Section 22, for stock uses; (2) Permit No. 26873; Certificate No. 8659; Elko Land and Livestock Co.; T35N, R50E, NE¼ of Section 20, for stock uses; and (3) Permit No. 28969; Certificate No. 9282; Elko Land and Livestock Co.; T36N, R50E, SE¼ of Section 30; for stock uses. There are no surface water rights listed within 3 miles of the Leeville site; however, numerous water rights are held by Barrick for the TS Ranch Reservoir at T35N, R49E, NW¼ of Section 3 (various water uses). In addition, two water rights for irrigation are held by A.C. Fox for Boulder Creek approximately downgradient of the Leeville Project site (T35N, R49E, NE¼ & SW¼ of Section 8).

SOILS

Soil resources in the soil survey study area, inclusive of the two alternative pipeline routes, were mapped as an Order II survey in the fall of 1997 by Resource Concepts, Inc. (RCI 1998). Information contained in the Order III Soil Survey of Tuscarora Mountain Area, Nevada completed by the Natural Resource Conservation Service (NRCS) in 1980 was used as the basis for the Order II soil survey. The soil survey study area is shown on **Figure 3-14** and soil map units are described in **Table 3-19**.

Soil resources in the area were evaluated for potential use in reclamation of disturbed areas using the criteria from Part 620.06f, Table 620-11 of the National Soil Survey Handbook (NRCS 1993) as a guide. The physical and chemical properties of soil that pertain to suitability as a growth medium were determined in the field and by FGL Environmental in Santa Paula, California. The properties were used as the basis to formulate a recommendation for salvage depth and volume of suitable growth medium. The Tuscarora Mountain Area Soil Survey (NRCS 1980) was consulted to determine potential erosion hazards from water and wind.

Soil series from the Order II map units and characteristics are listed in **Table 3-20** and shown on **Figure 3-14**. Data collected from the Order II Soil Survey include soil series identified, percent of soil series included in each mapping unit, slope range, landform, depth to induration or bedrock, depth of soil suitable for reconstruction material/soil salvage, rooting restricting depth, and parent material. Permeability, available water holding capacity, surface runoff class, and erosion hazard potential were taken from the existing Order III Soil Survey.

Depth of soil varies throughout the soil survey area, as indicated in **Table 3-19** and **Table 3-20**. Shallow soil is found along ridge lines and weathered slopes (**Figure 3-14**). Map units 02 and 03, although located in upland areas, exhibit soil depth dominantly ranging from 20 to 40 inches. Soil depth in the lowlands (map units 09 and 10) is moderately deep to very deep. Except for soil occupying drainages, soil in the Leeville Project area is well drained and not subject to saturated conditions. Soil in the Project area has very low available water capacity, and very slow to moderate permeability, with surface runoff ranging from very slow to rapid, primarily depending on degree of slope.

The major soil component(s) in an undisturbed state for each soil map unit within the Project area were used to evaluate potential for use as reclamation material. The NRCS (1993) guide rates suitability of soil using the major properties that influence erosion and stability of the surface and the productive potential of reconstructed soil. Those properties and ratings of soil identified in the soil survey are presented in **Table 3-19**. Soil reconstruction of disturbed areas is the process of replacing layers of soil material or unconsolidated geologic material, or both, in a vertical sequence of such quality and thickness that a favorable plant growth medium results.

Soil is rated in its current state, whether it is a natural or previously modified state. Only the most restrictive properties are evaluated for interpretation. The properties are listed in descending order of estimated importance.

A rating of “good” means that vegetation is relatively easy to establish and maintain, that the surface is stable and resists erosion, and that the reconstructed soil has good potential productivity.

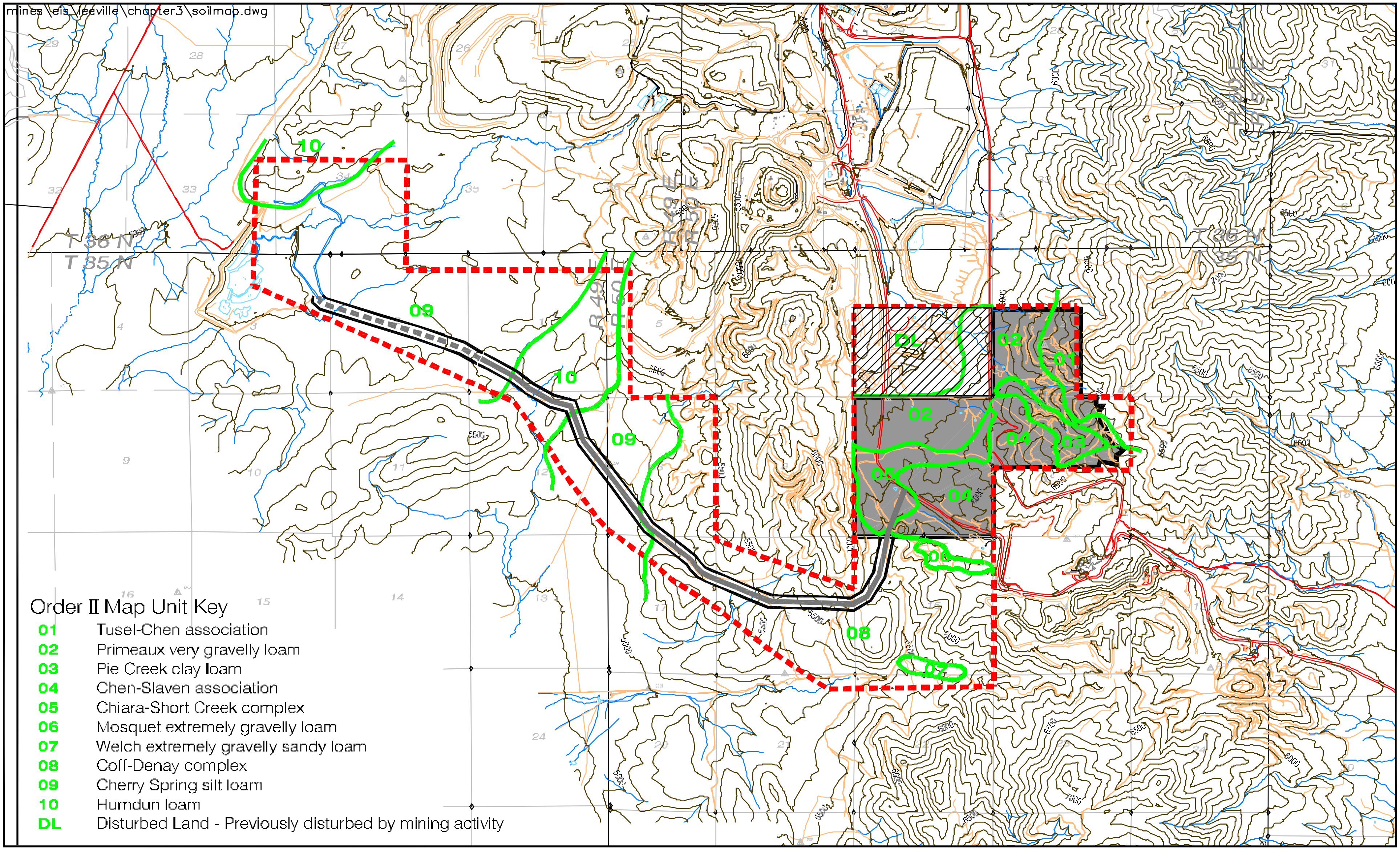
Material rated as fair can be vegetated and stabilized by modifying one or more properties. Top dressing with better material or application of soil amendments may be necessary for satisfactory performance.

Soil may be unsuitable for specific uses if it has one or more restrictive properties. Restrictive properties are physical or chemical characteristics that inhibit plant growth or make the soil structurally unsound. Soil properties considered most important when rating soil for use as salvage material include: soil texture, depth to bedrock (duripan), coarse fragment content (greater than 3 inches in diameter), salt content, and pH. Features such as steep slopes, rough terrain, and rock outcrop may limit access for salvage activities.

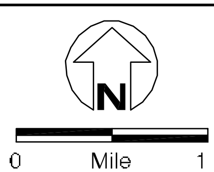
Soil map unit components identified in the study area were rated for salvage potential based on physical and chemical properties of the soil profiles described in the field, and laboratory analysis (**Table 3-20**). Recommended suitability of soil for salvage is summarized in **Table 3-19**.

Soil mapping units have been assigned a rating of good, fair, or poor based on the most limiting characteristic of any map unit component. Coarse fragment content and/or shallow depth to a restrictive layer are the most common limiting characteristics for salvage potential of soil in the study area. Using the most limiting characteristics of any map unit component, 2.5 to 5 feet of one map unit - Map Unit 10 (except rock outcrop), could be salvaged and stockpiled for reclamation purposes. The majority of map units rate as poor overall (**Table 3-19**). Salvage potential in Map Unit 03 and Map Unit 09 is high at 98 percent and 94 percent, respectively, if it is cost effective to restrict these activities to the primary components of those map units. The second component of Map Unit 04, the Slaven soil (30 percent) is conducive to salvage. In total, approximately 4 million cubic yards of native soil are conducive to salvage within the study area.

Ten of the 14 soil map units identified in the Leeville Project area rate as poor for one of the following properties: too cobbly, too stony, or thin layer. These properties are 11th, 12th and 13th in order of estimated importance of the 16 properties evaluated. The remaining properties are rated as good or fair for soil reconstruction material.



Source: Illustrated Map Units are from Order II Survey RCI 1998.



Legend

- Soil Survey Boundary
- Map Unit Boundary
- 01 Map Unit Symbol (See Table 3-19)
- Project Area
- Alternative C
- Proposed Pipeline Corridor

Order II Soil Map
Leeville Project
FIGURE 3-14

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TABLE 3-19
Suitability of Soil for Salvage In the Soil Survey Area

Soil Map Units	Soil Series	Limiting Characteristic	Recommended Soil Salvage Depth (feet)	Potential Soil Salvage Area (acres)	Growth Medium Salvage Volume (cubic yards)	Salvage Rating
01	Tusel (68%)	Too cobbly 40% of 3-10" dia. Thin layer 10-22"	0	0	0	Poor
	Chen (30%)	Cobbly 30-40% 3-10" dia.	0	0	0	Poor
	Rock outcrop (2%)	Not Applicable (NA)	NA	NA	NA	NA
02	Primeaux (98%)	Too stony 30% of >10"	0	0	0	Poor
	Welch (2%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
03	Pie Creek (98%)	Thin layer approx. 33"	2.5	86	346,867 [1]	Good
	Welch (2%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
04	Chen (60%)	Thin layer 10 – 22" Cobbly 30-40% 3-10" dia.	0	0	0	Poor
	Slaven (30%)	Thin layer approx. 32"	Approx. 2.5	130	524,333 [2]	Fair
	Rock outcrop (10%)	NA	NA	NA	NA	NA
05	Chiara (85%)	Thin layer approx. 17"	0	0	0	Poor
	Short Creek (15%)	Too stony 20% >10" dia.	0	0	0	Poor
06	Mosquet (96%)	Thin layer 11 to 18"	0	0	0	Poor
	Chen (2%)	Limited extent	0	0	0	Poor
	Coff (2%)	Limited extent	0	0	0	Poor
07	Welch (96%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
	Chen (2%)	Limited extent	0	0	0	Poor
	Denay (2%)	Limited extent	0	0	0	Poor
08	Coff (50%)	Too cobbly 60% of 3-10" dia.	0	0	0	Poor
	Denay (30%)	Too cobbly 20-70% of 3-10" dia.	0	0	0	Poor
	Mascamp (10%)	Too cobbly 20-70% of 3-10" dia.	0	0	0	Poor
	Rubble Land (5%)	Thin layer 11-23"	0	0	0	Poor
	Rock Outcrop	NA	NA	NA	NA	NA
09	Cherry Spring (94%)	None	2.5	520	2,097,333 [3]	Good
	Coff (4%)	Too cobbly 60% of 3-10" dia.	0	0	0	Poor
	Humdun loam (2%)	Limited extent	0	0	0	Poor
10	Humdun (90%)	None	5	116	935,733	Good
	Cherry Spring (8%)	None	2.5	10	40,333	Good
	Rock outcrop (2%)	NA	NA	NA	NA	NA
		TOTALS		**862[4]**	**3,944,599[5]**	

Note: dia. = diameter. Not all soil series shown in Table 3-19 would be disturbed by the Proposed Action.

[1] Restrict salvage to Pie Creek Soil
[2] Restrict salvage to Slaven Soil
[3] Restrict salvage to Cherry Spring Soil
[4] Total acres in soil survey area in which soils have the potential to be used in reconstruction of disturbed sites
[5] Represents total volume of suitable soil available in the soil survey area.

Source: NRCS 1980, 1993; RCI 1998.

TABLE 3- 20
Physical and Chemical Properties of Soil in the Soil Survey Area

Soil Map Unit Component	Depth (in)	USDA Texture[1]	Permeability (in/hr)	Available Water Capacity (in/in)	Salinity (mmhs/cm)	Shrink-Swell Potential	Erosion Factors Surface Layer K[2]	Erosion Factors Surface Layer T[3]	pH (Standard Units)
Chen	0 – 8 8 – 11 17 – 21	cbL, VgrL grC bedrock	0.6 - 2.0 0.0 - 0.06 0.0 - 0.01	0.13 – 0.15 0.07 – 0.09	0 0 0	Low Moderate	0.17	1	6.6 -7.8 6.6 -7.8
Cherry Spring	0 – 15 15 –36 36 – 60	SiL L, SiL, CL Duripan	0.6 - 2.0 0.2 - 0.6 0.0 - 0.01	0.19 – 0.21 0.17 -0.19	0 0	Low Low	.55	2	6.6 -7.8 7.4 - 9.0
Chiara	0 – 4 4 – 13 13 – 17	SiL SiL, CL Duripan	0.6 - 2.0 0.6 - 2.0 0.0 - 0.01	0.19 -0.21 0.16 -0.18	0 – 2 0 – 4	Low Low	.55	1	6.6 -8.4 6.6 -9.0
Coff	0 – 5 5 – 29 29 – 39	VgrSiL VgrSiL Duripan	0.6 - 2.0 0.6 - 2.0	0.09 -0.11 0.09 -0.11	0 0	Low Low	.17	2	7.9 -8.4 7.9 -8.4
Denay	0 – 10 10 – 60	grL XgrL	0.6 - 2.0 0.6 - 2.0	0.15 -0.17 0.09 -0.11	0 0 – 2	Low Low	.24	3	7.4 -8.4 7.9 -8.4
Humdun	0 – 8 8 – 30 30 – 60	SiL L SiL	0.6 - 2.0 0.6 - 2.0 0.6 - 2.0	0.19 – 0.21 0.17 -0.20 0.17 -0.20	0 0 2 – 4	Low Low Low	.49	5	6.6 - 7.8 6.6 - 8.4 7.9 -9.0
Mascamp	0 – 7 7 – 15 15 – 25	XstSL VcbSCL Bedrock	2.0 - 6.0 0.6 - 2.0 0.0 - 0.01	0.08 -0.11 0.08 -0.11	0 0	Low Mod	.20	1	6.1 -7.3 6.1 -7.3
Mosquet	0 – 5 5 – 14 14 – 24	VgrSL grCL Bedrock	2.0 - 6.0 0.06 - 0.2 0.0 - 0.01	0.06 -0.08 0.13 -0.15	0 0	Low High	0.10	1	6.1 -7.3 6.1 -7.3
Pie Creek	0 – 5 5 – 21 21 – 35 35 – 45	L C C Bedrock	0.6 - 2.0 0.0 - 0.06 0.06 - 0.2 0.0 - 0.01	0.16 -0.18 0.14 -0.16 0.16 -0.19	0 0 0 – 2	Low High High	.37	2	6.6 -7.3 6.6 -7.3 7.4 -8.4
Primeaux	0 – 11 11 – 20 20 – 35 35 – 45	grL CL VgrSCL Bedrock	0.6 - 2.0 0.2 - 0.6 0.6 - 2.0 0.0 - 0.01	0.10 -0.18 0.15 -0.19 0.15 -0.17	0 0 0	Low Moderate Low	.32	2	6.1 -7.3 6.6 -7.3 6.1 -7.3
Short Creek	0 – 8 8 – 23 23 – 60	grCL VgrC XgrC-SCL	0.6 - 2.0 0.06 - 0.2 0.0 - 0.01	0.07 -0.09 0.08 -0.11	0 0	Low Moderate	.24	5	6.6 -7.3 6.6 -7.3 7.9 -9.0
Slaven	0 – 5 5 – 22 22 – 32	VgrL XgrC-CL Bedrock	0.6 - 2.0 0.06 - 0.2 0.0 - 0.01	0.07 -0.09 0.08 -0.11	0 0	Low Moderate	.28	2	6.1 -7.3 6.6 -7.3
Tusel	0 – 17 17 – 60	VgrL XgrSCL-CL	0.6 - 2.0 0.2 - 0.6	0.13 -0.15 0.08 -0.11	0 0	Low Moderate	.24	5	6.1 -7.3 6.1 -7.3
Welch	0 – 7 7 – 60	L grCL	0.6 - 2.0 0.2 - 0.6	0.16 -0.20 0.18 -0.20	0 0	Low Moderate	.32	5	6.1 -7.3 6.1 -7.3

1 cbL = cobbly loam; VgrL = very gravelly loam; grC = gravelly clay; SiL = silt loam; L = loam; CL = clay loam: VgrSiL = very gravelly silt loam; grL = gravelly loam; XgrL = extremely gravelly loam; XstSL = extremely stony sandy loam; VcbSCL = very cobbly sandy clay loam; VgrSL = very gravelly sandy loam; grCL = gravelly clay loam; C = clay; VgrSCL = very gravelly sandy clay loam; VgrC = very gravelly clay; XgrC-SCL = extremely gravelly clay - sandy clay loam; XgrC-CL = extremely gravelly clay – clay loam; XgrSCL-CL = extremely gravelly sandy clay loam-clay loam.

2 K = Soil Erodability Factor. The higher the value, the more erodable the soil.

3 T = Tons per acre of tolerable soil loss without reducing crop production.

Source: NRCS 1980.

VEGETATION

Vegetation in the Leeville Project area is dominated by sagebrush steppe communities, with limited riparian vegetation bordering drainages, springs, and seeps. Big sagebrush dominates on deep, salt-free soil, along with bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass (Cronquist et al. 1972). The vegetation study area corresponds to the soil survey area.

In general, vegetation in the Project area reflects historic and ongoing disturbance by mining, grazing, and fire. Areas cleared of sagebrush, either mechanically or by wildfire, have generally converted to annual plant communities dominated by cheatgrass, unless previously seeded to adapted wheatgrass species. Riparian vegetation is sparse and infrequent with some willows or herbaceous riparian species along ephemeral drainages.

Vegetation located within the Project area is identified by the range site and presented in **Table 3-21**. These vegetation types were located and field-verified during the Order II Soil Survey (RCI 1998). Soil map units were correlated to range site descriptions published in the Tuscarora Mountain Area Soil Survey (NRCS 1980) and summarized below (NRCS 1992).

The **Loamy 8 to 10 inch precipitation zone (p.z.)** range site occurs on alluvial fans, low terraces, low foothills, sideslopes, and uplands on slopes ranging from 2 to 50 percent, but most commonly on slopes of 4 to 30 percent. Elevations range from 4,500 to 6,000 feet above mean sea level (AMSL). Dominant plant species include Wyoming big sagebrush, bluebunch wheatgrass, and Thurber needlegrass. Total vegetative canopy cover for this site ranges between 20 to 30 percent. The potential vegetation composition (by weight) for the site is 65 percent grasses, 5 percent forbs, and 30 percent shrubs. This range site constitutes 5 percent of the Project area.

The **Loamy 10 to 12 inch p.z.** range site occurs on sideslopes and summits of alluvial fans and hills on all exposures. Slopes range from 4 to 15 percent. Elevations for this site are 5,500 to 6,500 feet AMSL. Vegetation is dominated by an assemblage of sagebrush species, including basin big sagebrush, Wyoming big sagebrush, and mountain big sagebrush. Other dominant species include antelope bitterbrush, rabbitbrush, bluebunch wheatgrass, Thurber needlegrass, and bluegrass species. Total vegetation canopy cover approaches 30 to 40 percent. Based on dry weight production, potential vegetation compo-sition for this site is 65 percent grasses, 10 percent forbs, and 25 percent shrubs. This range site constitutes 4 percent of the Project area.

TABLE 3-21
Leeville Project Area Range Sites

Range Site	Percent of Mapped Area	Area (acres)
Loamy 8 to 10 inch precipitation zone	5	161
Loamy 10 to 12 inch precipitation zone	4	130
Cobbly claypan 8 to 12 inch precipitation zone	10	304
Claypan 10 to 12 inch precipitation zone	3	86
Shallow loam 8 to 10 inch precipitation zone	1	39
Shallow calcareous loam 8 to 10 inch precipitation zone	6	195
South slope 8 to 12 inch precipitation zone	1	30
Loamy slope 12 to 16 inch precipitation zone	24	754
Loamy bottoms 8 to 14 inch precipitation zone	1	40
Mountain ridge	4	136
Rock outcrop, rubble land	5	167
Annual ephemeral species	36	1,136
Total	**100 %**	**3,178**

Source: RCI 1998.

The **Cobbly Claypan 8 to 12 inch p.z.** range site occurs on hills, erosional fan remnants, and rock- pediment remnants on all aspects. Slopes range from 2 to 50 percent, but slope gradients of 8 to 30 percent are typical. Elevations range from 5,500 to 7,000 feet AMSL. Dominant plant species include bluebunch wheatgrass, Thurber needle-grass, and low sagebrush. Approximate ground cover (basal and crown) is 10 to 20 percent with potential vegetative composition approaching 55 percent grass, 10 percent forbs, and 35 percent shrubs. This range site constitutes 10 percent of the Project area.

The **Claypan 10 to 12 inch p.z.** range site occurs on summits and sideslopes of hills and alluvial terraces and fans on all aspects. Slopes range from 2 to 50 percent, but gradients of 8 to 30 per-cent are typical. Elevations for this site range from 5,500 to 6,500 feet AMSL. Dominant plant species include low sagebrush, antelope bitterbrush, and rabbitbrush with an understory of bluebunch wheatgrass, needlegrass species and a variety of perennial forb species. Potential vegetation composition by dry weight is 30 percent shrubs, 60 percent grass, and 10 percent forbs. Approximate canopy ground cover is 20 to 30 percent. This range site constitutes 3 percent of the Project area.

The **Shallow Loam 8 to 10 inch p.z.** range site occurs on sideslopes of hills and lower mountains with southern aspects. Slopes range from 8 to 75 percent, but slopes of 15 to 50 percent are most common. The plant community is dominated by Thurber needlegrass, Indian ricegrass, and Wyoming big sagebrush. Approximate ground cover (basal and crown) is 10 to 20 percent. Potential vegetation composition is about 50 per-cent grass, 5 percent forbs, and 45 percent shrubs. This range site comprises approximately 1 percent of the Project area.

The **Shallow Calcareous Loam 8 to 10 inch p.z.** range site occurs on summits and sideslopes of hills and mountains on all aspects. Slopes range from 2 to 50 percent, but slope gradients of 15 to 30 percent are most typical. Elevations range from 5,000 to 6,500 feet AMSL. The plant community on this site is dominated by black sagebrush and Thurber needlegrass. Spiny hopsage and Indian ricegrass are other important species associated with this site. Approximate ground cover (basal and crown) is 15 to 30 percent. Potential vegetation composition by weight for this site is about 50 percent grass, 5 percent forbs, and 45 percent shrubs. This range site constitutes approximately 6 percent of the Project area.

The **South Slope 8 to 12 inch p.z.** range site occurs on mountain sideslopes on all but north exposures. Slopes range from 30 to 75 percent, but slope gradients of 30 to 50 percent are most typical. Elevations are 6,000 to 8,500 feet AMSL. The plant community is dominated by bluebunch wheatgrass although big sagebrush may be prevalent enough to dominate the aspect. Other important plants are antelope bitterbrush, basin wildrye, Nevada bluegrass, and Idaho fescue. Approximate ground cover (basal and crown) is 35 to 45 percent with potential vegetative compo-sition (by weight) approaching 65 percent grass, 10 percent forbs, and 25 percent shrubs. This range site constitutes 1 percent of the Project area.

The Loamy Slope 12 to 16 inch p.z. range site occurs on sideslopes of mountains, hills and fan piedmonts. At lower elevations, this site is restricted to north exposures. Slopes range from 8 to 75 percent, but slope gradients of 15 to 30 percent are most typical. Elevations are 5,500 to 8,000 feet AMSL. The plant community is dominated by Idaho fescue, bluebunch wheatgrass, mountain big sagebrush, and antelope bitterbrush. Slopes of southerly exposure will normally express a higher percentage of bluebunch wheatgrass while north facing slopes support a higher component of Idaho fescue. Big sagebrush is usually prevalent enough to dominate the aspect. Approximate ground cover (basal and crown) is 40 to 50 percent with potential vegetation composition at about 60 percent grass, 15 percent forbs, and 25 percent shrubs. This range site constitutes 24 percent of the Project area.

The **Loamy Bottoms 8 to 14 inch p.z.** range site occurs on the outer margins of axial-stream flood-plains and inset fans. Slopes range from 0 to 8 percent. Elevations are 4,500 to 7,000 feet AMSL. The plant community is dominated by Great Basin wildrye. Other important plants include lupine and basin big sagebrush. Approximate ground cover (basal and crown) is 45 to 60 percent. Vegetation composition is approximately 85 percent grass, 5 percent forbs, and 10 percent shrubs. This range site comprises 1 percent of the Project area.

The **Mountain Ridge** range site occurs on summits, crests, and shoulders of mountains. Slopes are 4 to 75 percent and elevations are 6,000 to 9,500 feet AMSL. The plant community is dominated by Idaho fescue. Other important plants are low and black sagebrush, and bluegrass species. Approximate ground cover (basal and crown) is 15 to 25 percent with potential vegetative composition at about 50 percent grass, 15 percent forbs, and 35 percent shrubs. This range site constitutes 4 percent of the Project area.

Approximately 167 acres, or 5 percent of the Project area, contains miscellaneous land types including rock outcrop and rubble land. These types are not recognized as supporting vegetation types described by NRCS range sites.

Areas dominated by invasive, nonnative plant species are also found within the Project area. These ephemeral vegetation types can occur where the native plant component has been disturbed or otherwise removed such as by fire. Prolific and pervasive annual plant species such as cheatgrass and annual mustard are able to invade and dominate sites, and exclude native perennial species. On drier sites, these invasive communities can become relatively long-lived due to frequent fire and/or disturbance. On wetter sites, native vegetation can often out compete nonnative species and eventually become dominant again. **Table 3-22** lists the dominant plant species observed on or near the Project area during the Order II Soil Survey (RCI 1998).

Thirteen plants classified as Nevada Special Status Species, and designated as sensitive by the Nevada State Office of the BLM, exist or potentially exist on public land within the BLM Elko District. Only one, Lewis buckwheat, potentially occurs in the vicinity of the Project area; it is discussed in the *Threatened, Endangered, Candidate, and Sensitive Species* section of this chapter.

INVASIVE, NONNATIVE SPECIES

Weed species have also been documented in noxious weed inventories near the Project area. Three species of noxious weeds present in the area are Scotch thistle, Canada thistle, and saltcedar (tamarisk) (RCI 1998).

Scotch thistle can grow to eight feet tall and is armed with spines that prevent livestock use in areas of heavy infestation. Seeds remain viable in soil for more than 7 years. Canada thistle reproduces asexually, and is difficult to control. Saltcedar is associated with mesic (dry) sites, and can propagate from buried or submerged stems. Salt can accumulate in this plant, eventually resulting in saline soil and elimination of less salt tolerant vegetation.

Other invasive nonnative species that occur in the vicinity include hoary cress, leafy spurge, diffuse knapweed, and Russian knapweed. Exotic annual grass species, particularly cheatgrass and medusahead wildrye, often dominate native vegetation in many parts of the Great Basin, particularly in areas disturbed by fire (Entiwistle et al. 2000).

Saltcedar is present along Sheep Creek in Section 10, T35N, R50E, and along Boulder Creek, in the Boulder Valley at several injection and monitoring well locations, and along the Humboldt River near Dunphy. Scotch thistle currently exists on previously disturbed and reclaimed exploration sites within the Leeville Project area, along Sheep Creek, Lynn Creek, and the TS Ranch Reservoir. Hoary cress exists along several roads throughout the Boulder Valley (BLM 1993b).

The Natural Resource and Conservation Service is compiling existing BLM, USFS, and state data to delineate extent of noxious weed populations in Nevada.

TABLE 3-22
Plant Species Observed on or Near the Leeville Project Area

Grasses	
Thickspike wheatgrass	*Agropyron dasystachyum*
Western wheatgass	*Agropyron smithii*
Bluebunch wheatgrass	*Agropyron spicatum*
Cheatgrass	*Bromus tectorum*
Basin wildrye	*Elymus cinereus*
Idaho fescue	*Festuca idahoensis*
Indian ricegrass	*Oryzopsis hymenoides*
Sandberg bluegrass	*Poe secunda*
Bottlebrush squirreltail	*Sitanion hystrix*
Needle and thread	*Stipa comata*
Thurber needlegrass	*Stipa thurberiana*
Webber needlegrass	*Stipa webberi*
Forbs	
Aster	*Aster sp.*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Paintbrush	*Castilleja sp.*
Thistle	*Cirsium sp.*
Tapertip hawksbeard	*Crepis acuminata*
Cryptantha	*Cryptantha sp.*
Buckwheat	*Eriogonum sp.*
Goldenweed	*Haplopappus sp.*
Clingingleaf pepperweed	*Lepidium perfoliatum*
White stoneseed	*Lithospermum ruderale*
Lupine	*Lupinus sp.*
Spiny phlox	*Phlox hoodii*
Longleaf phlox	*Phlox longifoiia*
Shrubs	
Serviceberry	*Amelanchier alnifolia*
Low sagebrush	*Artemisia arbuscula*
Black sagebrush	*Artemisia arbuscula nova*
Basin big sagebrush	*Artemisia tridentata tridentata*
Wyoming big sagebrush	*Artmeisia tridentata wyomingensis*
Mountain big sagebrush	*Artemisia vaseyana*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Douglas rabbitbrush	*Chrysothamnus viscidiflorus*
Spiny hopsage	*Grayia spinosa*
Common pricklygilia	*Leptodactylon pungens*
Antelope bitterbrush	*Purshia tridentata*
Spineless horsebrush	*Tetradymia canescens*
Littleleaf horsebrush	*Tetradymia glabrata*

Source: RCI 1998.

WETLANDS/RIPARIAN ZONES

Four intermittent springs/seeps with seasonal flows up to 5 gpm are located in the Project area (**Figure 3-10**). Due to the seasonal nature of flow, neither hydric soil nor riparian vegetation are well developed at these locations. Rodeo Creek drains the majority of the Project area but is intermittent, flowing primarily during spring months (March through June). No riparian vegetation is found along its banks, and it has been described as "basically a ditch" (Lamp 2001).

The nearest identified riparian areas are along the upper reaches of Lynn and Simon creeks. Riparian/wetland vegetation along these streams total 31 acres, including 2 acres of herbaceous stream bank vegetation and 29 acres of wet meadow (BLM 2000a).

Approximately 2,150 acres of wetlands and riparian zones associated with streams, seeps, and springs are located in the vicinity of the Leeville Project in the southern end of the Tuscarora Range (BLM 2000a). The wetlands/riparian zones are further subdivided by type as follows: streambar, 362 acres; herbaceous streambar, 590 acres; wet meadow, 733 acres; salix streambar, 58 acres; salix-mesic meadow, 27 acres; mesic meadow, 161 acres; salexi-wet meadow, 217 acres; and salix-wet meadow, 1 acre. These riparian acres are located in the geographic area encompassed by **Figure 3-10**. The *Water Quantity and Quality* section of this chapter contains a detailed description of the location of springs, seeps, and perennial flowing segments of streams in the Project area.

Current discharge to the TS Ranch Reservoir and infiltration to groundwater have resulted in formation of three large spring areas (Sand Dune, Green, and Knob springs) south of the reservoir. Additional riparian areas within the general study area include those associated with Simon and Lynn creeks. Riparian areas associated with these streams are generally sporadic and contain vegetation types such as grassy wet meadow, and streamside sedge/herbaceous (BLM 2000a).

FISHERIES AND AQUATIC RESOURCES

The fishery resources study area for the Leeville Project includes the Boulder and Maggie creek drainages and portions of the Humboldt River (**Figure 3-5**). Fish species collected in the study area include several species of trout, including Lahontan cutthroat trout (LCT), minnows, suckers, and bass (**Table 3-23**). Lahontan cutthroat trout is federally listed as threatened and is the Nevada State fish (Coffin 1981). Since the late 1800's, other fish species (e.g., other trout and warm water fish species) have been planted in creeks in the study area. Due to exotic introductions and decline in stream habitat conditions, Lahontan cutthroat trout populations have declined. Lahontan cutthroat trout have also hybridized with rainbow trout in some areas of the Humboldt River Basin. Lahontan cutthroat trout is further discussed in the *Threatened, Endangered, Candidate, and Sensitive Species* section in this chapter.

Fishery resource surveys were conducted in Boulder, Brush, and Rodeo creeks in 1988 and 1990. Lahontan speckled dace was the only fish present (JBR 1988, 1990b). This fish is able to tolerate poor habitat quality present in these streams. Boulder, Bell, Brush, and Rodeo creeks
are small, intermittent streams, with some perennial flow in upper reaches. Streams in the Boulder and Maggie creek drainages have been impacted by livestock grazing and fires during 2001. Limiting factors for fish in the Boulder Creek drainage include lack of water, high water temperatures during spring and summer, lack of shade and cover, and lack of suitable pool habitat (A.A. Rich and Associates 1999). Brush Creek has been dry since 1994 (Adrian Brown Consultants 1997).

The Maggie Creek Watershed Restoration Project was implemented in 1993 by Newmont, BLM, and the Elko Land and Livestock Company, as mitigation for Newmont's South Operations Area Project. As a result, aquatic habitat parameters such as riparian zone width, riparian condition class (percent optimum growth), stream width/depth ratio, bank overhang distance, woody vegetation overhang distance, and percent stream width with quality pools have improved (BLM 1997b). Specific streams with improved conditions include Maggie, Coyote, Little Jack, and Simon creeks (BLM 2000c).

Fish sampling was conducted in 1997 in Lynn, Maggie, Beaver, Little Beaver, Spring, Little Jack, and Coyote creeks within the Maggie Creek sub-basin. Fish species documented included speckled dace, Lahontan redside, Tahoe sucker, and Lahontan cutthroat trout (AATA International 1997). Speckled dace was the most abundant species in the middle and lower reaches of all streams. Lahontan cutthroat trout were dominant in the upper reaches of Beaver, Little Jack, and Coyote creeks (BLM 2000c).

Macro-invertebrate communities in streams within the Project area are generally low in diversity, with species composition reflecting degraded con-ditions in the streams (e.g., high temperature). Primary factors limiting macro-invertebrate diversity and abundance in the area include intermittent stream flow, sediment loading, high temperature, and lack of shade.

TABLE 3-23 Fish Species Collected Within the Study Area	
Salmonidae (Trout and Salmon)	
Lahontan Cutthroat Trout[1]	*Salmo clarki henshawi*
Brook Trout[1]	*Salvelinus fontinalis*
Rainbow Trout[1]	*Oncorhynchus mykiss*
Brown Trout[1]	*Salmo trutta*
Cyprinidae (Minnows)	
Lahontan Reside Shiner[1,2]	*Richardsonius balteatus*
Lahontan Speckled Dace[1,2]	*Rhinichthys osculus* robustus
Lahontan Tui Chub[2]	*Gila bicolor obesa*
Common Carp[2]	*Cyprinus carpio*
Catostomidae (Suckers)	
Mountain Sucker[1,2]	*Catostomus platyrhynchus*
Ictaluridae (Catfish)	
Channel Catfish[2]	*Ictalurus punctatus*
Centrarchidae (Bass)	
Smallmouth Bass[2]	*Micropterus dolomieui*

[1] Creeks
[2] Humboldt River
Source: JBR Consultants 1992a; AATA International, Inc. 1997, 1998; BIO/WEST 1994.

TERRESTRIAL WILDLIFE

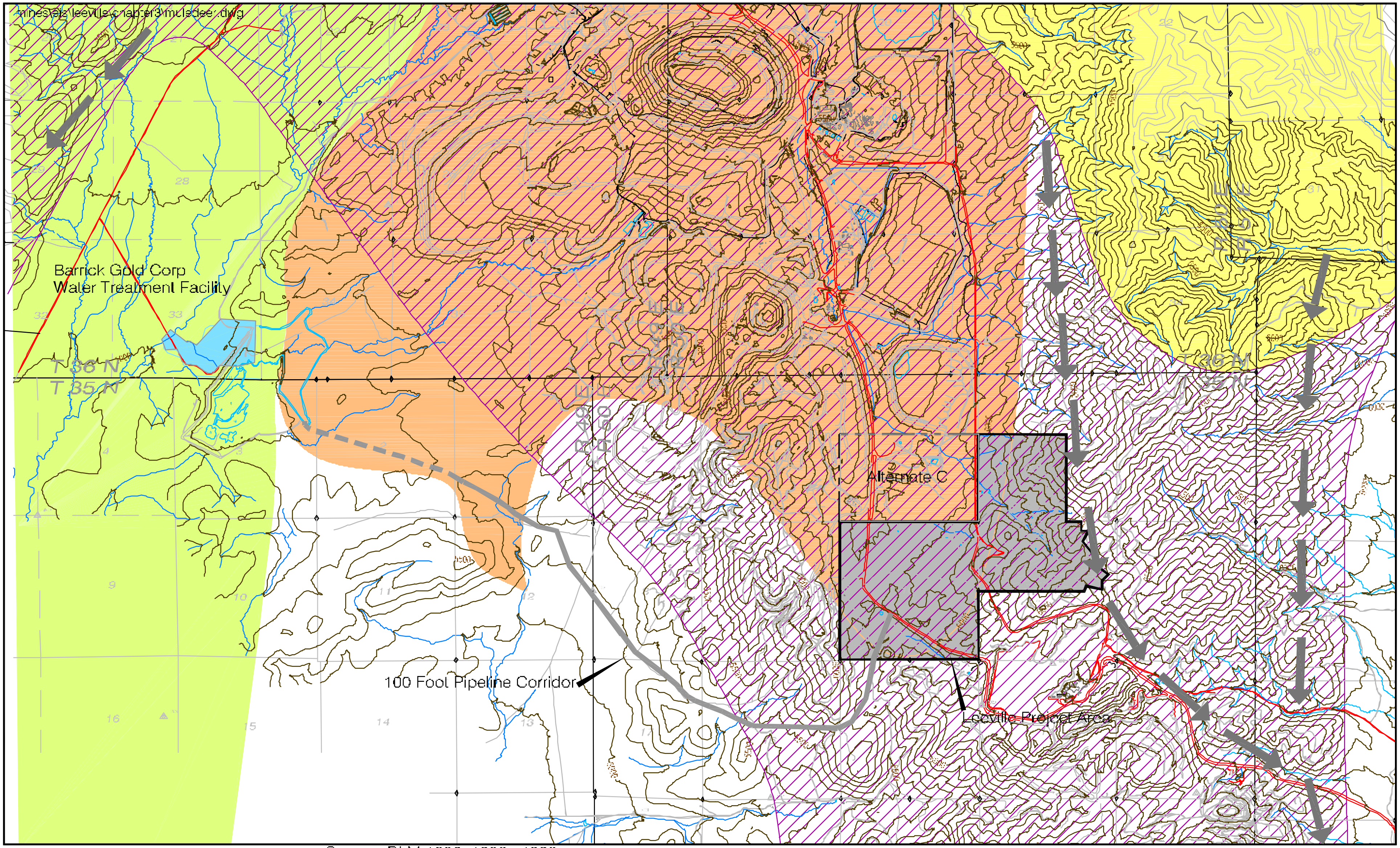
The study area for terrestrial wildlife resources for the Leeville Project includes the Tuscarora Mountains, Little Boulder Basin, and Sheep Creek Range. The Leeville Project is the area that would be directly impacted by mine development, and the pipeline/canal water conveyance system. Descriptions of terrestrial wildlife and range conditions have been developed from site visits, general literature sources, Nevada Division of Wildlife (NDOW) reports, BLM reports, JBR Consultants baseline data reports, and Cedar Creek Associates' data summary reports.

Other sources of information on wildlife found in the Elko area include Christensen 1970 (Chukar Partridge), Clark 1987 (mammals), NDOW 1992 (raptors), Rawlings and Neel 1989 (Humboldt River Wildlife), and Zevaloff 1988 (Western mammals).

MULE DEER

The Project Area is located within NDOW Management Area Six. Mule deer are the most abundant big game species in the management area. The mule deer population in Area Six experienced a decrease of 50 to 60 percent during the winter of 1992-93 due to severe winter conditions and poor condition of winter habitat. Over the past 6 years, the population has experienced significant growth (up to 70 percent) as a result of mild winters and good recruitment. Forage conditions for mule deer in recent years have ranged from good to excellent in the area.

The Leeville Project is located in mule deer transitional range used during migration from summer range in the higher elevations of the northern Tuscarora Mountain Range to winter range in the lower elevations of the Tuscarora Range, Sheep Creek Range, and Boulder Valley (**Figure 3-15**). Timing and duration of the fall and spring migrations of mule deer are primarily dependent on severity of climatic conditions. Snow accumulations in the higher elevations of the Tuscarora Range initiate southern migration. When snow accumulations are light, mule deer tend to remain on transitional range for longer periods, taking advantage of the security and forage on available browse in shrub communities and riparian zones. In mild winters, it can be late December before mule deer reach their winter range. In harsher winters, when snow begins to accumulate earlier in the season, mule deer move more rapidly through transitional range to winter range. During harsh winters, more time is spent on winter ranges, some of which have been degraded by wildfire (BLM 1993a, 1996a).



Source: BLM 1992, 1993a 1993c.

N

0 Mile 1

Legend

- Mule Deer Transitional Range
- Crucial Mule Deer Summer Range
- Crucial Pronghorn Antelope Winter Range
- Crucial Pronghorn Antelope Summer Range
- Project Area
- Migration Routes
- 100 Foot Pipeline Corridor
- Open Canal Segment
- Alternative C Boundary

Mule Deer and Pronghorn Antelope Habitat Leeville Project

FIGURE 3-15

blank

Some winter range in the Dunphy Hills, as well as transitional range in the Tuscarora Mountains, has been targeted for restoration by Newmont. Work-ing in conjunction with the TS Ranch, NDOW, and BLM, Newmont began reseeding 2,300 acres in the Dunphy Hills winter range improvement area in 1992. The areas seeded had been impacted by range fire in the 1960s and have since been dominated by cheatgrass. The 1992 seeding was the first of a three-phase program designed to rejuvenate native vegetation communities lost to range fires. The final phase of the program was completed in 1995. In addition, approximately 9,800 acres of mule deer winter range was seeded in 1996-1997 as a result of the Bob Flat Emergency Fire Rehabilitation and Mule Deer Mitigation Reseeding Project.

Mule deer use transitional areas for longer periods due to high quality browse generally available on this range. This improves the animals' physical condition prior to moving onto winter range. Late arrival on winter range also subjects limited forage species to less browsing, which reduces stress on mule deer populations related to quality and quantity limitations of the food supply (BLM 1996a).

Prior to 1987, mule deer reportedly migrated south along both the east and west flanks of the Tuscarora Mountains to their winter ranges (Gray 2001). Due to mining activities in the Carlin Trend and degradation of habitat by wildfire, mule deer on the west side of the Tuscarora Mountains have shifted their preferred migration route to the east flank of the Tuscarora Mountains at Simon Creek. At Welches Canyon, some mule deer migrate to the west side of the mountains enroute to the Dunphy Hills and Boulder Valley areas, while others continue to move south to Marys Mountain, Emigrant Pass, and Palisade Canyon areas. Some mule deer, migrating on the western slopes of the Tuscarora Mountains, advance west to Sheep Creek and Izzenhood winter ranges (BLM 1993b, 1993c; Gray 1997; Evans 1992).

PRONGHORN ANTELOPE

The Leeville Project is located at the southwestern edge of the Little Boulder Basin within an area designated as critical pronghorn antelope (pronghorn) summer range (**Figure 3-15**). The area surrounding much of the proposed mine development is relatively poor pronghorn habitat due to high relief. However, important pronghorn summer habitat occurs at lower elevations of the area where the proposed dewatering pipeline and canal is located. Up to 200 pronghorn have been recorded in the vicinity of the proposed canal (Gray 2001; Lamp 2001).

Pronghorn are typically associated with open grasslands, grasslands-brushlands, or bunch grass-sagebrush areas where overall shrub cover is less than 30 percent, shrub stature is less than 24 inches, and a good component of forbs exist. In summer, pronghorn graze on a number of plants including grass, various forbs, sagebrush, and bitterbrush. In winter they browse on many different plants but favor sagebrush.

Areas lacking a shrub component, areas of high topographic relief, or areas with large stands of tall sagebrush which restrict visibility, are poor pronghorn habitat (BLM 1993b; Evans 1992; Burt and Grossenheider 1976; and Whitaker 1988).

OTHER MAMMALS

The list of mammals compiled by BLM for the Elko District contains 76 species, including 5 shrews, 12 bats, 5 rabbits and hares, 33 rodents, 15 carnivores, and 6 ungulates. About 50 to 60 species of mammals could potentially inhabit the Leeville Project area. They include 2 to 3 shrews, 9 to 10 bats, 4 rabbits and/or hares, 22 to 27 rodents, 11 to 13 carnivores, and 2 ungulates (BLM 1993b, 1997c).

Of the species that occur in the Project area, a few (e.g. house mouse) are generally restricted to human-related habitats such as buildings. Four species (river otter, mink, beaver, and muskrat) are essentially aquatic. Although they are occasionally observed away from water, it is unlikely that they would be found within the Project area. Eight or nine species, including the vagrant shrew, montane vole, Nuttall's cottontail, and raccoon, are usually found in riparian or wetland habitats.

Most mammals present in the Project area are upland species, though they sometimes occur in forest, riparian, or wetland habitats. For example, the Merriam shrew, pygmy rabbit, several ground squirrels, and the sagebrush vole may be entirely restricted to sagebrush or grassland habitats, while the coyote, porcupine, mountain lion, and mule deer are found in a wide variety of habitats. Some bats roost in buildings, trees, mine adits, caves, or cracks and crevices in rocks in upland habitats even though they forage for insects in habitats near water (BLM 1993b).

UPLAND GAME BIRDS

Sage grouse, chukar, and Hungarian partridge are present year-round in the vicinity of the Leeville Project. Sage grouse are native to the area and are associated with sagebrush habitats in the rolling hills and benches along drainages. In spring, they congregate at breeding sites called leks, where males conduct displays to attract females. In summer, sage grouse occupy the foothills and higher elevations of the Tuscarora Range, using meadows and seeps along creeks for foraging and watering. During winter, sage grouse use low elevation sagebrush stands, which are usually large areas containing a mosaic of sagebrush species, heights, ages, and forage quality. Sagebrush stands located on south or west-facing slopes provide important habitat during severe winters. Further discussion of sage grouse can be found in the *Threatened, Endangered, Candidate, and Sensitive Species* section in this chapter.

Chukar is an Old World species introduced to North America. They are found on rugged slopes, in canyons, and associated drainages. Availability of water directly influences occurrence of chukar within these habitats. During summer, broods and adults feed extensively on succulent vegetation, seeds, and insects found in mesic habitats. Groups of 27 chukar have been documented along Brush and Bell creeks in the Little Boulder Basin (National Geographic Society 1987; BLM 1993b; JBR 1994).

The Hungarian or gray partridge is an introduced species associated with complexes of grassland, shrubland, grain fields, and water sources. Hungarian partridge are wide-spread but not abundant in the area. A small population exists in Little Boulder Basin on lower Rodeo Creek. These birds are not as water-dependent as chukar, or as riparian-dependent as sage grouse, although they probably visit mesic habitats to feed on insects, green vegetation, and consume water (BLM 1993b).

The mourning dove is a native migratory game bird found seasonally in and around the Project area. They use habitat in the area but are commonly found at lower elevations. Adults feed in open areas on seeds, which comprise 99 percent of their diet. Young feed on crop milk for the first three days and then on crop milk and seeds. By the time they are 6 to 8 days old the young feed entirely on seeds. Doves generally nest in tall shrubs and trees and tend to congregate near water sources. Large numbers of mourning doves have been observed along upper Maggie Creek and in the Little Jack and Indian creek drainages. Adult doves have also been sighted along portions of Boulder and Bell creeks foraging for food and water (BLM 1993b, 1996a; Ehrlich et al. 1988).

RAPTORS

Raptor species occupy a wide range of habitats including woodland, wetland, riparian, and desert. While some species restrict their activities, such as nesting and foraging, to one distinct habitat (e.g., sharp-shinned hawk), others range over broad areas of varying habitats (e.g., golden eagle). Some species nest and forage in the same habitat type while others nest in one type and forage in another. All habitats within the study area are used as foraging habitat by one or more raptor species. Riparian habitats are used by a greater variety of raptors than upland habitats because of the abundance, diversity, and density of prey species. However, upland habitats are the dominant type in the Project area and provide the majority of foraging habitat for raptors.

Primary nesting habitat for raptors within the study area includes cliffs (golden eagle, red-tailed hawk, ferruginous hawk, prairie falcon, American kestrel, great-horned owl), aspen and cottonwoods (red-tailed hawk, Swainson’s hawk, American kestrel, northern goshawk, great horned owl), juniper (ferruginous hawk), and riparian (Swainson’s hawk, northern harrier, great horned owl, long-eared owl). Other sites used by some raptors for nesting include utility poles, abandoned buildings, mine pit walls, stream banks, and marsh vegetation (BLM 1993b).

According to BLM’s bird species list, there are currently 27 raptor species identified within the Elko District. They include 1 vulture, 2 eagles, 11 hawks, 4 falcons, and 9 owls. Raptor use of habitat within Little Boulder Basin is restricted to species that are adept at hunting in open country and nesting on the ground, rock outcrops, cliffs, or vertical stream banks. Baseline studies for Little Boulder Basin conducted by JBR from 1987 to 1993 documented 12 species of raptors in the basin. They include turkey vulture, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, rough-legged hawk, ferruginous hawk, Swainson's hawk, golden eagle, bald eagle, northern harrier, prairie falcon, and American kestrel.

In 1992, JBR conducted an inventory of raptor nest sites within the Newmont Inventory Area. The Newmont Inventory Area encompassed approximately 166,400 acres between the Tuscarora Mountains and Independence Mountains north to the southern end of T37N and south to the southern end of T32N, which included Maggie Creek and Susie Creek. The northwestern edge of the Newmont Inventory Area boundary cuts through a portion of the Project area in Section 11, T36N R50E. The inventory did not cover areas west of the Project site. During this inventory, nests of seven raptor species, including red-tailed hawk, northern goshawk, great horned owl, American kestrel, golden eagle, ferruginous hawk, and northern harrier, were located within a 10-mile radius east of the Project area. The most common nesting species documented within the 10-mile area was the red-tailed hawk.

Other species found within the Newmont Inventory Area included Swainson's hawk, prairie falcon, and long-eared owl. Species suspected of nesting within the area include turkey vulture, sharp-shinned hawk, Cooper's hawk, short-eared owl, and burrowing owl. Northern goshawk, ferruginous hawk, and burrowing owl are BLM sensitive species (BLM 1993b, 1997c; JBR 1992a).

Northern goshawks generally inhabit mature, uneven-aged coniferous and mixed forest habitats, with relatively open understory, dominantly in mountainous areas. In Nevada, aspen groves provide preferred nesting habitat. Goshawks demonstrate high fidelity to specific nesting territories, but from year to year may use alternative nest sites within a territory. The Northern goshawk is a common nester in the Independence Mountains east of the Project, however habitat preferred by this species does not exist in the Project area (Cedar Creek Associates 1997; JBR 1992b).

MIGRATORY BIRDS

BLM lists 75 species of waterfowl and shorebirds found in the Elko District. Historically, migratory bird numbers were not high in the Little Boulder Basin, however, the incidence of use and number of birds have increased during the last decade. This increase was attributed to the TS Ranch Reservoir and mounding groundwater resulting in the formation and expansion of Green, Sand Dune, and Knob springs (**Figure 3-10**). Increased surface water availability and increased emergent and submergent vegetation in Boulder Valley have provided additional foraging, cover, resting, and breeding habitats for migratory bird species, particularly waterfowl and shorebirds. The number of waterfowl using these habitats within Boulder Valley fluctuates according to changing water levels. Some species may forage and nest in adjacent habitats, such as irrigated alfalfa fields or springs and seeps. Waterfowl use in the remainder of the study area is restricted to limited available surface water.

Due to the limited amount of water, the number of species potentially occurring in the Project area would be much less. Waterfowl and shorebirds recorded in the Little Boulder Basin include eared grebe, white-faced ibis, Canada goose, mallard, gadwall, pintail, green-winged teal, blue-winged teal, cinnamon teal, American widgeon, northern shoveler, ruddy duck, redhead, ring-necked duck, lesser scaup, American coot, American avocet, black-necked stilt, killdeer, greater yellowlegs, and Wilson's phalarope (BLM 2000b; JBR 1993, 1994).

NONGAME BIRDS

The BLM has identified 246 species of birds in the Elko District. In the Little Boulder Basin, 66 non-game species not previously discussed in this section have been documented during baseline studies (JBR 1988, 1990b, 1990c, 1992c). Due to habitat limitations, many of these birds are not expected to occur in the Project area. Most birds frequent wetland and riparian habitats. Some species might nest in upland habitats found in the Project area and forage in riparian habitats; others might nest in riparian habitats and forage in up-land habitats. Still others might nest and forage in both. Most of the songbirds that reside in the area during the summer months are neotropical mig-rants, which winter in Central and South America.

A few species such as rock wren, northern mockingbird, pinyon jay, loggerhead shrike, and house finch are present in the area year-round.

REPTILES AND AMPHIBIANS

Twenty-eight species of reptiles and amphibians have been identified in the Elko District. The diversity of species in the area is likely limited by the cool, dry climate of northeastern Nevada. During baseline studies conducted by JBR from 1988 to 1993, nine amphibian and reptile species were documented in the Little Boulder Basin: Great Basin spadefoot toad, Pacific treefrog, desert horned lizard, long-nose leopard lizard, northern sagebrush lizard, Great Basin western fence lizard, western yellow-bellied racer, red coachwhip, and Great Basin gopher snake. Bullfrogs were documented along the Humboldt River, and the Great Basin whip-tailed lizard and Great Basin rattlesnake have been documented in the Boulder and Bell creek drainages.

Amphibians found in the Elko District are dependent on water sources, primarily during the breed-ing and juvenile stages. Two species docu-mented in the Little Boulder Basin (the Great Basin spadefoot toad and the Pacific treefrog), both require a water source during breeding and the tadpole stage. Reptiles generally do not require a water source; however, many species forage extensively in mesic and wetland habitats. Reptiles and amphibians documented in Little Boulder Basin were considered uncommon or rare and probably represented a small portion of the potential prey base in the Project area (BLM 1992, 1997d; JBR 1994; Cedar Creek Associates 1997).

THREATENED, ENDANGERED, CANDIDATE, AND SENSITIVE SPECIES

Threatened, endangered, and candidate species are those species for which state or federal agencies afford additional protection by law, regulation, or policy. Included are federally listed species protected by the Endangered Species Act (ESA); species proposed for federal listing, and federal candidate species, as identified by the United States Fish and Wildlife Service (USFWS); and species designated as state-sensitive by BLM (BLM 2000c). The BLM has also incorporated part of the Nevada State Protected Animal List into its sensitive species list. These species are afforded the same level of protection as candidate species if present on public land administered by BLM (BLM 2000c). The study area for threatened, endangered, candidate and sensitive species is the same as that for terrestrial wildlife.

THREATENED AND ENDANGERED

Bald eagle (threatened, proposed for delisting), and Lahontan cutthroat trout (threatened) occur in or near the study area. LCT do not occupy habitat in the immediate Project area, but are present in the Maggie Creek drainage to the east, and the Rock Creek drainage north of the Project area (**Figure 3-5**).

Bald Eagle

Bald eagles are periodic seasonal migrants and winter residents in Nevada. A few bald eagles occasionally may be present near the Project area as transient visitors and may winter near bodies of water that remain free or partially free of ice (e.g., Humboldt River and Maggie Creek). Bald eagles usually winter near bodies of water because fish and waterfowl are common prey and riparian areas often have trees which are used as hunting perches or for roosting. In the absence of waterfowl and fish, bald eagles eat carrion or prey upon small mammals such as black-tailed jackrabbits (Ryser 1985). Wintering bald eagles are present along the Humboldt River and have been observed in Independence Valley and along the North Fork Humboldt River (Cedar Creek Associates 1997). No nests or communal roosts are known to occur in or near the Project area.

Lahontan Cutthroat Trout

Lahontan cutthroat trout have historically occupied streams including the mainstem of the Humboldt River. Habitat degradation, water development projects, and introduction of non-native trout that hybridize and compete with LCT have eliminated the species over much of its former range (USFWS 1995).

Within the Humboldt River Basin, LCT presently occur in 83 to 93 streams, in approximately 14 percent of its historical range within the basin (USFWS 1995). Most existing populations are found in eight subbasins, including Marys River, Maggie Creek, Rock Creek, Little Humboldt River, Reese River, and the North, South, and East forks of the Humboldt.

Populations of LCT in the Maggie Creek subbasin declined markedly during the early 1900s. LCT are currently present in upper Maggie, Little Jack, Toro Canyon, Coyote, Beaver, Little Beaver (BLM 1993b), Jack (AATA 1997), Indian, and Lone Mountain (Valdez and Trammel 2000) creeks. Populations are in an upward trend due to improving habitat conditions. Habitat improvement is largely due to implementation of recent habitat enhancement efforts, including measures enacted by Newmont through the Maggie Creek Watershed Restoration Project (MCWRP), implemented in 1993. Streams once characterized by eroding streambanks and wide, shallow channel profiles now support healthy functioning riparian zones and stable, well vegetated streambanks.

LCT are relatively abundant in Little Beaver, Toro Canyon, and upper Coyote Creeks. Reproducing populations have been documented in Beaver, Little Jack, lower Jack, Toro Canyon, and Coyote creeks (AATA 1997; NDOW 2000). Due to possible fish migration barriers, including some perched culverts on the Maggie Creek Road, and lack of perennial streamflow in the lower reaches of some tributaries, it is believed that each LCT population in the subbasin is genetically isolated (AATA 1997). Migratory pathways may be available during high water flow years.

Although habitat conditions in the majority of the Beaver Creek drainage improved in recent years as a result of changes in livestock grazing, a wildfire in August of 2001 caused damage to riparian zones in the drainage. Almost the entire watershed and all of the aspen/willow community along Beaver Creek and its tributaries was burned. Although limited numbers of LCT survived the fire, the long-term effects of the fire are unknown at this time.

Populations of LCT in the Rock Creek subbasin have been documented in Willow Creek Reservoir, and in Frazer, Willow, Toe Jam, Nelson, and Rock creeks. Toe Jam and upper Rock Creek have the highest quality occupied habitat in terms of linear miles. Frazer is the most productive creek in the subbasin. There are an estimated 25 miles of potential LCT habitat in the subbasin (BLM 2000a).

CANDIDATE AND SENSITIVE SPECIES

Habitat exists within or near the Project area for the following plant and animal species considered by BLM as special status: Preble's shrew, spotted bat, pale Townsend's big-eared bat, Pacific Townsend's big-eared bat, long-legged myotis, western long-eared myotis, western small-footed myotis, fringed myotis, golden eagle, northern goshawk, Swainson's hawk, ferruginous hawk, burrowing owl, sage grouse, Lewis buckwheat, Columbia spotted frog, Nevada viceroy, California floater, and spring snails. Other special status species for which suitable habitat is not present are not discussed.

Preble's Shrew

Preble's shrew has been documented in northern Elko County (Ports and George 1990) and Washoe County (Hoffman and Fisher 1978). This shrew is found in a variety of habitats, including arid grassland and shrubland, alpine tundra, forest edges, and wetland habitat containing emergent and woody species. Prebble's shrew has not been documented in the immediate vicinity of the Leeville Project, but suitable habitat is present (BLM 2000c).

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Spotted Bat

This species has not been reported in northeastern Nevada, but is typically found in rough desert terrain with limestone or sandstone cliffs (Zevaloff 1988). The spotted bat favors cliffs or rocks near perennial watercourses (Clark 1987). Its range extends over most of the western United States and includes all of Nevada.

Townsend's Big-Eared Bat

Two subspecies, Pale and Pacific of Townsend's big-eared bats, could inhabit northcentral Nevada (BLM 2000c). It is not known which subspecies has been reported in the vicinity of the Project area. Townsend's big-eared bats use a variety of habitats, including shrub-grassland present in the Project area. Townsend's big-eared bats were observed near the Project area in abandoned mine shafts in the upper Lynn Creek drainage. Two males in breeding condition were captured in mine shafts, and bats suspected to be big-eared bats were observed flying over springs and ponds near an abandoned mine shaft (Butts 1992). A subsequent survey in accessible mine adits revealed two adult males roosting separately in two adits near Lynn Creek in 1993 (Cedar Creek Associates 1997). This species has not been documented in the Project area.

Long-Legged Myotis

The long-legged myotis is a colonial bat species which roosts in buildings, caves, abandoned adits, trees, and rocky crevices. The species is known to hibernate in abandoned adits and caves (Zevaloff 1988). Long-legged myotis have been observed in the Independence Mountains, approximately 20 miles northeast of the Leeville Project. They have not been documented in the Project area.

Western Long-Eared Myotis

The western long-eared myotis roosts individually or in small groups, in trees, crevices, and occasionally in mines and caves. The species has been observed in the Independence Mountains and near Soap Creek, about 20 miles southeast of the Project area (Butts 1992).

Western Small-Footed Myotis

The western small-footed myotis inhabits canyons and rocky areas of the western United States. They roost and raise young in crevices in cliffs, and talus slopes. Summer roosts are variable and include buildings, mines, tree bark, and rock crevices (Cedar Creek Associates 1997). Rock outcrops in the Project area may provide suitable habitat for this species. This species was documented in an adit at the nearby Lantern Project in 1996.

Fringed Myotis

Fringed myotis are usually associated with desert, arid grassland, and woodland habitat at elevations between 3,500 and 6,500 feet AMSL in the western United States (Barbour and Davis 1969). It uses abandoned mines and caves as hibernacula. Fringed myotis could occur in the Project area based on habitat affinities and results of previous field studies, though none have been documented (BLM 2000c).

Golden Eagle

The golden eagle is found in a variety of open, often relatively dry habitat throughout the western United States. In Nevada, the golden eagle often nests on cliffs overlooking sagebrush flats, pinon-juniper woodland, salt desert shrub, and other habitat supporting an adequate prey base (Herron et al. 1985). Primary prey include rabbits, prairie dogs, ground squirrels, marmots, woodrats, grouse, and some carrion (DeGraaf et al. 1991).

Golden eagles are year-round residents of north-central Nevada. A large number of foraging and roosting golden eagles have been documented throughout the region, including mountains and foothills of the Tuscarora Range (BLM 2000c). An active nest site was recorded along Boulder Creek in 1990 (JBR 1992b). Potential foraging habitat is present within the Project area.

Osprey

The osprey is primarily a spring and fall migrant in Nevada. Ospreys nest in trees or dead snags, usually within a mile of water, and will readily use man-made structures when available (e.g. utility poles, steel transmission line towers, chimneys). In Nevada, one pair of nesting ospreys was recorded at Lake Tahoe in the 1970's (BLM 2000c). The primary diet of the osprey is fish, usually caught near the surface while in flight. Other minor food sources include frogs, snakes, ducks, and small mammals.

Breeding of ospreys is unlikely in the vicinity of the Carlin Trend, though occasional migrants may roost or forage within the cumulative effects area. One osprey was recorded along the Humboldt River near Herrin Slough in Humboldt County (BLM 2000c). Ospreys have also been recorded in the Dunphy area (Gray 2001).

Northern Goshawk

The northern goshawk is a year-around resident of northern Nevada, occupying higher elevation woodland, primarily aspen and conifer stands, in summer, and wintering in lower foothills and valleys (Herron et al. 1985). Primary prey includes birds, small mammals, and insects (DeGraaf et al. 1991). Potential wintering habitat is found in parts of the Tuscarora Range, and northern goshawks may conceivably forage within the Project area.

Swainson's Hawk

The Swainson's hawk is a summer resident of north-central Nevada, and is one of the least abundant raptors in the region (BLM 2000c). In Nevada, the majority of nesting territories have been located in agricultural valleys ranging in elevation between 4,000 and 6,500 feet. Nests have been found in buffaloberry, serviceberry, sagebrush, willow, and aspen, though most documented nests in Nevada have been in Cottonwood or elm trees (Herron et al. 1985). Several nesting pairs have been documented in valleys near the Tuscarora Range (BLM 2000c). Forage consists of a variety of small mammals, birds, reptiles, and amphibians (DeGraaf et al. 1991). Swainson's hawks have not been documented on the Project area, but foraging habitat is found along some nearby drainages at lower elevations.

Ferruginous Hawk

The ferruginous hawk inhabits grassland, shrub-land, and steppe-deserts of the western United States and is considered fairly common through-out northeastern Nevada. In Nevada, preferred nesting habitat is scattered juniper in the edges between pinyon-juniper and desert shrub com-munities where they nest in trees, on buttes, and on the ground. Ferruginous hawks forage in desert shrub, open prairie, brushy open country, grassland, and badland communities. They feed on small mammals, especially ground squirrels and jackrabbits, but also eat snakes, lizards, and insects. During baseline surveys, performed by JBR from 1987 to 1993, ferruginous hawks were sighted twice, once in Boulder Valley and once near Bell Creek. During the 1992 raptor nest inventory (JBR 1993), four ferruginous hawk nests were found in the Newmont Inventory Area and six birds were sighted. Nesting habitat (e.g., juniper trees) for this species is not present in the Project area (Cedar Creek Associates 1997; JBR 1992a, 1994).

Sage Grouse

Sage grouse are present throughout the year in sagebrush habitat in the foothills of the Tuscarora Range, including the Project area. Sage grouse winter in sagebrush habitat and feed primarily on sagebrush foliage. During spring and summer, they use meadows, springs, and seeps for foraging and water. Sage grouse exhibit courtship display on traditional strutting grounds (leks) in March through early May. Broods hatch in June and feed on insects and forbs.

Field surveys indicate sage grouse populations vary from year to year. Five leks were observed in the South Operations Area and two in the North Operations Area (one in the northern part of Little Boulder Basin and one in the North Fork Bell Creek). No leks are known to occur in the Project area, although sage grouse are present in low numbers.

Burrowing Owl

During the summer months, western burrowing owls inhabit open grassland areas throughout the western United States. Breeding by burrowing owls is strongly dependent on presence of burrows, usually constructed by ground squirrels, prairie dogs, or badgers. Prime burrowing owl habitat is open country with short vegetation and abundant mammal burrows. Some burrowing owl habitat exists in the Project area, however, no burrowing owls were documented during baseline studies (Cedar Creek Associates 1997).

Lewis Buckwheat

Lewis buckwheat is a low-growing, matted, or mounded perennial forb that is restricted to dry, open, relatively barren, and undisturbed ridgeline crests and knolls underlain by silicaceous carbonate and limestone rock (Morefield 1996). Known habitat typically includes sparse to moderate stands of low sagebrush, green rabbit-brush, Indian ricegrass, and squirreltail. It is endemic to the Tuscarora, Bull Run, and Independence Mountains, and the Jarbidge Mountains complex (Morefield 1996). Thirty-three populations in 10 general localities have been documented. Three populations are located south of the Project area in the Tuscarora Mountains, north of Emigrant Pass and adjacent Marys Mountain, at approximately 6,950 to 8,337 feet (Morefield 1996). None have been documented in the Project area, though suitable habitat exists.

Nevada Viceroy

The Nevada viceroy is associated with willow stands in riparian habitat found in valley floors below 6000 feet. Its current distribution includes northcentral Nevada, where it is rare, though it has been reported from several locales in the Carlin area. Potentially suitable habitat was iden-tified along Little Jack, lower Suzie, Maggie, Coyote, Boulder, and Bell creeks, though no Nevada viceroys have been documented in these areas (BLM 2000c). They may, but are unlikely to occur in willow habitat at lower elevations near the Project area.

California Floater

The California floater is a freshwater mussel that occurs primarily in small, permanent streams with pool or run habitats and substrates consisting of silt, gravel, and sand (McGuire 1995). California floaters have been documented at two locations on Maggie Creek, east of the Leeville Project area. One site is immediately north of the confluence of Maggie Creek and the East Fork of Cottonwood Creek, and the other about midway between the confluences of Maggie Creek with Cottonwood Creek and with Jack Creek/Little Jack Creek (BLM 2000c). They have also been documented in lower Rock Creek Canyon, west of the Leeville Project area.

Springsnails

Springsnails are tiny mollusks found in some perennial springs and seeps in the Carlin Trend. Springsnails were documented at three of 65 sites surveyed in 1992 area and at seven of 41 springs and seeps surveyed in 1995 and 1996 in the area (BLM 2000b). Sites include: Willy Billy Spring (unnamed tributary of Buck Rake Jack Creek), Rattlesnake Spring (flowing into Humboldt River), Warm Spring (adjacent to Humboldt River near Carlin), and six springs in upper Antelope Creek (BLM 2000a). Springsnails have not been found in the Maggie Creek subbasin. Habitat in springs supporting springsnails have stable, moderately high discharges; gravel, cobble, or boulder substrates; and dense aquatic vegetation (McGuire 1995).

Columbia Spotted Frog

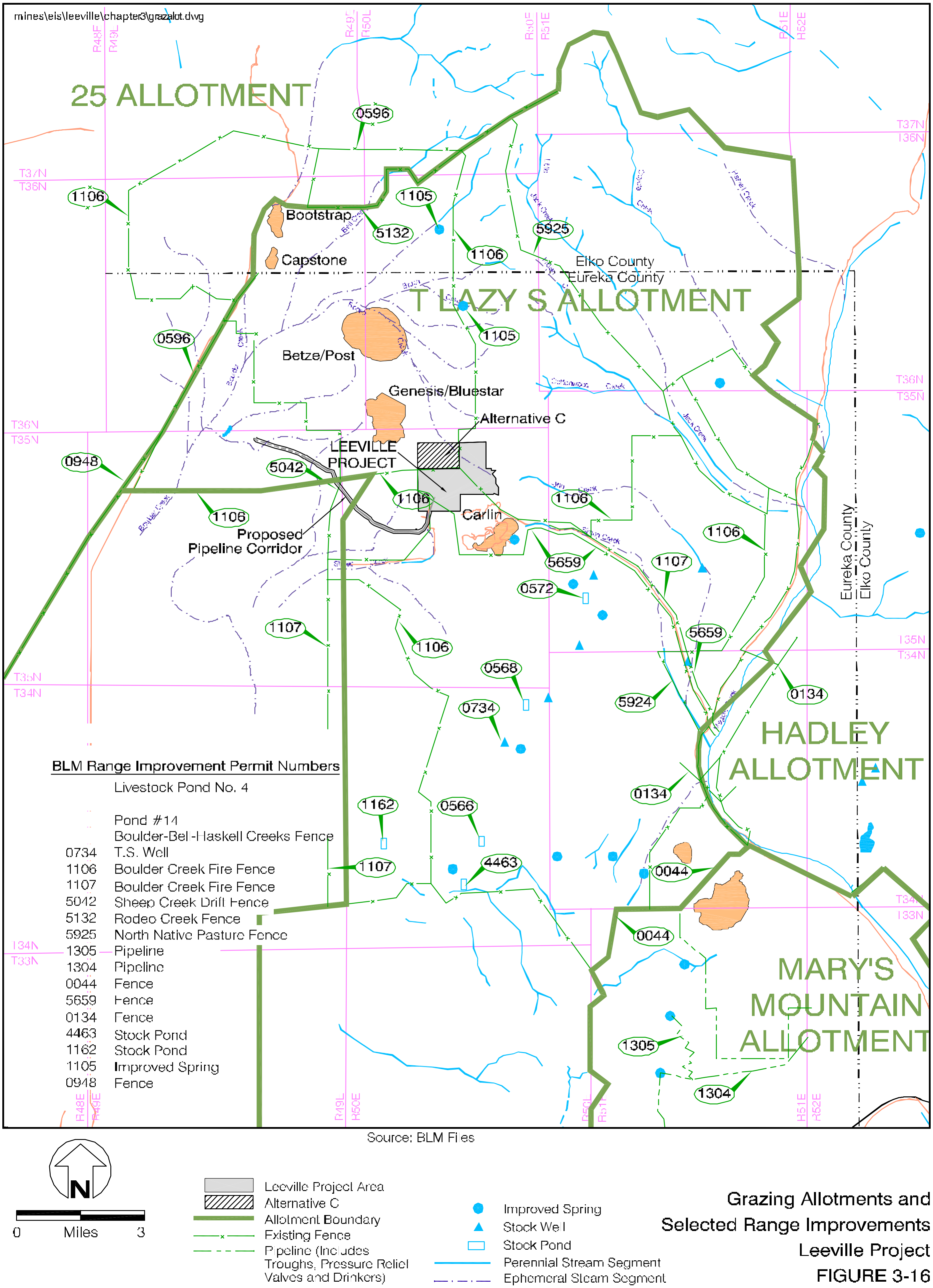
Columbia spotted frogs occur in wetland habitats ranging from subalpine forests to lower elevation grassland and shrubland. They are generally associated with permanent water bodies with emergent vegetation, though they may be found in many habitats including shrubland and grassland. Columbia spotted frogs have been documented in and around permanent water in middle Maggie Creek, lower Coyote Creek, and lower Little Jack Creek. They were not observed during surveys conducted on Antelope, Rock, and Boulder creeks in 1995 (BLM 2000b).

GRAZING MANAGEMENT

Grazing allotments are areas of public and unfenced private land used by permittees for livestock grazing. Grazing within these allotments is permitted and administered by BLM.

The T Lazy S Allotment (**Figure 3-16**) is permitted to the Elko Land and Livestock Company, a subsidiary of Newmont. Due to extensive mining operations within its confines, past adjustments have occurred to the T Lazy S permit to account for withdrawn land associated with Barrick's Betze/Post Mine, Newmont's South Operations Area, and all of Newmont's mining operations collectively referred to as the North Operations Area (BLM 1995a). Based on these past adjust-ments, the current permitted use is 11,999 animal unit months (BLM 1998a). An animal unit month (AUM) is the amount of forage required to sustain one cow and calf for one month. Total permitted grazing use for the allotment, including active use and suspended non-use (due to mining activity and short-term fire rehabilitation closures), is 14,209 AUMs.

The T Lazy S Allotment is operated as a commercial cow/calf operation. Depending on climatic and forage conditions, and the status of several ongoing habitat improvement projects, the BLM grazing permit has evolved in recent years to allow approximately 2,300 to 2,800 head, managed in two herds, to graze the allotment during the interval of mid-February through November (Nyrehn 1998). The type and location of existing range improvements located within the allotment are summarized in **Table 3-24.**



Grazing Allotments and Selected Range Improvements
Leeville Project
FIGURE 3-16

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TABLE 3-24
T Lazy S Allotment Range Improvement Permits Near Leeville Project

Permit No.	Project Name	Location	Notes / Comments
0566	Pond # 4	T34N R50E Sec 22	Stockwater reservoir
0568	Pond # 10	T34N R50E Sec 2	Stockwater reservoir
0572	Pond # 14	T35N R51E Sec 30	Stockwater reservoir
0596	Boulder-Bell-Haskell Creeks Fence	T33&37N R48&51E	Pasture fence.
0734	Hot Water Well (or TS Well)	T34N R50E Sec 10	Well with storage tank and trough
1070	Boulder Creek Seeding	T35-36N R49-50E	
1072	Boulder Aerial Seeding	T35N R50E	1964-1965 Fire Rehabilitation Seeding (6840 acres).
1106	Boulder Creek Fire Fences	T34-35N R50-51E	Fences constructed around Welches Creek; Coyote and Antelope seedings.
1107	Boulder Creek Fire Fences	T35N R50-51E	Fence constructed in Boulder Creek complex to protect fire rehabilitation seedings.
5042	Sheep Creek Drift Fence	T35N R49E Sec 12	Pasture fence.
5132	Rodeo Creek Fence	T36N R49-50E Sec 1, 2, 3, 6	Pasture fence.
5925	North Native Pasture Fence	T36N R50-51E	Pasture fence between Upper Northern Native and Lower Northern Native Pastures.

Source: Compiled by RCI from BLM permit / allotment files and BLM (1993c).

Two habitat improvement projects are now underway or have been completed within the T Lazy S Allotment. The Maggie Creek Watershed Restoration Project involved temporary closure of nine pastures to grazing until defined riparian habitat conditions are achieved. Prescripitive livestock grazing has resumed in all nine pastures. A controlled grazing plan, designed to improve riparian habitat conditions and watershed functions, has been implemented in two additional pastures (Nyrehn 2002).

A second habitat improvement project is the Bob Flat Emergency Fire Rehabilitation and Mule Deer Mitigation Reseeding. This project involved a cooperative effort by Newmont, NDOW, BLM and the Elko Land and Livestock to seed approximately 9,800 acres in the area of Bob Flat for wildfire rehabilitation and mule deer habitat enhancement (Nyrehn 1998). An important component of this project included a combination of livestock exclusion and controlled spring grazing designed to promote seedling establish-ment. Following successful establishment of the seeding (as monitored in 2000), livestock in this seeded area are currently controlled by pasture rotation, stockwater availability and active herding practices. Carrying capacity adjustments associated with the Maggie Creek Watershed Restoration Project are accounted for in the active grazing preference referenced above.

RECREATION AND WILDERNESS

The study area for Recreation and Wilderness is shown on **Figure 3-17** and consists of the BLM Elko District (which includes all of Elko County and northern portions of Eureka and Lander counties) and the eastern portion of Humboldt County. The Elko District extends over 12 million acres, about one-sixth of Nevada's total area. BLM administers 7.4 million acres of public land in the District that consist primarily of high desert and mountainous areas. Humboldt County is located in the BLM Winnemucca District and consists of 6.2 million acres, 5 million of which are publicly owned.

RECREATION

Outdoor recreational areas and facilities in the study area include those managed by BLM, Nevada Division of State Parks (NDSP), United States Forest Service (USFS), United States Fish and Wildlife Service (USFWS), Bureau of Indian Affairs (BIA), and private operators (**Figure 3-17**).

Public land within these areas provide diverse recreational activities, including fishing, sightseeing, hunting, cross-country skiing, horseback riding, white water rafting, photography, rockhounding, and off-highway vehicle use (BLM 1985, 1996b). The BLM does not maintain current recreational use data for public land in the Winnemucca District; however, recreational use in this area is assumed to be limited due to low population levels, difficult access to public land caused by the checkerboard pattern of public and private land boundaries, and lack of improved roads in the region (BLM 1996b).

BLM has designated six Special Recreation Management Areas (SRMAs) in the Elko District. SRMAs are areas warranting intensified manage-ment. The nearest SRMA to the Leeville Project is South Fork Canyon, located approximately 30 miles southeast of the Project area. South Fork Canyon encompasses 3,360 acres and has no developed facilities. The Zunino/Jiggs Reservoir SRMA is approximately 55 miles southeast of the Project area and has a restroom, picnic tables, barbecues, and campground. The Wilson Reser-voir SRMA is located 55 miles north of the Leeville Project area. Facilities include a boat ramp, restrooms, campground, and drinking water. Wild Horse SRMA, approximately 55 miles northeast of the Leeville Project area, has a BLM campground. A campground and boat ramp are located on BIA administered land within the SRMA boundaries. In addition, the Wild Horse State Recreation Area is located within the SRMA boun-daries. The South Fork Owyhee River SRMA is located 60 miles north of the Project and contains a narrow corridor along the river which is eligible for Wild and Scenic River designation. Salmon Falls Creek SRMA, is over 100 miles from the Project area near the town of Jackpot, Nevada.

There are no BLM-designated SRMAs in the portion of the study area located in eastern Humboldt County. Water Canyon, however, is a secluded mountainous area located along Water Canyon Creek in the Sonoma Range about 2 miles south of Winnemucca. The BLM acquired approximately 2,000 acres at Water Canyon which is being developed into a recreational area for picnicking, mountain biking, hiking, hunting, and wildlife viewing (Moritz 1998).

The BLM Back Country Byways Program identifies historical and scenic routes on public land. The Byways Program is designed to encourage use of existing back roads through greater public awareness. In the northeast corner of the Elko District, the California Trail Back Country Byway provides over 80 miles of scenic travel paralleling the original California Trail. The trail was a major route used by pioneers traveling from the Midwest to California and Oregon.

The Carlin Canyon Historical Wayside includes interpretative signs describing the geology and history of the area, parking spaces, and benches.

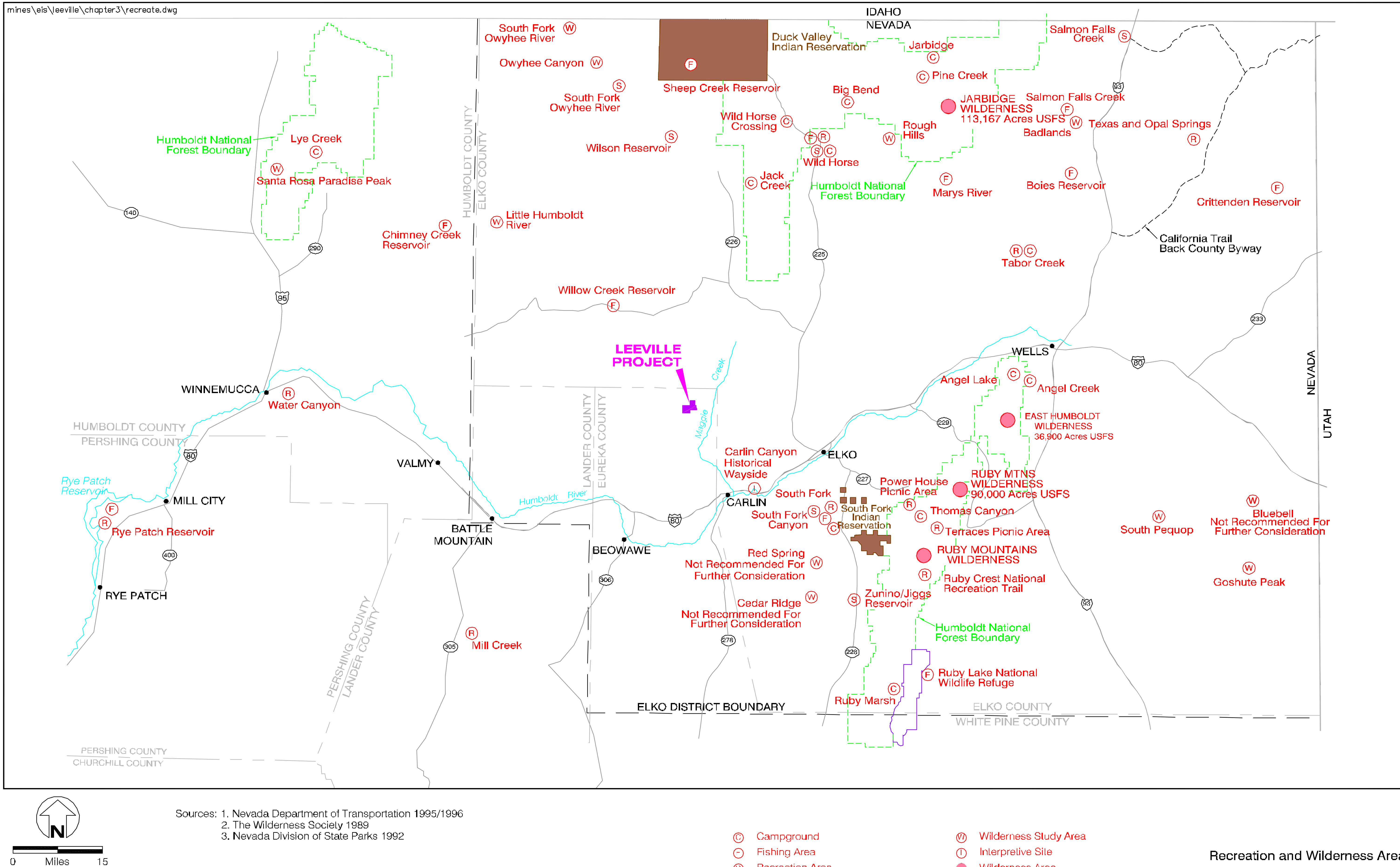
The United States Forest Service has three ranger districts in Elko County: Ruby Mountains, Mountain City, and Jarbidge. Santa Rosa Ranger District is located in Humboldt County. Of the three districts in Elko County, Ruby Mountains Ranger District experiences the heaviest recreation use. Located within 20 miles of Elko and Interstate 80, the Ruby Mountains Ranger District has 121 campsites in four campgrounds, two picnic areas, and two wilderness areas. The Lamoille Canyon Scenic Byway provides 12 miles of paved access in the Ruby Mountains with three pullouts and interpretive signs. At the end of the scenic byway, a trailhead provides access to the 40-mile-long Ruby Crest National Recreation Trail.

The Mountain City Ranger District has three campgrounds. The Jarbidge Ranger District has two campgrounds and one wilderness area. Both districts experience heavy use on weekends.

The Lye Creek and Hinkey Summit campgrounds are located in the Santa Rosa Ranger District approximately 75 miles from the Leeville Project. The facilities at Lye Creek include group camping, running water, and areas for picnicking. The Hinkey Summit campground has no developed facilities.

Willow Creek and Willow Creek Pond, located in western Lander County approximately 65 miles southwest of the Leeville Project, receive a large amount of recreation use. The creek is managed under the wild fishery designation of the Nevada Coldwater Fishery Program Management Con-cepts (NDOW 1988 *in* BLM 1998b). The pond is stocked by NDOW and managed as a catch and release fishery.

The Willow Creek Reservoir is located in Elko County approximately 18 miles north of the Leeville Project. Willow Creek Reservoir is owned by Barrick but is open to the public. NDOW manages the reservoir as a warm water fishery and periodically stocks it with crappie and channel catfish. The reservoir is also known to contain Lahontan Cutthroat Trout



Sources: 1. Nevada Department of Transportation 1995/1996
2. The Wilderness Society 1989
3. Nevada Division of State Parks 1992

Recreation and Wilderness Areas
Leeville Project
FIGURE 3-17

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(Haskins1998). Camping is allowed at the reservoir, however there are no developed facilities.

The South Fork State Recreation Area (SRA) is located 35 miles southeast of the Leeville Project area adjacent to the BLM's South Fork Canyon SRMA. Facilities at the South Fork Reservoir SRA include a boat ramp, campground, and administrative facility. The Wild Horse SRA is located approximately 55 miles northeast of the Project area. The Wild Horse SRA encompasses 80 acres situated on the northeast shore of the Wild Horse Reservoir just off Nevada Highway 225. Amenities at the Wild Horse SRA include a campground and restrooms. Although there is no boat launch, there is vehicle access to the lake. According to the Nevada Division of State Parks, a boat launch may be constructed in the near future (NDSP undated brochure).

The Rye Patch SRA is a 22-mile long reservoir located on the Humboldt River approximately 125 miles west-southwest of the Leeville Project area. Recreation facilities at the Rye Patch Reservoir include three picnic areas, two developed campgrounds and numerous undeveloped campsites, a sanitary dump station, a boat ramp, and dock. The primary recreation activities are fishing, swimming, boating, water-skiing, camping, and picnicking. According to the Nevada State Parks Visitation Summary (prepared for calendar year 1997), there were 82,611 visitors at Rye Patch in 1997.

The Chimney Creek Reservoir is operated by Humboldt County. The reservoir contains over 2,000 surface acres and is located approximately 60 miles northwest of the Project site. Developed facilities at this site include a picnic table, pit toilet, and a boat ramp. Camping is allowed, however there is no running water.

The communities of Carlin and Elko (including Spring Creek) have a number of recreational facilities. Carlin has an archery range, three baseball fields, a park and playground area, a moto-cross track, a tennis court, and a volleyball court. Elko has numerous baseball fields, a BMX track, one bowling alley, fairgrounds, five gyms, two golf courses (one of which is under county jurisdiction), an indoor horse arena, moto-cross track, movie theaters, five parks, rifle and pistol range, three soccer complexes, six tennis courts, trap and skeet range, and a swimming pool (Sierra Pacific Power Company 1994). Snobowl Ski and Winter Recreational Area is located 6 miles north of Elko and provides opportunity for alpine and cross-county skiing, sledding, tubing, and snowmobiling. According to the Preliminary Draft Parks, Recreation, Open Space Plan, additional acreage within the city limits has been set aside that will meet community demands for parks, open space, and recreational facilities beyond 2010 (City of Elko 1998).

The Nevada Department of Conservation and Natural Resources (NDCNR) published the Statewide Comprehensive Outdoor Recreation Plan (SCORP) in 1987 and revised it in 1992. Comments received from the public indicated that primary recreation concerns for Nevadans included funding for maintenance and development of outdoor recreation facilities; protection and allocation of water resources; and access to natural, cultural, or historical resources in the state.

WILDERNESS

There are 10 Wilderness Study Areas (WSAs) in the Elko District **(Figure 3-17)**, seven of which all or portions of have been recommended for wilderness designation. The Little Humboldt River WSA and Red Spring WSA, approximately 25 miles northwest and 25 miles southeast (respectively) of the Leeville Project, are the closest WSAs, although Red Spring WSA is not recommended for further consideration as a wilderness area. The upper drainage basin of the South Fork of the Little Humboldt River is located in the Little Humboldt River WSA. This WSA offers a wide variety of recreational opportunities, including fishing, hiking, camping, hunting, rock climbing, and wildlife study. Portions of the Little Humboldt and Bullhead Wild Horse Herd Areas are located within this WSA, providing for wild horse viewing and photographing. The BLM has recommended 29,775 acres of the Little Humboldt River WSA as suitable for wilderness and 12,438 acres as unsuitable for wilderness (BLM 1987).

The remaining WSAs recommended for wilderness designation are the Badlands, Goshute Peak, Owyhee Canyon, Rough Hills, South Fork Owyhee River, and South Pequop.

Cedar Ridge, Bluebell, and the Red Spring WSAs were not recommended for wilderness designation (BLM 1987).

The USFS has four designated wilderness areas within the study area (**Figure 3-17**): 90,000-acre Ruby Mountains Wilderness, located approximately 55 miles southeast of the Project area; East Humboldt Wilderness, approximately 60 miles east of the Project area; Jarbidge Wilderness, approximately 85 miles northeast of the Project area; and Santa Rosa-Paradise Peak, located approximately 75 miles northwest of the Project area in Humboldt County.

ACCESS AND LAND USE

The primary study area for access and land use is the Leeville Project area (**Figure 2-2**), however, portions of Elko and Eureka counties are also addressed in this section.

ACCESS

The Leeville Project is located approximately 20 miles northwest of Carlin and is accessed via State Highway 766. Highway 766 connects with Interstate 80 south of the Project area in Carlin. The annual average daily traffic on Highway 766 is estimated to be 2,600 vehicles. Access is north from Carlin via State Highway 766 to Simon Creek Road, then north to Carlin Mine. The Leeville Project is located 2 miles north of Carlin Mine along the Barrick Access Road.

The Dunphy Road (also known as Boulder Valley Road) is a secondary road that extends north from the community of Dunphy and accesses the northwest portion of the North Operations Area near the Bootstrap Mine. Eureka County claims the Dunphy Road to the Elko County line. Elko County does not claim the road within its jurisdiction. According to the Nevada Department of Transportation (NDOT), annual average daily traffic in 1997 at the west-bound off-ramp from Interstate 80 onto Dunphy Road was 345 vehicles. From the east-bound off-ramp, the traffic count at the Dunphy ramp was 100 vehicles per day. These statistics represent a two-fold increase in traffic at the Dunphy interchange compared to 1996 (NDOT 1997).

There are no BLM-designated roads in the Project area. The Leeville Project area is dominated by exploration activities and mining, and has numerous haul roads and other support roadways throughout the North Operations Area. Public access to haul roads is restricted for safety purposes.

LAND USE

The Leeville Project is located in Eureka County, Nevada (T35N R50E, portions of Sections 2 and 11 and all of Section 10). In addition, part of the Proposed Action includes a water pipeline that would be located in Sections 8, 10, 15, 16, and 17, T35N, R50E; Sections 1,2,3, and 12, T35N, R49E. Eureka County encompasses 4,182 square miles and is bordered on the north and northeast by Elko County, the west by Lander County, the south by Nye County, and the southeast by White Pine County.

Approximately 81 percent of Eureka County is managed by federal agencies, including BLM, USFS, and BIA. There is no state land in the Project area. Federal land is well consolidated except for a checkerboard of private and federal land on both sides of the Humboldt River and Interstate 80. This land pattern was created when alternating sections of land were granted to the Union Pacific and Central Pacific railroads as incentive to construct a transcontinental railroad. Both private and public land are present within the Project boundary.

Dominant land uses in the Project area include mining, livestock grazing, and, to a lesser extent, outdoor recreation. Although mining has occurred in the area throughout the last century, the majority of mine development has been since 1980. Mining is now the dominant land use in the Project area and will likely remain the principal activity for decades.

Land associated with the Leeville Project, including the proposed pipeline route, is located within the T Lazy S grazing allotment. This allotment has undergone past adjustments to account for withdrawn land parcels due to extensive mining in the area. Current grazing capacity and details of range condition are provided in the *Grazing Management* section of this chapter.

Existing rights-of-way in the Project area include two Barrick access roads (N-54682 and N-48045), two Sierra Pacific Power Company powerline rights-of-way (N-47775 and N-46957), a pipeline and access road granted to Newmont in Section 16, T35N, R50E (N-064876), and a livestock watering pond (N-54209) in Section 2, T35N, R49E granted to the Elko Land and Livestock Company. Rights-of-way are shown on **Figure 2-2**.

Water in Boulder Valley is used for irrigation, stock watering, mining and milling, and domestic purposes. Irrigation and stock watering uses are scattered throughout the Boulder Valley, whereas mining and milling occur primarily in the upper reaches of Boulder and Rodeo creeks, where most of the active mines are located. Other nearby mining and milling water uses are located on the east side of the Tuscarora Mountains in the South Operations Area. Most domestic uses are associated with the various mine operations (BLM 1993b).

NOISE

Perception of noise is affected by intensity, pitch, and duration. Loudness is measured in decibels (dB). On this scale, human perception of sound is linear. The sound spectrum (the plot of amplitude vs. frequency) of a sound must be weighted by the auditory function of an animal to characterize its audibility (Bowles 1995). The Environmental Protection Agency (EPA) recommends the A-weighted scale to describe environmental noise because it emphasizes frequencies that humans hear best, is accurate, convenient, and used internationally (EPA 1978).

Sound attenuates (fades) as it travels from a source to a receiver. Attenuation is a function of the square of the distance, but is also dependent upon other factors, such as altitude of the source, temperature, humidity, wind speed, terrain, and vegetation (Bowles 1995). The noise heard by a human or an animal is dependent on these variables, and upon other factors, such as ambient noise, and the auditory system and physiology of the animal.

Because of the remote location of the Leeville Project, no measurements or estimates of baseline sound were made at the proposed mine site. The nearest residential noise receptor area is Carlin, approximately 20 miles southeast. Carlin is located along Interstate 80 and is affected by traffic noise from the highway as well as normal urban sounds.

Noise generated by trucks, dozers, and other equipment generally ranges from 85 to 90 dBA (A-weighted decibel sound scale) at the source. Sound levels from blasting range from 115 to 125 dBA at 900 feet. **Table 3-25** shows typical noise levels generated by mining equipment; for comparison, **Table 3-26** lists noises frequently experienced in daily activities.

TABLE 3-25
Average Sound Levels for Equipment and Mine Operations

Equipment/Operation	Sound Level[1]	Source of Information
Blasting	115-125 dBA @ 900 feet	United States Bureau of Mines 1976
Haul Trucks	90 dBA @ 50 feet	EPA 1978
Loaders	87 dBA @ 50 feet	Reagan and Grant 1977
Blasthole Drilling	86 dBA @ 50 feet	Reagan and Grant 1977
Dozers	85 dBA @ 50 feet	Reagan and Grant 1977

[1] dBA = A-weighted decibel sound scale.

TABLE 3-26
Relative Scale of Various Noise Sources and Effect on People

Public Reaction	Reference Level	Noise Level (dBA)[1]	Common Indoor Noise Levels	Common Outdoor Noise Levels
		110	Rock band	
		105		Jet flyover @ 1000 ft.
Local committee activity with influential or legal action		100	Inside New York subway train	
		95		Gas lawn mower @ 3 ft.
Letters of protest	4 X as loud	90	Food blender @ 3 ft.	
Complaints likely	2 X as loud	80	Garbage disposal @ 3 ft., Shouting @ 3 ft.	Noisy urban daytime
Complaints possible	Reference	70	Vacuum cleaner @ 10 ft.	Gas lawn mower @ 100 ft.
		65	Normal speech @ 3 ft.	Commercial area, heavy traffic @ 300 ft.
Complaints rare	½ as loud	60	Large business office	
Acceptance	¼ as loud	50	Dishwasher in next room	Quiet urban daytime
		40	Small theater, large conference room	Quiet urban nighttime
		35		Quiet suburban nighttime
		33	Library	
		28	Bedroom @ night	
		25	Concert hall (background)	Quiet rural nighttime
		15	Broadcast and recording studio	
		5	Threshold of hearing	

[1] dBA = A-weighted decibel sound scale.
Source: Hatano 1980.

VISUAL RESOURCES

The study area for visual resources includes all land areas from which the Proposed Action and Alternatives would be visible. This includes the northern portion of Little Boulder Basin and the western slopes of the Tuscarora Mountains. The dewatering pipeline corridor would be visible from portions of Boulder Valley.

The landscape of the study area is characterized by broad, open vistas framed by scattered hills and mountain ranges. The Project site is hilly terrain on the western slope of the Tuscarora Mountains, which rise abruptly to over 7,500 feet AMSL. The Leeville Project lies in the upper Little Boulder Basin, an area with numerous mining facilities.

The study area vegetation consists primarily of homogenous patterns of sagebrush-grassland. Natural vegetation patterns are disturbed by active mining operations and reclaimed mining sites. Dominant vegetation colors are gray, gray-green, and olive green.

Soil and rock are exposed in numerous areas where vegetative cover is sparse or has been disturbed by mining activities. Soil color ranges from chalky off-white to beige. Disturbed soil exhibits a wider range of color including black, dark gray, reddish brown, buff, and chalky white.

Color hues of disturbed soil are stronger than those of undisturbed areas, and exhibit much greater variation. These colors contrast strongly with surrounding soil and vegetation. Rocks vary in color from light brown to dark brown to burnt orange.

The existing mine disturbances (mine pit and waste rock area) in the vicinity of the Leeville Project create moderate to strong contrasts with horizontal lines, smooth surfaced blocky and pyramidal forms, and more vivid colors from disturbed soil and rock. Existing disturbance at the Leeville Project consists of exploration roads, drill pads, and small pits. Existing mining facilities in Little Boulder Basin create moderate to strong contrasts with the forms, lines, and colors of the existing landscape.

Views of the proposed Leeville Project are limited due to adjacent hilly terrain. Distant views are limited to the upper regions of the Tuscarora Mountains. Potential viewers of the Project site include mine workers, supply haulers, and recreationists. The latter would view the Project site from nearby mountain areas. Recreationists include hunters and, to a limited degree, sightseers.

VISUAL RESOURCE RATINGS

BLM has developed the Visual Resource Management (VRM) system to classify visual resources based on scenic quality, visual sensitivity, and visual distance zones. Land in the study area is assigned to VRM Class III and IV (**Table 3-27** and **Figure 3-18**). Of the four VRM classes, Class IV allows the greatest modification of the landscape by disturbance or development (BLM 1986a). The portion of the Project located on VRM Class III land lies in the headwaters of Rodeo Creek. Views of these facilities would be limited due to terrain.

Key observation points (KOP) were selected for evaluating the visual contrast ratings presented in Chapter 4 - *Visual Resources*. Factors considered in selecting KOPs included angle of observation, number of viewers, duration of view, relative apparent size of the project, season of use, and lighting conditions (BLM 1986b). The KOPs were selected to represent locations on roads approaching the Project site from which a person may be expected to view project features. Three KOPs were identified and evaluated (**Figure 3-18**).

KOP 1 is located along the Barrick Access Road approximately 1,500 feet south of the northeast corner of Section 10, T35N R50E. The Barrick Road provides access to the Project site from the Carlin Mine area. This KOP represents views seen by supply haulers and workers traveling to the various mining operations in the Little Boulder Basin. KOP 1 overlooks the western portion of the Project site with views of proposed facilities extending for approximately 1 mile across Little Boulder Basin. Surrounding hills limit distant views from KOP 1. Foreground views of the water treatment facility, waste rock facility, and refractory ore stockpile would be dominant.

TABLE 3-27
Visual Resource Management Objectives

Class	Objective
I	The objective of this class is to preserve the existing character of the landscape. This class provides natural ecological changes, it does not preclude limited management activity. The level of change to the characteristic landscape should be 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 attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant 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 features of the characteristic landscape.
IV	The objective of this class is to provide for management activities that 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. The impacts of these activities should be minimized through careful location, minimal disturbance and repetition of the basic elements.

Source: BLM 1986b

The characteristic landscape is flat in the foreground and middleground, and hilly in the background. Landforms are generally rounded. Exposed soil and rock colors are reddish brown to dark gray, with vegetation colors ranging from gray-green in the foreground to gray, tan, buff, and yellowish tan in the background. Textures are generally smooth. Existing mining operations offer moderate to strong contrasts in form and color. Existing ore stockpiles and waste rock facilities introduce horizontal and diagonal lines along with black, dark gray, and beige colors. The Beast Pit highwall offers moderate contrasts in texture (**Figure 3-19**).

KOP 2 is located along the Barrick Access Road approximately 0.75 mile north of KOP 1. Views of the waste rock disposal facility and water treatment plant would be dominant from KOP 2. The production shaft area and headframe would also be visible from KOP 2. The characteristic landscape features bold, rounded forms with diagonal, curving lines. Vegetation offers no distinct form. Colors of exposed soil and rock range from gray and dark brown to black. Vegetation colors are gray to yellow buff with a smooth texture. Existing mining facilities offer moderate contrasts in form and color, introducing horizontal and diagonal lines and dark gray and black colors (**Figure 3-19**).

KOP 3 is located on a ridge west of the Leeville Project area, above the Beast and Sold mine pits. The Project site is viewed from a higher elevation than KOPs l and 2. This vantage point allows views of the entire Project site, as well as extensive views of the dewatering pipeline corridor and existing mining facilities. These provide moderate to strong visual contrasts, especially in form, line, and color. In the fore-ground-middleground zone, bold rounded forms grade into domed, undulating forms in background mountains. Lines are complex, with horizontal, rounded, and weak to moderate diagonal lines in the background zone. Coarse, patchy textures in the foreground-middleground zone grade into smoother textures in the background zone. Dominant colors on undisturbed land are gray, buff, gray-green, and yellowish tan. In contrast, dominant colors on disturbed land are reddish brown, brown, dark gray, and black. Textures are more patchy on disturbed land (**Figure 3-19**).

CULTURAL RESOURCES

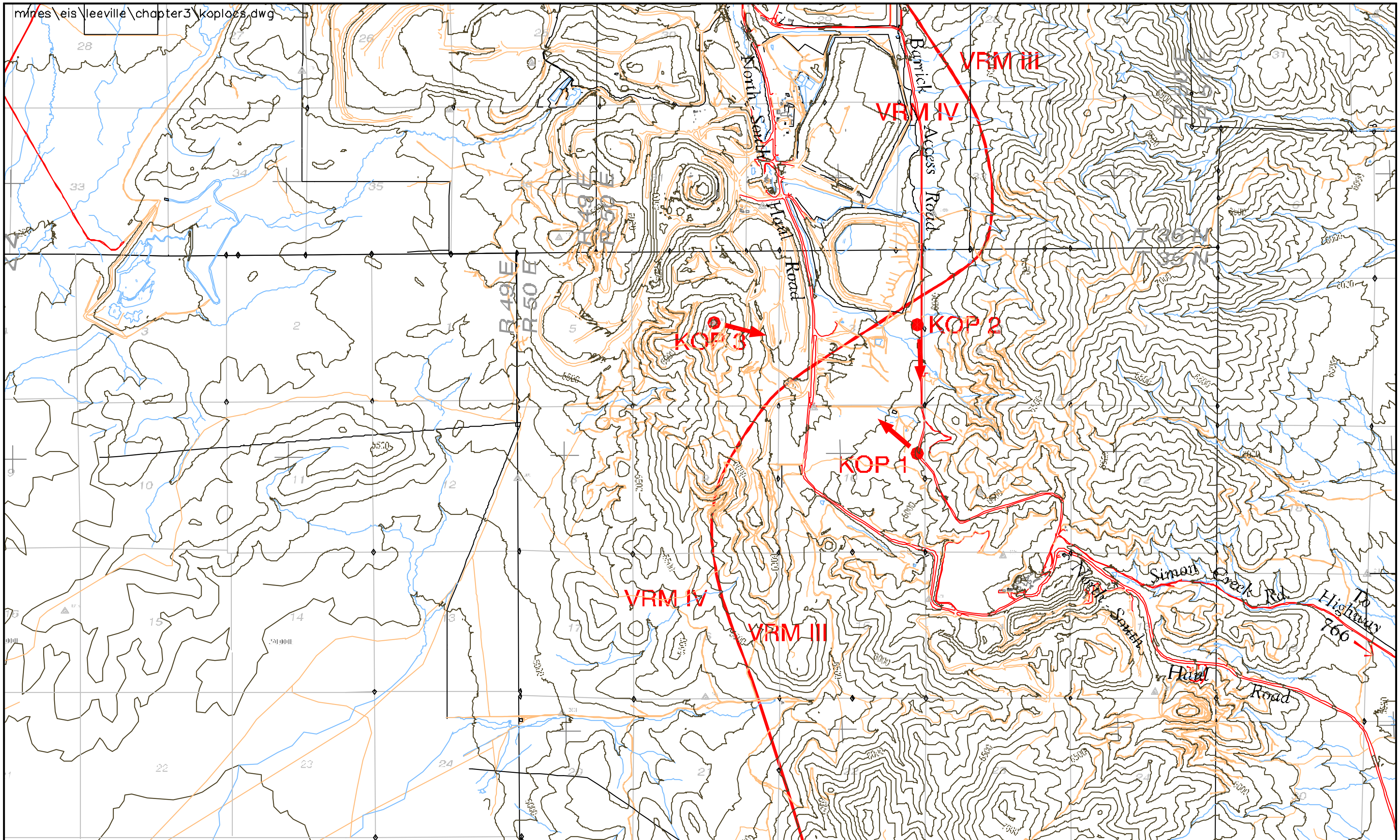
Cultural resources are locations of past human activity, occupation, or use. Prehistoric resources reflect activities that occurred prior to introduction of written records. Historic resources reflect Euro-American and Asian-American occupation. The scientific value of these resources relates to their potential to inform how human societies operate and change. Since written documentation is absent, archaeological sites are the only source of data concerning prehistoric societies. In addition to their scientific value, cultural resources may have aesthetic and cultural value. Aesthetic values may be expressed in rock art sites found throughout Nevada, or in standing structures of architectural significance. Historic sites may have cultural value if they link a living community to a place that conveys a sense of cultural identity. For purposes of this review, a study area was defined that included the greater Carlin Trend. This area extended from Carlin on the south to Willow Creek on the north, and from the Independence Range on the east to the Sheep Creek Range on the west.

PREHISTORIC OVERVIEW

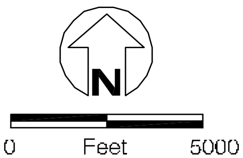
James (1981), Tipps (1988), Elston and Budy (1990), Elston and Drews (1992), and Schroedl (1995) provide overviews of regional prehistory. Schroedl (1995) divides regional prehistory into six chronological periods.

The Pre-Archaic Period (12,250 to 8000 B.C.) was a period marked by cool, moist conditions. Originally thought to represent an adaptation to pluvial lakeshore environments, Pre-Archaic sites have increasingly been recognized in other settings. Subsistence revolved around lake shore-marsh resources and the taking of large game. Population density was quite low, and groups were highly mobile. No sites ascribed to this period have been identified in or adjacent to the Project area.

Environmental conditions changed toward the end of the Pre-Archaic Period as temperatures increased and available surface water decreased. The Early Archaic Period (8000 to 4500 B.C.) appears to have been a time of limited occupation in the north-central Great Basin. Period sites are not common regionally and few have been identified in or near the Project area.



Source: BLM 1986a, 1986b.



Legend

- Key Observation Point
- Visual Resource Management (VRM) Boundary

VRM Class Boundary
and KOP Locations
Leeville Project
FIGURE 3-18

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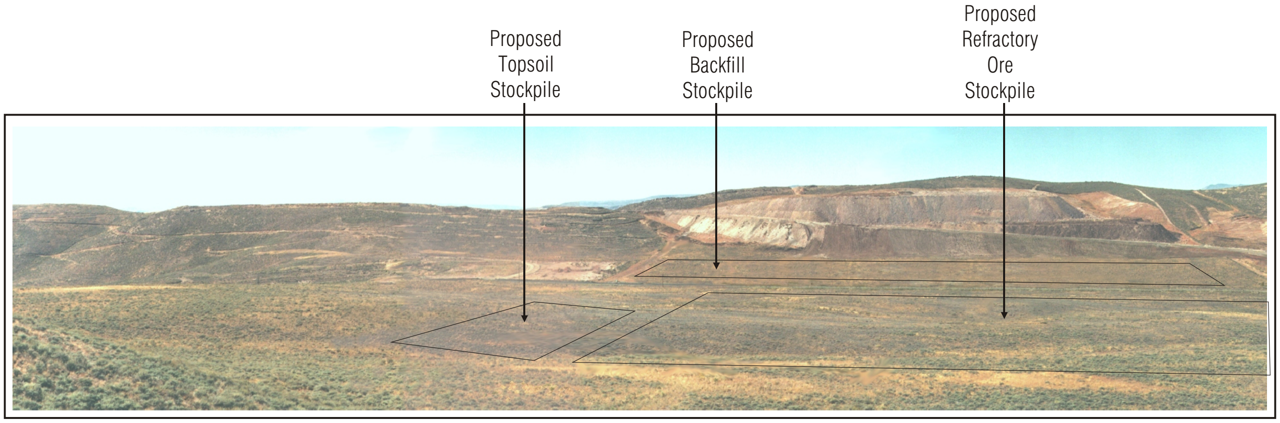
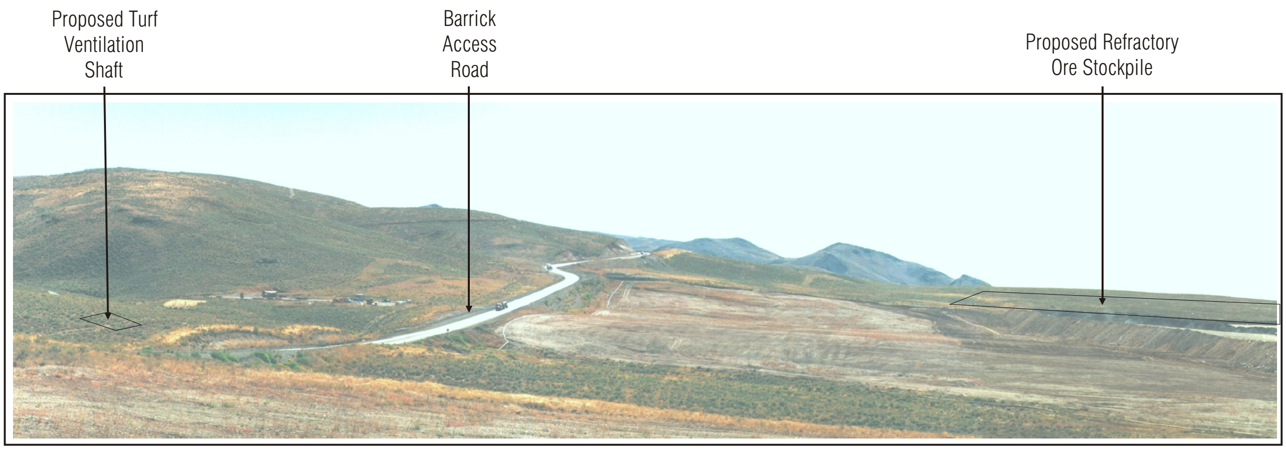
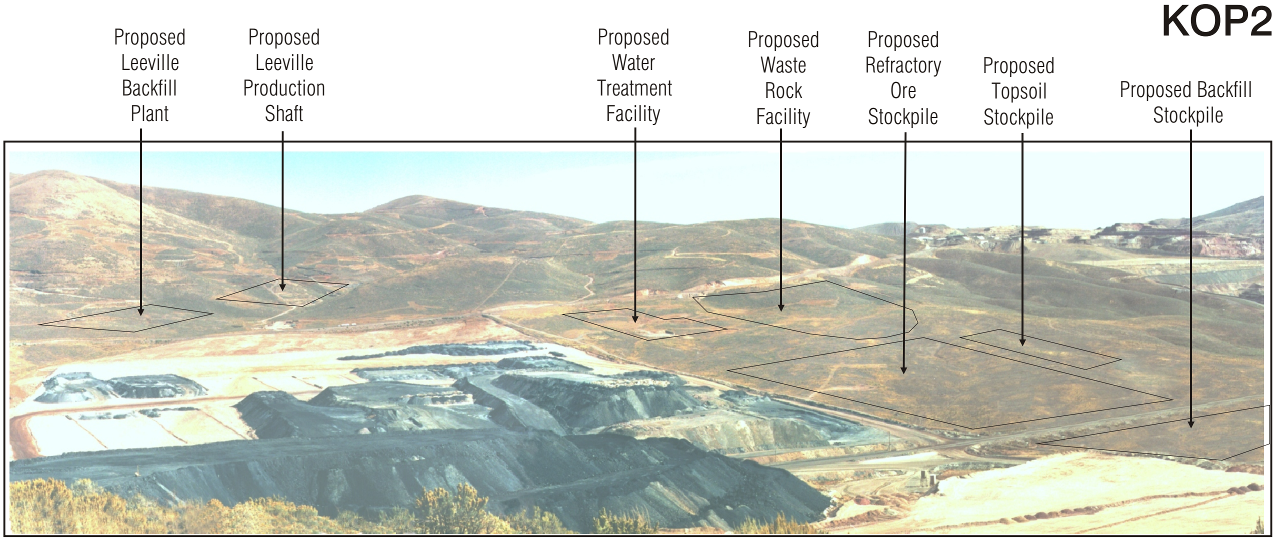


KOP1



KOP2



KOP3

Existing Conditions
Leeville Project
FIGURE 3-19

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The appearance of ground stone implements is evidence of subsistence diversification brought on by reduced carrying capacity of local environ-ments. The variety of site types encountered increased during this period, again suggesting resource procurement strategy diversity.

The Middle Archaic Period (4500 to 850 B.C.) corresponds to the onset of a cooler period when increased precipitation caused the expansion of some resources associated with lakes and marshes. Local manifestations of the Middle Archaic Period are referred to as the South Fork Phase. Trends during the period include population increases and broadening economic activities. While hunting was an important subsistence focus, the processing of plant food took on greater importance as evidenced by the abundance of ground stone artifacts. Also, use of upland resources increased notably. Sites assigned to this period are present in the region and are especially abundant in the Tuscarora Mountains south of Richmond Summit.

The Late Archaic Period (850 B.C. and A.D. 700) corresponds with the James Creek Phase. Technologically, this period is marked by increased diversification in ground stone artifacts and a greater emphasis on use of small flake tools. Subsistence and settlement changes appear to reflect increased local and regional population. This prompted an intensification and diversification in localized subsistence practices. Resources seldom used during earlier periods were added to the diet. Regional use of pinyon also became pronounced during this period. Sites associated with this period are numerous in the immediate region, especially in the Little Boulder Creek area north of the Project area.

The Late Prehistoric Period (A.D. 700 to A.D. 1300) corresponds with the Maggie Creek Phase and exhibits a general continuity with the previous era. Occupation levels were consistent with, if not higher than, previous periods. Appearance of smaller Rosegate series projectile points suggests that the bow and arrow were introduced during this period. A general emphasis on smaller tools may be evidence of gradual diminishment of quality lithics in the region. An alternative explanation is that a burgeoning population forced an increased reliance upon the taking of smaller animals.

The Protohistoric Period extended from A.D. 1300 to historic times and corresponds with the Eagle Rock Phase. Occupational levels appear to have declined during this period; assemblages are small and lack evidence of much diversity. Local materials are not abundant, suggesting a fairly mobile subsistence practice. This period saw expansion of Numic groups throughout most of the Great Basin from a homeland in the Southwest. While there is little dispute that this event occurred, there is disagreement over its mechanics and timing.

HISTORIC PERIOD

Patterson, Ulph, and Goodwin (1969) and Vlasich (1981) address local history. Topical references of relevance include Cline (1963) on early explor-ation; Cline (1974) on the Hudson's Bay Com-pany; Goodwin (1965) on emigration; Myrick (1962) on railroads; Lincoln (1923), Hill (1918), and Elliot (1966) on mining; and Vestrom and Mason (1944), Sawyer (1971), and Young and Sparks (1985) on ranching and agriculture.

Economic interests fostered early exploration of the region. Acting on behalf of the Hudson's Bay Company, Peter Skene Ogden made several incursions into the Great Basin during the 1820s and 1830s. During his fifth such exploration (in 1828 and 1829), he traversed portions of the Maggie Creek drainage before traveling north into the Owyhee drainage. Others who explored the general Humboldt region included John Work and Joseph Walker. Exploration of a different sort occurred during the 1840s through the 1860s, when military expeditions traversed the region in search of scientific information or transportation routes. Leaders of these expeditions included Captain John C. Fremont, Lieutenant E. Beckwith, Captain James Simpson, Clarence King, and Lieutenant George Wheeler.

Beginning in the 1840s, Euro-Americans moved through Nevada on their way to Oregon and California. The number of people moving along these trails swelled in the 1850s and 1860s after the discovery of gold in California and Nevada. The first Euro-American settlers in Nevada were traders who established posts along emigrant trails. Farmers, ranchers, and miners moved out from these posts into the hinterlands. Construction of the transcontinental railroad in the 1860's established new population centers and incentives for local and regional development. Nearby Carlin was established as a major railroad facility. Ponds along the Humboldt River and Maggie Creek produced ice for use by the railroad.

Ready access to the railroad spurred development of the livestock industry throughout the state, especially in northeast Nevada. Access to regional and national markets prompted an increased demand for extensive rangeland. Ranching operations in northeast Nevada came to depend on the availability of land for summer and winter pasture. This pattern continued into the 1890s, after which the character of ranching shifted due to changes in federal land management, regional and national economics, and private land ownership patterns.

Mining has played a major role in the history of northeast Nevada. The Project area is a part of the Lynn District established in 1907 when placer gold deposits were discovered in the Lynn Creek drainage. To the north of the Lynn District were the Boulder Creek (Bootstrap), Ivanhoe, and Gold Circle districts. The Boulder Creek District was a comparatively late development, dating to the 1950s and 1960s. The Ivanhoe District was known for mercury deposits mined during the first half of the 20th century. Of the local mining districts, Gold Circle (Midas) was the most lucrative. Significant amounts of gold and silver were produced between 1907 and 1922. Production was halted by the onset of World War II. The Maggie Creek District was located south and east of the Lynn District. Established in 1906, the district was the scene of intermittent activity through the 1920s. Limited amounts of silver, lead, copper, and gold were produced. Lignite coal and oil shale were mined on a limited scale near Carlin as early as the 1860s and continued into the 20th century. Carlin also saw some gold production in 1908 and again in 1934.

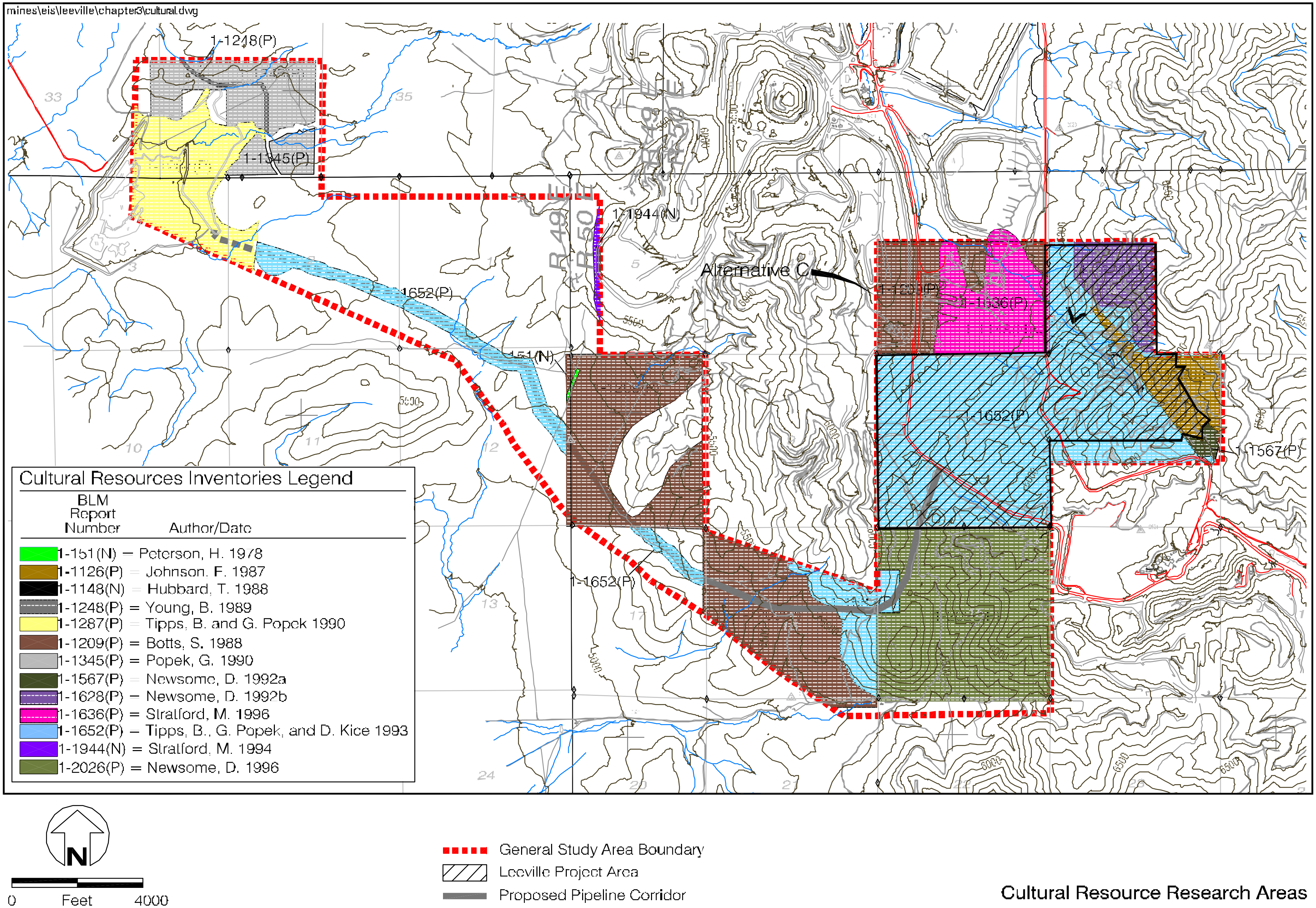
CULTURAL RESOURCES IN THE AREA OF POTENTIAL EFFECT

Compliance with regulations affecting cultural resources requires definition of an Area of Potential Effect. For analytic purposes, the Area of Potential Effect is divided into two sub-areas: Area of Direct Effect and Surrounding Area of Effect. The Area of Direct Effect is the area where proposed surface disturbance or occupancy would occur as described in the Proposed Action and Alternatives. The Surrounding Area of Effect lies outside the Area of Direct Effect but may be subject to impact even though no surface disturbance is proposed. For example, some resources may be impacted due to the introduction of visual or audible intrusions (**Figure 3-20**).

Archival data were collected to determine location and nature of prehistoric, historic, and architectural resources known to be present within the Area of Potential Effect. Project and site records maintained by BLM were examined. Archival research indicated the immediate mine area had been inventoried previously. Twelve intensive inventories were conducted within or overlap some portion of the Area of Direct Effect (see **Table 3-28**). Only portions of the proposed dewatering pipeline/canal alignment had not been inventoried. The subsequent examination of those areas is documented in BLM Report BLM1-1652(P) (Newsome 1997). Viewed collectively, these inventories address all of the Area of Direct Effect. Forty-one additional inventories extend into the Surrounding Area of Effect (see **Table 3-28**).

Prehistoric and historic period cultural resources identified as a result of Class III inventories in each sub-area of the Area of Potential Effect are listed in **Table 3-28**. A total of 335 sites have been recorded, of which 31 are partially or completely within the Area of Direct Effect. None of the sites identified in the Area of Direct Effect are eligible or potentially eligible to the National Register of Historic Places. One site (CrNV-01-10801), a multi-component prehistoric site, located in the Surrounding Area of Effect near the proposed pipeline and canal system has been determined eligible to the National Register of Historic Places by BLM.

A total of 304 cultural resources have been identified in the Surrounding Area of Effect. Of the identified sites, 22 have been determined eligible for the National Register; data recovery has occurred at three of those sites. One site is listed as potentially eligible and 137 have been determined ineligible for the National Register. A determination has not been made for the remaining 145 sites. Given provisions of the Statewide Agreement between BLM and the



Cultural Resource Research Areas
Leeville Project
FIGURE 3-20

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TABLE 3-28
Cultural Resource Inventories Entirely or Partially Within the Leeville Mine Area of Potential Effect

BLM Report Number	Author	Date of Report	Number of Sites Located			Correspondence	
			Large – Lithic Sites	Small Sites	Isolates	BLM Decision	SHPO[1] Concurs
Area of Direct Effect							
1126	Johnson, F.	1987	0	0	0	-	-
1148	Hubbard, T.	1988	0	0	0	-	-
1160	Coulam, N.	1988	0	1	0	-	-
1209	Botts, S.	1988	0	0	0	1/4/89	1/20/89
1287	Tipps, B. and G. Popek	1990	0	0	1	5/18/90	5/31/90
1567	Newsome, D.	1992	17	0	11	9/1/92	9/28/92
1628	Newsome, D.	1992	0	0	0	2/26/93	3/22/93
1636	Stratford, M.	1996	0	0	0	-	-
1652	Newsome, D.	1997	0	0	1	-	-
1942	Kenzle, S.	1994	0	0	0	10/26/94	11/8/94
1944	Stratford, M.	1994	0	0	0	-	12/8/94
2026	Newsome, D.	1996	0	0	0	9/27/96, 4/24/97	10/30/96, 5/30/97
Totals			**17**	**1**	**13**		
Surrounding Area of Potential Effect							
151	Peterson, H.	1978	0	0	0	-	-
388	Jaynes, S. and T. Murphy	1981	2	1	0	-	-
902	Spencer, L.	1985	0	0	0	-	-
967	Matranga, P., D. Mathiesen, & P. deBunch	1985	0	0	0	-	-
1040	Schroedl, A.	1986	5	11	3	-	-
1042	Russell, K., A. Tratebas, and A. Schroedl	1986	0	0	0	12/18/86	1/21/87
1126	Johnson, F.	1987	0	1	4	-	-
1148	Hubbard, T.	1988	0	0	0	-	-
1160	Coulam, N.	1988	1	0	0	-	-
1188	Tipps, B.	1988	0	0	0	-	-
1209	Botts, S.	1988	2	4	3	1/4/89	1/20/89
1241	Hicks, P. and S. Livingston	1988	0	0	0	1/4/89	1/20/89
1244	Hicks, P.	1989	3	8	11	10/5/89	9/24/91
1248	Young, B.	1989	1	4	2	-	10/18/89
1287	Tipps, B. and G. Popek	1990	10	11	16	5/18/90	5/31/90
1323	Schroedl, A.	1990	6	5	5	10/28/91	9/24/91, 11/8/91
1345	Popek, G.	1990	3	2	5	8/28/92	9/29/92
1443	Tipps, B.	1991	15	6	13	1/27/93	2/1/93
1465	Nelson, K.	1991	0	0	0	8/26/92	9/4/92
1544	Newsome, D. and B. Tipps	1992	0	0	0	5/6/92, 6/17/92 8/28/92	6/4/92, 9/30/92
1567	Newsome, D.	1992	16		4	9/1/92	9/28/92
1628	Newsome, D.	1992	15		10	2/26/93	3/22/93
1636	Stratford, M.	1996	10			-	-
1637	Newsome, D.	1996	4		5	-	-
1644	Newsome, D., G. Popek, and B. Tipps	1993	4	0	3	5/14/93	6/1/93
1684	Tipps, B., G. Popek, and D. Kice	1993	0	0	0	1/20/94	1/25/94
1689	Newsome, D.	1992	12		5	1/26/93	2/1/93
1725	Newsome, D.	1993	3		3	3/24/94, 4/20/94	4/7/94, 5/20/94
1788	Kautz, R.	1993	0	3	5	1/18/94	1/25/94
1800	Newsome, D., G. Popek, and B. Tipps	1993	15		8	8/1/94, 10/7/94	8/10/94, 11/16/94
1807	Kenzle, S.	1993	1		1	3/24/94, 4/20/94	4/7/94, 5/20/94
1867	Newsome, D.	1994	0	0	0	-	12/5/94
1889	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1905	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1921	Stadelman, J.	1994	0	0	0	-	-
1926	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1942	Kenzle, S.	1994	2	0	3	10/26/94	11/8/94
1944	Stratford, M.	1994	0	0	0	-	12/8/94
2026	Newsome, D.	1996	4	0	5	9/27/96, 4/24/97	10/30/96, 5/30/97
2027	Newsome, D.	1996	0	0	0	-	-
2028	Newsome, D. and E. Tallman	1996	0	0	0	-	-
Totals			**134**	**56**	**114**		

[1]SHPO – State Historical Preservation Office

Nevada State Historic Preservation Office, isolates are by definition not eligible to the National Register.

Of the approximately 68 square miles contained in the Area of Potential Effect, some 35 square miles have been subject to Class III inventory. As noted above, 335 cultural resources have been identified as a result of that inventory effort. This reflects a site density of 9.6 sites per square mile. Site density estimates have been developed for areas immediately north and south of the Project area. In the South Operations Area, inventories suggest a site density of about 2.7 sites per square mile. This estimate increases to 6.4 sites per square mile in areas located along drainage ways (Newsome and Tipps 1997). Site densities are notably higher in the Little Boulder Basin. Newsome and Tipps (1997) report a site density of 17 sites per square mile, while Burke (1990) suggests a density of 21 sites per square mile. Noted differences in site densities may be due to the differing availability of water. Little Boulder Basin has several perennial drainages and springs, and archaeological sites are abundant. In contrast, terrain in the South Operations Area is more rugged and fewer sources of water are available. Fewer archaeological sites have been identified in this context. Site densities noted for the Area of Potential Effect are intermediate between those noted for the adjacent areas.

NATIVE AMERICAN RELIGIOUS CONCERNS

Ethnographic resources include sites or areas of concern to Native American groups either for heritage or religious reasons. A site may have a heritage value if it serves as a link between a living community and a place that conveys a sense of cultural identity, or a particular social or religious concern has been expressed regarding the site.

Newe/Western Shoshone History

The Leeville Project area lies within the ethnographic territory of the Western Shoshone, or Newe. Ethnographic sources include Chamberlain (1911), Steward (1937, 1938, 1941, and 1943), and Harris (1940). Murphy and Murphy (1960), the Inter-Tribal Council of Nevada (1976), Janetski (1981), Thomas, et al. (1986), and Crum (1994) provide recent ethnographic reviews. Information on worldview and religious beliefs is contained in Miller (1983a, 1983b), Hultkrantz (1986), Clemmer (1990), Rusco and Raven (1992), and Deaver (1993).

The Newe/Western Shoshone, members of the Uto-Aztecan linguistic family, inhabited an area extending from southeast California into northwest Utah. Their territory was bordered to the north by the Northern Shoshone, to the east by the Ute, to the south by the Southern Paiute, and to the west by the Northern Paiute. The nuclear family was the basic unit of Shoshone society. Nuclear families conducted most subsistence activities and were largely self-sufficient. Three to ten families jointly occupied semi-permanent camps during the winter months and foraged together for parts of the year. The Shoshone joined into larger groups only when resources were sufficiently concentrated to allow cooperative harvests. These gatherings were often the occasion for fandangos, festivals that provided an opportunity for courtship, socializing, and dancing.

The Shoshone utilized a flexible subsistence and settlement system, one based on the scheduling of activities according to the seasonal availability of food. In the spring, Shoshone dispersed in family groups each of which foraged for greens and roots on valley floors. Small mammals were an important meat source. These could be hunted with bow and arrow, snares, or deadfalls. Sometimes, their burrows were flooded or dug out. Individual hunters stalked deer.

Summer gathering strategies focused on ripening grass seeds. These became available on valley bottoms first and then upslope as the season progressed. Seeds were harvested either by knocking them into burden baskets or by cutting seed heads from stalks. Seeds were winnowed, ground, and either prepared for consumption or stored. Berries and roots were gathered in late summer and early fall. Small animals continued to be an important resource throughout the summer. Small groups ambushed mountain sheep from blinds.

The character of the subsistence pattern changed in the fall. Multiple families assembled to procure large amounts of food for storage at winter base camps. Pinyon was an important plant resource in the fall. Long hooked poles were used to shake cones from trees, while others could be picked from the ground. As necessary, cones were roasted to release the seeds. Cones often were stored in aboveground caches or open pits, while nuts were stored in sealed underground pits. Pinyon were sparse in areas north of the Humboldt River. Groups often traveled long distances to secure seeds, which were then transported to winter village sites. After the pinyon harvest, people sometimes gathered for pronghorn antelope and jackrabbit drives on valley bottoms. Jackrabbits were driven into nets and clubbed. Pronghorn antelope were driven into large corrals where archers dispatched them. Newe/Western Shoshone also made occasional forays to the Snake River to fish for salmon during the fall spawning run.

The Shoshone depended on stored food during winter months. Pinyon and other stored seeds could be supplemented by collecting cactus and the roots of marsh plants such as cattails and bulrush. Mountain sheep could be hunted at lower elevations in the winter and ice fishing sometimes occurred along the Humboldt River.

Newe/Western Shoshone World View

The Newe/Western Shoshone trace their occupation of the Great Basin back to when the earth was young - when “animals were people” (Miller 1983a). The coyote and wolf figure in creation stories, with prominent mountain peaks honored as sacred places connected with their creation.

The belief that supernatural power (*Puha*) has permeated the earth since its creation is a central feature in Newe/Western Shoshone religious beliefs. Religious behavior revolves around the acquisition of *Puha*. Sources of *Puha* are numerous, including sources of water, prominent mountain peaks, and caves. Animals and, to a lesser extent, plants have power, and this power can be conveyed to people by supernatural spirits who control individual species. Because power is attracted to life, it remains present in places where people have lived, particularly around graves. Power sources are associated with spirits. As noted, animal and plant species have their spirits, and fixed places such as water sources, mountains, caves are viewed as power spots. Other forms of spirits include guardian spirits and little men.

Religious expression takes several primary forms, including ceremonies; individual prayer to the spirits of plants, animals, water, power spots, and little men; and use of power spots for vision questing (acquisition of a guardian spirit), curing, and doctoring. The most frequent form is the individual prayer. Prayers are especially important in connection with places where spirits may live, or that are regarded as power spots. People who exhibit discipline and strength may obtain special power. For example, the shaman may obtain the power to heal illnesses or injuries. Relatively few people have special powers. Most people participated in a variety of rituals associated with hunting, gathering, attending a birth, or burying and mourning the dead.

Power also may be used for non-legitimate, malevolent purposes. Certain spirits may, in some circumstances, act in a malevolent manner. For example, little men can be benevolent or malevolent, depending on how they are treated. Correcting neglected or abused relationships between humans and spirits is a major aspect of Newe/Western Shoshone religion. Many rituals are directed at controlling and use of power and balancing the potentially dangerous spiritual powers that pervade nature. Shoshone religion depends on maintaining the integrity of power spots, maintaining the presence of little men, maintaining their relationship with the owner-spirits of plants and animals, and maintaining life-giving forces such as the sun, earth, and water.

Consultation

Specific laws, regulations, and executive orders mandate that federal agencies consult with Native American communities about projects that could effect traditional cultural or religious beliefs, or practices. These include the National Historic Preservation Act, the Native American Graves Protection and Repatriation Act, and Executive Order 13007, among others.

Previous consultation with members of the Newe/Western Shoshone community was documented in a report entitled “*Consultation With the Western Shoshone Regarding the*

Proposed Expansion of Newmont Gold Quarry Mine, Carlin, Nevada" (Deaver 1993), and was subsequently integrated into BLM (1993b). Since general ethnographic inquiry tends to be broad in scope, the BLM (1993b) addressed issues relevant within the area of direct effect and the area of cumulative effect. Neither area was discussed individually.

Based on consultation conducted in 1993, the following statements characterize the general concerns of Newe/Western Shoshone traditionalists as they pertain to mining activities.

- Ground-disturbing activities associated with mining can disrupt the flow of spiritual power (*Puha*) as well as the distribution or disposition of spirits (e.g., Little Men and Water Babies). Maintaining access to undisturbed concentrations of *Puha* (power spots) and continuing relationships with the spirits is integral to spiritual life.

- Dewatering efforts, with the resultant reduction or loss of flow to springs, could alter the distribution or disposition of spirits associated with water. Maintaining a relationship with these spirits is integral to spiritual life. Spring water is used medicinally, for drinking, as a sacrament, and in prayer. In addition, some springs are a source of sacred white clay, and burials often take place near these springs.

- Ground disturbance results in loss of plants and minerals used by Newe/Western Shoshone traditionalists.

- Cultural resource inventories conducted by archaeologists prior to mining activities often result in the collection of artifacts that Newe/Western Shoshone traditionalists consider as powerful and sacred objects (e.g., complete projectile points and items of Tosawihi chert). Current curation practices can prevent traditionalists from securing these items for use in healing practices.

Additional consultation for the Leeville Project has occurred in two phases. Phase I was initiated via certified letter on May 22, 1997. The Te-Moak Tribe; Elko, Wells, Battle Mountain, and South Fork Band Councils; and Western Shoshone Historic Preservation Society were invited to discuss potential effects of ground-disturbing activities associated with the Leeville Project on areas of cultural or religious importance to the Shoshone people. BLM received two written responses. The South Fork Band of the Te-Moak Tribe indicated it had no comments or concerns regarding the Project. The Western Shoshone Historic Preservation Society stated the Project would occur within traditional boundaries of the Newe/Western Shoshone. The Society contends that because the Ruby Valley Treaty of 1863 is the "law of the land", the Leeville Project is illegal. As a result, the Society stated it does not support the proposed activity. Further, the Society states there are contemporary, prehistoric, and historic campsites that lie within traditional boundaries of the Newe/ Western Shoshone. The Society con-cludes its letter by stating, "The proposed Leeville Project lies within these boundaries, therefore, such a project will in fact have a direct impact on the cultural resources of the Native American Indian."

None of the remaining groups provided a written response. In each case, they were contacted by telephone and asked to provide written comment on the Proposed Action. Repeated attempts by BLM to solicit comments from the groups were unproductive. Consequently, Phase I of the consultation effort did not result in identification of traditional, cultural, or religious sites of importance to the Newe/Western Shoshone. Evidence of BLM's effort to consult in good faith regarding potential effects of the Leeville Project on Western Shoshone cultural, religious, and spiritual areas are outlined in **Appendix A**.

Phase II of the consultation effort was conducted in conjunction with the mine dewatering cumul-ative impact assessment prepared on behalf of Newmont's Gold Quarry and Leeville projects, and Barrick's Betze/Post operation (BLM 2000a). This consultation effort was initiated on October 1, 1998. To date, the main finding of Phase II consultation is the identification of two traditional cultural properties, one along Rock Creek and one at the Tosawihi Quarries. The BLM determined the Rock Creek area was eligible for the National Register as a traditional cultural property under criteria *a, c,* and *d*, and the Tosawihi Quarries area was eligible for the National Register as a traditional cultural property under criteria *a* and *d*. In a letter dated May 19, 1999, the Nevada State Historic Preservation Office concurred with the BLM's determinations. The Western Shoshone expressed concerns about possible effects of dewatering to the traditional cultural properties at Rock Creek and Tosawihi. The Newe/Western Shoshone also expressed concern about the declining number of sage grouse, the loss of native plants and animals, and impacts to water resources.

SOCIAL AND ECONOMIC RESOURCES

The socioeconomic study area encompasses portions of Elko and Eureka counties, the communities of Elko, Carlin, and Spring Creek, and the Elko Band Colony. Since the Project is situated within Eureka County and local government would receive increased tax revenues as a result of the Project, this section describes economic conditions in Eureka County. The majority of employees and their families are expected to live in Elko County, rather than Eureka County, due to long commuting distances between the project and communities within Eureka County. Therefore, social life and community services, which will have negligible impact as a result of the Project, are not described for Eureka County. A socioeconomic technical report was prepared and is available at the BLM Field Office in Elko.

SOCIAL LIFE

Mining and related development in the 1980s and 1990s caused rapid population growth in Elko and Carlin and was a dominant force in shaping the socioeconomic character of the area. The in-migration of newcomers created changes in some aspects of daily life, such as increased traffic, overcrowded parks, and higher crime rates. In a more positive light, low unemployment rates, greater diversity of services, and increased business opportunities also were a result of increased economic development.

Local residents enjoy the small-town atmosphere and are proud of the area in which they live. Residents appreciate the quiet and friendly neighbors, peaceful country living, natural environ-ment, and outdoor recreational opportunities. Some residents, however, perceive negative features of the area such as inadequate selection of goods and services, isolation from major urban centers, lack of ample recreational activities for youth, severe climate, lack of trees, and environmental changes created by mining activities. Residents sense that law enforcement is handling social problems such as domestic violence, alcohol or other drug abuse, and excessive gambling; however, improved access to counseling and more recreational opportunities are needed to further reduce these problems.

Social stratification in the area is often defined by income, length of residence, educational attainment, and ethnicity. Local residents earning high incomes are considered to be the most influential in the community. The most powerful groups viewed by residents as making decisions about the area's future include federal and state government, county commissioners, environ-mental organizations, and large corporations.

The effects of declining gold prices have been felt by the mining industry, businesses, local governments, and residents. As gold prices remain in a slump, the community experienced layoffs of mine workers, some mines announced early closures, and exploration and mine expansion plans were shelved. As mine workers were laid off, local business establishments also experienced a decrease in local spending by unemployed mine workers and their families.

POPULATION TRENDS AND DEMOGRAPHIC CHARACTERISTICS

Nevada experienced dramatic growth during the past decade, ranking it as the fastest growing state in the country with a 51 percent growth rate compared with a 9.6 percent rate nationwide. In-migration accounted for 81 percent of the population increase.

Similar to the state, Elko County's population grew from 33,530 in 1990 to 45,291 in 2000, a 35 percent increase over the past decade. The City of Elko also experienced an increase of 13 percent in population between 1990 (14,736 residents) and 2000 (16,708 residents) and the "bedroom community" of Spring Creek outside of Elko increased by 80 percent from 5,866 in 1990 to 10,548 in 2000. Population in Carlin, the community closest to the mine site, decreased by 3 percent from 2,220 in 1990 to 2,161 in 2000 (United States Department of Commerce, Bureau of the Census 2001.

The demographics of the Elko County population differ from the state as a whole with respect to gender (higher percent of males than females in the county than in the state); age (a higher population of residents less than 18 years of age in the county than in the state); ethnicity (higher percent of Caucasian and Native American populations in the county than in the state); and poverty (fewer percent of people below the poverty level in the county than in the state).

Tribal enrollment of the Elko Band Colony increased 9 percent between 1995 (1,326 residents) and 1997 (1,445 residents). Forty-three percent of the enrolled members live on or near the colony. In 1997, 29.4 percent of colony residents were under 16 years of age, 64.4 percent were between 16 and 64 years old, and 6.2 percent were 65 years and older (United States Department of the Interior, Bureau of Indian Affairs 2001).

COMMUNITY SERVICE PROVIDERS

Education

Eleven schools are located in the socioeconomic study area, all within Elko County School District. The four elementary schools located in Elko (Elko Grammar School #2, Mountain View, Northside, and Southside) provide education to students enrolled in kindergarten through grade 6. Elko Junior High School serves grades 7 and 8, while Elko High School provides education to students in grades 9 through 12.

Spring Creek students enrolled in kindergarten through grade 5 attend Spring Creek and Sage elementary schools. Spring Creek Middle School provides education for students in grades 6, 7, and 8, while Spring Creek High School serves grades 9 through 12. The Carlin elementary school provides education to students in kindergarten through grade 6, and Carlin High School serves students enrolled in grades 7 through 12.

Education of children in kindergarten through grade 12 from the Elko Band Colony is provided through the Elko County School District. A Head-start Program is housed and operated at the Colony for children aged 3 through 5. Under con-tract with the BIA, the Elko Band Council provides higher education and an adult vocational program at the Colony.

LAW ENFORCEMENT

The Nevada Highway Patrol, Elko County Sheriff's Department, Elko City Police, Carlin City Police, and BIA Police provide law enforcement services to community residents. The Highway Patrol is responsible for law enforcement activities on state highway systems. The Sheriff's Department is accountable for Elko County including the unincorporated towns (17,135 square miles) and is aided in search and rescue operations and emergency situations by the Sheriff's Posse and Reserves. The Elko County Jail, operated by Elko County Sheriff's Department, is located in Elko.

The Elko and Carlin City Police are restricted to the city limits (14.1 square miles and 9 miles, respectively). The BIA Police is accountable for law enforcement on the Elko Band Colony (192.8 acres).

FIRE PROTECTION

Fire protection in the socioeconomic study area is provided by the Elko City Fire Department, Carlin City Volunteer Fire Department (a combined fire, ambulance, and rescue unit), BLM, USFS, and Northeastern Fire Protection Department of the Nevada Division of Forestry. The Elko and Carlin Fire departments primarily serve residents within their respective city limits and the Elko Band Colony; however, both departments maintain mutual aid/cooperative agreements with other firefighting agencies in the area. BLM is primarily responsible for fighting wildland fires.

AMBULANCE SERVICES

Ambulance services are available in Elko and Carlin for ground transportation of patients. Fixed-wing ambulance aircraft also is available at the Elko Airport.

HEALTH CARE

The Northeastern Nevada Regional Hospital (formerly Elko General Hospital) opened in September 2001. The hospital is situated on a 50-acre medical campus and offers 75 acute care rooms. Services at the hospital include 24-hour emergency care, physical therapy, full-service laboratory, intensive care unit, pediatric unit, inpatient pharmacy, obstetrics and gynecology, 24-hour radiology, MRI and CAT Scan, nuclear medicine, mammography, ultrasound, chemotherapy, neurology, inpatient and outpatient surgery, cardio-pulmonary therapy, community outreach programs, pediatric clinic support groups, and nutrition counseling.

The hospital, under contract with Indian Health Service (IHS), provides medical care and emergency services to Native Americans. In addition, comprehensive medical care through IHS is provided at the Elko Band Colony by the Health Center which opened in July 1992. The Center houses a pharmacy, a two-chair dental operatory with a laboratory, and other support services such as a community health nurse, alcohol/drug prevention, and after-care programs.

PUBLIC ASSISTANCE

Public assistance in Elko County is provided by Elko County Social Services and the Nevada State Welfare Department. Other smaller organizations also provide temporary assistance to residents suffering hardships. The Elko Band Council, under contract with the BIA, provides eligible Native Americans with general welfare assistance, adult institutional care, Indian child welfare (including foster care and institutional placements), indigent burial assistance, counseling services, and assistance with Social Security, disability, and death benefits, and state Medicare and Medicaid benefits.

WATER SUPPLY

Elko city water is obtained from 18 deep-water wells. The system has a designed maximum flow capacity of 14.5 million gallons per day (mgpd), with peak usage of 13 mgpd and low usage of 3 mgpd. Water is stored in 10 storage tanks with total storage of 25 million gallons. Natural springs and a deep well provide the city of Carlin with its public water supply. Water is stored in a two-million-gallon tank. The system has a peak flow capacity of 980 gallons per minute (gpm), with an average flow of 450 gpm.

Nine wells throughout the village of Spring Creek provide public water to Spring Creek residents. Water is retained in 7 storage tanks.

WASTEWATER TREATMENT FACILITIES

The Elko wastewater treatment facility is a “fixed-film” biological sewage plant constructed in 1983. The Carlin wastewater treatment facility consists of two lagoons with a reservoir and rapid infiltration basins. The sewage flows by gravity lines into a force main that feeds the aerated treatment lagoons. The treated sewage is used for irrigated pastures and wetlands. Residents and businesses in Spring Creek use septic systems for wastewater disposal.

SOLID WASTE

The city of Elko regional landfill is one of two landfills serving the county. Estimated life of the landfill, at 1,000 tons of solid waste per day, is approximately 94 years. The landfill currently accepts approximately 240 tons of solid waste per day.

HOUSING

In 2000, there were 18,456 housing units in Elko County, of which 85 percent were occupied and 15 percent were vacant housing units. Of the 15,638 occupied units, 70 percent were owner occupied and 30 percent were renter occupied. Housing occupancy in the cities of Elko, Spring Creek, and Carlin ranged from a high of 93 percent in Spring Creek to a low of 78 percent in Carlin, while 89 percent of the housing units in the city of Elko were occupied. Of the occupied housing units, 63 percent were owner occupied in Elko, 89 percent were owner occupied in Spring Creek, and 73 percent were occupied by owners in Carlin (United States Department of Commerce, Bureau of the Census 2001).

In 1997, 41 mobile home parks in Elko County had a total of 1,711 spaces of which 86.9 percent were occupied, 2.1 percent were vacant, and 11.0 percent were mobile homes owned by the parks. Of the 1,711 spaces in the county, 55.4 percent were in Elko, 7.5 percent were in Carlin, and 37.1 percent were located in other communities within the county. In 1996, there were 1,656 motel/hotel rooms in the city of Elko. An estimated 8 percent of the rooms were occupied by individuals on a semi-permanent to permanent basis.

GOVERNMENT AND PUBLIC FINANCE

Major governing bodies in Elko County include Elko County Commissioners, Elko County Planning Commission, Elko County School District, city of Elko, city of Carlin, and the Tribal Council of the Elko Band Colony-Te-Moak Tribe of the Western Shoshone Indians.

The state of Nevada collects taxes on a multitude of items. The primary contributors to the revenue fund are gaming, sales, and use taxes. Relative to the affects of the mining industry on the demand for public services and other industries in Nevada, mining is among the highest taxed industries in the state and the only industry in Nevada that pays taxes to state and local governments on the basis of net proceeds. Mineral producers are allowed to deduct direct costs of production, such as mining and milling, and are taxed on the remaining amount.

The biggest share of fiscal year (FY) 1999-2000 revenues for Elko County, 46.3 percent came from intergovernmental revenues, while property taxes provided about 21.8 percent of Elko County revenues. The majority of the expenditures were for general government (26.6 percent), public safety (21 percent), judicial (17.2 percent), and public works (15.7 percent). Expenditures exceeded revenues in FY 1999-2000 by $2,550,607 (County of Elko 2001).

Approximately 45 percent of Eureka County revenue was derived from intergovernmental revenues in FY 1999-2000, followed by property taxes (37.5 percent). The largest share of expenditures were for general government (26.1 percent), public works (22.8 percent) and public safety (16.1 percent). Revenues exceeded expenditures by $2,064,551 in FY 1999-2000 (County of Eureka 2001).

EMPLOYMENT

The gaming industry drives Nevada's economy; therefore, the hotel, gaming, and recreation sectors employ the most workers in the state. Employment in Nevada in 1999 was dominated by service industries, which accounted for approximately 43 percent of the state's jobs. Wholesale and retail trade, the next largest employment sector, provided about 21 percent of jobs statewide. Approximately 1.2 percent of jobs statewide were in the mining industry (Nevada Department of Employment, Training and Rehabilitation 2001a).

In spite of the recent decline in the price of gold and consequent layoffs and closures in Nevada's mining industry, mining has always been and continues to be important to the economic well-being of Nevada. Over the years, Nevada has led the nation in the production of gold, silver, and barite. In addition to direct employment created by the mining industry, it is estimated that, for every job in the mining industry, at least 1.25 additional jobs are created in the state economy. Using the employment multiplier of 1.25 for indirect jobs and the Nevada 1999 mining employment total of 11,923, an estimated 14,904 indirect jobs were created in the state as a result of mining.

Elko and Eureka counties contribute substantially to Nevada's overall mining employment; collectively, mining jobs in Elko and Eureka counties made up 41 percent of the state's mining jobs in 1999. In 1999, 6 percent of 19,820 jobs in Elko County were in mining, compared with 89 percent of the 4,151 jobs in Eureka County. Employment numbers collected and reported by the Nevada Department of Employment represent the location of a job and not necessarily where employees live. The mining boom along the Carlin Trend, primarily in Eureka County, has greatly contributed to increased commuting for employment between Elko and Eureka counties (i.e., Elko County residents traveling to Eureka County for work). Data indicate that approximately 78 percent of people working in Eureka County commute from other areas of the state or outside of the state (i.e., 4,151 jobs in Eureka County with a labor force of only 900).

In 1999, the largest employer in Elko County was the service industries sector, employing 44 percent of the county's workers, followed by the wholesale and retail trade sector (19 percent) and government (17 percent). In 1999, the county unemployment rate was 5.3 percent, slightly higher than the state rate of 4.4 percent (Nevada Department of Employment, Training and Rehabilitation 2001b).

Unlike the state and Elko County, the major employer in Eureka County was the mining industry in 1999 (89 percent). This sector was followed by the government sector (5.6 percent). The unemployment rate in 1999 for Eureka County was 4.2 percent, which is lower than the state and Elko County.

Basic employers of the Elko Band Colony are the Elko Band Council, the Te-Moak Tribe, the Te-Moak Housing Authority, the Bureau of Indian Affairs, and the Indian Health Service. The Tribe owns and operates a smokeshop and a con-venience store on the Colony and many tribal members work seasonal agricultural and ranching jobs in the area. In 1997, of 250 people employed, one-third were employed in the public sector and the remaining two-thirds were employed in the private sector. Twenty-nine percent of the 352 persons available for work were unemployed in 1997 (United States. Department of the Interior, Bureau of Indian Affairs 2001).

INCOME

Jobs associated with the gaming industry are the most numerous in the state, but most are low paying positions. The statewide average annual wage for service industries in 1999 was $29,103. While there are relatively fewer mining jobs statewide, mining jobs paid the highest wages ($55,744 average annual wages statewide). In 1999, the annual average wage in the mining industry was $58,696 in Elko County, and $55,517 in Eureka County (Nevada Department of Employment, Training, and Rehabilitation 2001c). Per capita personal income in Nevada in 1998 was $29,200, compared with $23,574 for Elko County and $20,718 for Eureka County (United States Department of Commerce, Economics and Statistics Administration 2001).

ENERGY GENERATION AND DISTRIBUTION SYSTEMS

Sierra Pacific Power Company provides electrical service in the study area. Relocation of the existing 120kV transmission line in the Project area would be required in an area to be selected by BLM, Sierra Pacific, and Newmont. To reduce the voltage for distribution to underground and surface support facilities, a substation also may be required at the Project site.

Natural gas in the study area is provided by Southwest Gas Corporation. Southwest Gas Corporation has extended its service to provide Newmont's roaster facility with natural gas; however, service is currently not available at the Project site. The natural gas pipeline has a right-of-way adjacent to Interstate 80 near the Carlin Trend.

ENVIRONMENTAL JUSTICE

Executive Order (EO) 12898 directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. Minority populations included in the census are identified as Black: American Indian, Eskimo, or Aleut; Asian or Pacific Islander; Hispanic; or other. The low-income level is defined as the percentage of families with an income below the 1990 poverty level. The average poverty threshold for a family of four was $12,674 in 1989.

USEPA (1998) and CEQ (1997) guidelines for the conduct of environmental justice assessments were followed when preparing the present analysis. United States Bureau of Census data were reviewed for the census tract in which the Proposed Action and Alternatives would occur. The Leeville Project is located in census tract 9601, which is bordered on the north and east by the Elko/Eureka County line, Lander County on the west, and interstate 80 on the south. Census tract 9516.01 adjoins on the east and includes the town of Carlin. Tracts 9506 and 9507.02 are located north and northeast of tract 9601, respectively. The closest residence to the Leeville Project is located in Carlin. Because 2000 census tract data will not be available until summer 2002, 1990 data were employed in this analysis.

The 1990 census data indicate 23 percent of Tract 9516.01 is comprised of Blacks (**Table 3-29**). By comparison, less than one percent of persons in Eureka or Elko County are assigned to this group, and only seven percent of persons in the State of Nevada are assigned to this group. Further examination revealed that all of the Blacks living in the tract were males between the ages of 30 and 35, and that they were housed in “group quarters” located in Block 141a. These “group quarters” represent the Carlin Conservation Camp, a minimum-security unit of the Nevada State Prison system. Black inmates held at that camp in 1990 did not, nor do they now represent a part of the resident population of the census tract. Therefore, for the purpose of screening for environmental justice concerns, Blacks in Tract 9516.01 do not represent a minority population as defined by EPA’s guidelines (1998).

Racial composition data for adjacent census tracts (9601, 9506, and 9507.02) are consistent with regional and state levels. Therefore, a minority population does not exist within these tracts.

Summary data are available for 2000. Data specific to ethnic composition in Eureka and Elko counties and in Nevada at large are contained in **Table 3-29.** Those data indicate an increase of 66 percent in the state population; 7 percent increase in Eureka County population; and a 35 percent population increase in Elko County. The relative abundance of ethnic groups within those political units does not appear to have changed substantially over the decade. As a result, trends apparent in the 1990 census tract data appear relevant within the context of the present study.

Table 3-30 contains information on the number of persons living below the poverty level as of 1990. These data indicate that within Tract 9516.01, a disproportionately high percentage of White persons lived below the poverty level. **Table 3-30** also indicates that a disproportionately high percentage of Asians in tracts 9516.01 live below the poverty level (this finding is based on a comparatively small population of persons living in that area - 4 individuals). For environmental justice screening purposes, low-income populations (Whites and Asians), as defined by EPA’s guidelines (1998), exist within Tract 9516.01.

Table 3-29
1990 and 2000 Ethnic Composition of Study Area and State of Nevada Populations

	White			Black			American Indian, Eskimo, or Aleut			Asian or Pacific Islander			Other Race			
Location[1]	Qty.	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Total Popu-lation
Census Tract 9601[2]	56	95%	11%	0	-	-	3	5%	0%	0	-	-	0	-	-	59
Census Tract 9506[3]	90	100%	0%	0	-	-	0	-	-	0	-	-	0	-	-	90
Census Tract 9507.02[4]	955	86%	10%	0	-	-	9	0.8%	0%	32	3%	0%	117	11%	100%	1,113
Census Tract 9516.01[5]	163	70%	4%	54	23%	0%	2	1%	0%	4	2%	100%	9	4%	100%	232
Eureka County 1990	1,467	95%	6%	4	0.3%	0%	32	2%	6%	6	0.4%	0%	38	2%	100%	1,547
Elko County 1990	29,004	87%	8%	280	0.8%	2%	2,014	6%	8%	307	0.9%	1%	1,923	6%	98%	33,528
State of Nevada 1990	1.012,890	84%	7%	78,310	7%	2%	20,398	2%	11%	38,053	3%	3%	52,182	4%	98%	1,201,833
Eureka County 2000[6]	1,531	93%	-	9	0.5%	-	68	4%	-	15	0.9%	-	86	5%	-	1,651
Elko County 2000[6]	38,298	85%	-	362	0.8%	-	2,847	6%	-	554	1%	-	4,552	10%	-	45,291
State of Nevada 2000[6]	1,565,866	78%	-	150,508	8%	-	42,222	2%	-	128,690	6%	-	193,720	10%	-	1,998,257

1. United States Department of Commerce, Bureau of the Census, 1990, United States Census, Summary Tape File 3A.
2. Census Tract 9601 includes Eureka County north of I-80.
3. Census Tract 9506 includes part of Elko County north of the Project area.
4. Census Tract 9507, Block Group 2 includes part of Elko County northeast of the Project area.
5. Census Tract 9516, Block Group 1 includes a part of Elko County east of the Project area and north of I-80.
6. United States Department of Commerce, Bureau of the Census, Tape DP-1, Profile of General Demographic Characteristics, 2000.

Source: United States Department of Commerce 1990, 2000.

Table 3-30
Persons Below Poverty Level by Race in the Study Area Compared with the State of Nevada (1989)

Location[1]	White		Black		American Indian, Eskimo, or Aleut		Asian or Pacific Islander		Other Race		Total Population	
	Number Below Poverty Level[2]	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Pop.
Census Tract 9601[3]	3	5%	0		0		0		0		3	5%
Census Tract 9506[4]	0		0		0		0		0		0	
Census Tract 9507.02[5]	23	2%	0		0		0		0		23	2%
Census Tract 9516.01[6]	62	38%	0		0		4	100%	3	33%	69	30%
Eureka County	142	10%	2	50%	5	16%	0		8	215	157	15%
Elko County	1,963	7%	14	5%	614	30%	26	8%	472	25%	3,089	9%
State of Nevada	83,235	8%	17,262	22%	4,766	23%	3,843	10%	10,554	20%	119,660	10%

1. United States Department of Commerce, Bureau of the Census, 1990 United States Census, Summary Tape File 3A and 3C1 unless otherwise noted.
2. The average poverty threshold for a family of four persons was $12,674 in 1989. The poverty threshold is not adjusted for regional, state, or local variations in the cost of living.
3. Census Tract 9601 includes Eureka County north of I-80.
4. Census Tract 9506 includes part of Elko County north of the Project area.
5. Census Tract 9507, Block Group 2 includes part of Elko County northeast of the Project area.
6. Census Tract 9516, Block Group 1 includes a part of Elko County east of the Project area and north of I-80.

Source: United States Department of Commerce 1990.