5.0 TERRESTRIAL WILDLIFE

5.1 Affected Environment

5.1.1 Habitat

Representative species' lists and additional descriptions of terrestrial habitats associated with the cumulative assessment area and along the Humboldt River can be reviewed in a number of sources, including: the Betze Project Draft EIS; BLM (1992, 1993b, 1996a); Bradley (1992); Neel (1994); Bradley and Neel (1990); Rawlings and Neel (1989); JBR (1990b, 1992a,b,g); and Fox (1993).

5.1.1.1 Dewatering and Localized Water Management Area

These studies have documented a diversity of wildlife resources that occupy the native upland sagebrush habitat, limited riparian areas, and modified habitats (e.g., agricultural lands, reclaimed communities, seeded grassland, burned areas, mining zones). The vegetation types or communities that comprise the primary wildlife habitats in the cumulative assessment area include upland sagebrush, juniper ridgelines, seeded grassland, and limited riparian habitats. The riparian habitat associated with wetlands and perennial stream channels is considered the highest value habitat for area wildlife. Available water for wildlife consumption and riparian vegetation for cover, breeding, and foraging are the predominant limiting factors for wildlife resources in northern Nevada. Therefore, riparian habitats, particularly those with multistoried canopies and open (free) water, typically support a greater diversity and population density of wildlife than the drier, upland habitats.

Surface water sources potentially available to wildlife are described in Section 3.1.2. The riparian habitats range from the limited lower-elevational wetlands, stock ponds, or isolated springs that are primarily composed of small, narrow drainages or moist soils with scattered patches of emergent vegetation to the higher-elevational springs that maintain a greater-value riparian habitat for wildlife use (JBR 1990a,b, 1992a,b) (see Section 4.1, Riparian Vegetation). The higher elevations of the Tuscarora Mountains, Independence Mountains, and, to a lesser extent, the Sheep Creek Range and Adobe Range support a variety of species that differ substantially from those generally found at the lower elevational water sources in the surrounding basins. Important habitat characteristics for both aquatic and terrestrial wildlife include the amount of open water; the extent of both herbaceous and woody vegetation, which is used for cover, foraging, and breeding activities; the quality of these plant communities, relative to the long-term use by wildlife (i.e., community longevity); and the diversity of plant species present.

Recent wildfire events in northern Nevada have seriously affected the native ranges for wildlife. These wildfires have resulted in decreased plant diversity and abundance, affecting the overall carrying capacity of the habitats and the wildlife that depend on them. Currently, the BLM is implementing reclamation and reseeding programs in conjunction with adjacent private landowners in order to improve range conditions and minimize cheatgrass invasions.

5.1.1.2 Humboldt River Basin

The Humboldt River is located within the largest watershed in Nevada. Habitats vary along the river corridor, ranging among wide floodplains, agricultural hay meadows, developed pastures, native willow and wild rose stands, natural sloughs, a limited number of trees, and steep cliff walls that intersect directly with the river. The diversity of wildlife species associated with these varied habitats along the river corridor has generally depended on the past settlement patterns, man-induced channelization projects, and land uses. As human populations along the Basin have increased, vegetation modifications have resulted in associated changes to resident and migratory wildlife species. These activities have altered the overall landscape or the physical and biological character of the Humboldt system, thereby affecting the wildlife populations that depend on the floodplain and riparian habitats. General habitat trends recorded along the Humboldt River indicate that some portions of the system have maintained overall ecological health, while others have deteriorated or the habitat conditions are currently in a downward trend (Bradley 1992; Neel 1994).

As with many river systems throughout the arid western United States, the Humboldt River supports a variety of wildlife species, ranging among waterfowl, shorebirds, small to large mammals, raptors, amphibians, and reptiles. Approximately 52 percent of the bird species recorded for the Humboldt River system were associated exclusively with the riparian habitat type, while only 3 percent of species observed were affiliated exclusively with upland communities (Rawlings and Neel 1989).

The NDOW initiated a program in 1983 to assess wildlife habitat values along the Humboldt River system floodplains and to measure, where feasible, the effects to those habitat values from human-related activities (Bradley 1992; Neel 1994). NDOW's wildlife and habitat studies extend downstream to Rye Patch Reservoir. Few data exist for the portion of the Humboldt River downstream of Rye Patch Reservoir to the Humboldt Sink. Wildlife surveys were designed to determine overall species' occurrence and habitat preferences. These survey results are detailed in Bradley (1992), Neel (1994), and Bradley and Neel (1990) and are summarized in Rawlings and Neel (1989).

Habitats along the Humboldt River can be broadly categorized as riparian-wetland or upland habitat types. The riparian-wetland habitat includes the willow, rose, bulrush, cattail, meadow, and cottonwood communities, in addition to the river channel and on-channel ponds. The upland habitat includes the saltgrass, wildrye, greasewood-rabbitbrush, upland shrub, and annual weed communities. The buffaloberry community is classified in a third, separate category because of its unique properties, as discussed below (Rawlings and Neel 1989). The type and availability of these plant communities are primary factors in determining overall wildlife distribution along the Humboldt River (Rawlings and Neel 1989; Bradley 1992; Neel 1994).

The descriptions for the Humboldt River system focus on the riparian-wetland habitat type, since available water and the riparian-wetland vegetation (which provide cover, forage, and breeding areas) are limiting factors for both resident and migratory wildlife in Nevada.

Willow communities are considered one of the most valuable wildlife habitats. The greatest diversity of wildlife species along the Humboldt River has been recorded within the willow community, particularly for bird species (Rawlings and Neel 1989). Willows provide both vertical and horizontal structure for breeding sites, escape cover, and thermal cover and are important to maintaining bank stability. Willows aid in maintaining and building floodplains, since they are a primary pioneering species that can become established on stream deposits following flood events. The capability of either directing or absorbing floodwaters is important in maintaining quality wildlife habitat, and some sections of the Humboldt River and its tributaries have lost much of their ability to store floodwaters. If willows were removed or inhibited from establishing along the riverbank, stream deposits may remain unvegetated and inherently unstable (Bradley 1992). Willow stands often support a mid-story of rose and currant, with an understory of bulrush, cattail, rushes, sedges, and meadow grasses. Because of the available cover, willows provide primary wildlife movement corridors along the river system.

Cottonwood communities are scattered along the river corridor. This community provides additional canopy structure for avian species, particularly during the breeding season. In some locations along the Humboldt River, heron rookeries occur in cottonwood trees (Bradley 1992).

Another community that is valuable to wildlife is dominated by buffaloberry. The majority of buffaloberry within the project region occurs in portions of Humboldt and Pershing counties. Buffaloberry exhibits characteristics of both the riparian-wetland and upland habitat types, resembling more of a riparian-wetland type, but typically occupying drier portions of the floodplain that generally support more upland plant species. Buffaloberry stands provide additional vertical structure and often support high-value, mid- and understory species (e.g., wild rose, currant, and annual forbs), which supply a quality food source for wildlife (Neel 1994). A multi-storied buffaloberry stand also may approach the diversity of bird species recorded for the willow community (Rawlings and Neel 1989).

Subsequent to manipulations by humans for irrigation and livestock grazing, areas along the Humboldt River were converted to hay meadows. Vegetation composition within these meadows can vary, depending on soil moisture, ranging from wet meadows to drier, more upland areas. Wet hay meadows often provide marsh-like habitat, which generally receives more use from shorebirds, waterfowl, raptors, etc., than the drier meadows that are dominated by annual grasses found in the more upland sites. The wet meadows support the highest avian species diversity, second only to the willow community. These meadows provide critical foraging and nesting habitat for a number of species of waterfowl, shorebirds, passerines (i.e., songbirds), and raptors along the Humboldt River. Even higher species diversity has been recorded in wet meadow or buffaloberry communities interspersed with willow stands (Rawlings and Neel 1989).

As discussed in Section 3.1.3.2, the sinuosity of the Humboldt River varies dramatically from human-induced changes. A greater sinuosity typically equates to higher wildlife habitat values, species diversity (i.e., species richness or variety), biodiversity (i.e., a greater genetic diversity or variation relative to the structure and community composition), and species density (i.e., numbers of animals within an area).

Historically, wetland conditions were created by meander scars and old oxbows, which intersected with ground water and maintained open or available water for long periods of time. Currently, cattail, bulrush, and some willow stands are generally limited to the remaining meander scars and oxbows along the river channel. Ponded water in these areas provides important nesting, brooding, foraging, and resting habitat for other water-dependent species. Fish may become trapped during low-flow periods, providing increased prey availability for bird and mammal predators, such as mink, otter, great blue heron, bald eagle, etc. (Bradley 1992; Neel 1994).

The past changes to and channelization of the Humboldt River system that have occurred since settlement along the river corridor are described in Chapter 3.0 under Water Resources and Geochemistry. A net loss of 13.4 miles of river length has resulted, particularly in the Dunphy and Argenta areas, in addition to the river reach downstream of Winnemucca. The straightening of the river channel for the Humboldt Project, which was designed to deliver increased water flows to the Lovelock Valley for irrigation purposes, resulted in a reduction in channel sinuosity, thereby reducing the availability of wetland habitats, open water areas, and riparian vegetation typically associated with these habitat types. Further erosion also has resulted in increased channelization. As the floodplains are dewatered by increased channelization, vegetative changes occur, resulting in a loss of riparian vegetation; encroachment of drier, upland plants; and a greater propensity to flooding.

The Argenta Marsh was located near Battle Mountain. Historically, the marsh provided valuable habitat used by large numbers of migratory waterfowl, shorebirds, and passerines (Bradley 1998). In the 1950s, the Humboldt drainage was channelized to drain the marsh. The majority of the 2,600 acres of the bulrush community and an unknown amount of native hay and willow communities, which had been historically associated with the Argenta Marsh and Rock Creek, were lost during this channelization effort. The current habitat conditions of the marsh area and Rock Creek are more structured for upland wildlife species. Willow regeneration along Rock Creek is low to none from the willow eradication programs previously implemented along the channel, combined with the past and current livestock grazing pressure. These activities dramatically reduced the relative habitat value for wildlife species typically associated with the wetland communities along this river reach (Bradley 1992).

An area along the Humboldt River east, or upstream, of the Comus Gage near the Herrin Slough supports large stands of hardstem bulrush, dense willow stands, and sufficient woody and herbaceous understory plants to provide valuable cover, breeding sites, and forage for a wide diversity of wildlife species. The Herrin Slough is an area of braided, low-gradient channels in the Humboldt River floodplain. Many of the wildlife species associated with this area (e.g., great blue heron, snowy egret, gadwall, Wilson's phalarope, Virginia rail, yellow warbler, black-headed grosbeak, lazuli bunting) are indicative of a healthy community along the Humboldt River corridor (Neel 1994). Beaver, river otter, and mountain lion were recorded in this area in 1988. Mountain lions are rare along the Humboldt River because of the lack of adequate cover along a majority of the river corridor. This area upstream of the Comus Gage and northwest of Valmy likely represents one of the few river reaches capable of supporting a mountain lion for any extended period of time (Neel 1994).

Immediately downstream of the Comus Gage near Golconda, extensive bulrush-cattail communities support a high diversity of wildlife species. River channel meanders and oxbows are still present and dense willow stands occur along the river channel, contributing increased breeding sites, cover, and foraging potential for wildlife (Neel 1994).

Rye Patch Reservoir provides limited habitat value for terrestrial wildlife. Because of the water depth and limited amount of shoreline and shallow, littoral habitat, the reservoir mainly provides resting areas for waterfowl and some shorebirds and available water for a large variety of other species. The Pitt-Taylor Reservoirs, which hold additional storage for Rye Patch Reservoir, provide a greater habitat value for both resident and migratory wildlife. These smaller reservoirs are consistently more shallow than Rye Patch, maintain a greater amount of shallow-water shoreline habitat, and periodically dry out, thereby increasing plant productivity and food production for wildlife, particularly migratory waterfowl and shorebirds. Increased forage production is partly because of the shallow depths and the increased oxygenation from fluctuating water levels. In 1993-1994, the Pitt-Taylor Reservoirs supported approximately 800 pairs of white-faced ibis (Neel 1998).

The portion of the Humboldt River upstream of Lovelock provides some valuable habitat for wildlife resources; however, portions of this area have been compromised by tamarisk invasion. Increasing channelization and irrigation diversions for agricultural activities within the Lovelock Valley have reduced the amount of native wetland habitats for wildlife resources. Although substantial agricultural activities are ongoing in the Lovelock Valley, the river corridor and upland areas continue to provide habitat for both resident and migratory wildlife species. In addition to the riparian habitat along the river, the agricultural fields provide some forage and cover, depending on the season and environmental conditions. Fallow agricultural fields (from November to April) within the Lovelock Valley are often invaded by ground squirrels, which attracts large concentrations of migrating raptors (Neel 1994, 1998). Downstream of Lovelock, great blue heron rookeries containing up to 25 nests have been documented (Neel 1998). Other areas along the river downstream of Lovelock support dense stands of willow; however, the incidence of this plant community is less than that observed upstream of Lovelock.

5.1.1.3 Humboldt Sink and Carson Sink

The Humboldt Sink is the closed-basin terminus of the Humboldt River. The Humboldt WMA, covering 36,235 acres, is located in the Humboldt Sink directly north of the Fallon National Wildlife Refuge and approximately 20 miles north of the Stillwater WMA. The Humboldt WMA was established in 1954 as a primary feeding, nesting, and resting area for migratory birds associated with the Pacific Flyway. It is considered one of the most important wildlife habitats in Nevada and is currently managed by the NDOW.

The Humboldt WMA encompasses three wetland units, including Toulon Lake and both the upper and lower portions of Humboldt Lake (see Figure 3-12). Birds typically move among all of these sites (Seiler et al. 1993). Species diversity recorded at the Humboldt WMA parallels that documented within the Lahontan Valley, which supports over 200 bird species, most of these species being migratory (Seiler and Tuttle 1997).

The wetlands systems associated with the Humboldt Sink are generally characterized by wet and dry cycles and vary in size and depth on an annual basis. In 1990, the wetland surface area averaged 12,850 acres. The most common vegetation recorded for the Humboldt Sink wetlands include alkali bulrush, cattails, sago pondweed, and muskgrass (Seiler et al. 1993).

The Humboldt Sink is of greater value for wildlife resources than the Carson Sink. The Carson Sink is considered to be of marginal value for waterfowl because of the lack of adequate foraging opportunities and high salinity levels in this basin (Saake 1998). Water flow from the Humboldt Sink south into the Carson Sink only occurs during high-flow years (e.g., operational releases, increased precipitation). During these high-water events, the increased flow into the Humboldt WMA flushes the wetlands systems, removing accumulated salts. Water flushed from the Humboldt Sink moves south into the Carson Sink. The water in this closed basin ultimately evaporates, concentrating the dissolved water constituents (e.g., salts, metals) over time (Seiler et al. 1993). Constituents tied to the soils may be subsequently removed from the area by wind action across the Carson Sink (and dry portions of the Humboldt Sink), dispersing them across a large area located predominantly to the east of the basin areas (Saake 1998). The quantity of constituents removed by wind erosion is not well documented in the sink. However, in other regions, wind removal has been found to account for up to several million tons a year of material (Feshbach and Friendly 1992).

5.1.2 Game Species

5.1.2.1 Big Game Species

Mule deer are the most prominent big game species in northern Nevada. The Management Area 6 deer herd that occupies the cumulative assessment area experienced population declines in the past, particularly during the 1992-93 winter season (NDOW 1996a). Mule deer winter and transitional ranges have been affected by wildfires in the project region (Lamp 1999; BLM 2000a). Winter range is considered to be the most limiting factor for the deer population (BLM 1992). However, the herd has been increasing in recent years. This population increase is partly attributed to mild winter seasons and successful rehabilitation of a portion of the winter range, resulting in increased fawn survival rates (Lamp 1999; BLM 2000a).

Seasonal ranges and movement corridors for mule deer that have been documented by NDOW for the area (JBR 1995a; BLM 1992, 1993b, 1996a; NDOW 1998a) are shown on Figure 5-1. These areas of use include deer winter range, summer range to the north, intermediate (transitional) range, and the migration or movement corridors between these seasonal ranges (NDOW 1998a). The importance and use of these ranges in any one year to the mule deer herd typically depends on such variables as snow depth, forage availability, cover, and weather patterns. The Sheep Creek Range and the Tuscarora Range to the west and east of Boulder Valley, respectively, provide important regional migration corridors for deer. The specific range designations by NDOW and BLM, levels of use, and movement patterns, are described in more detail in JBR (1995a), BLM (1992, 1993b), NDOW (1993a), and the State’s annual Herd Composition Survey Narrative, available through NDOW.

Mule deer movements in the transitional habitats of the Tuscarora Mountains along the eastern boundary of Boulder Valley have shifted within the last 11 years. Prior to 1987, deer used both the east and west sides of the range to move south into winter range from summer range located to the north. Since 1987, the majority of deer movement has shifted to the east flank of the mountains along a portion of their route. Although area wildfires have reduced the overall quality of the mule deer habitat along the west side of the Tuscaroras (BLM 1992, 1993b; NDOW 1993a), NDOW primarily attributes the shift in the migratory pattern to mine development along the Carlin Trend (NDOW 1993a).

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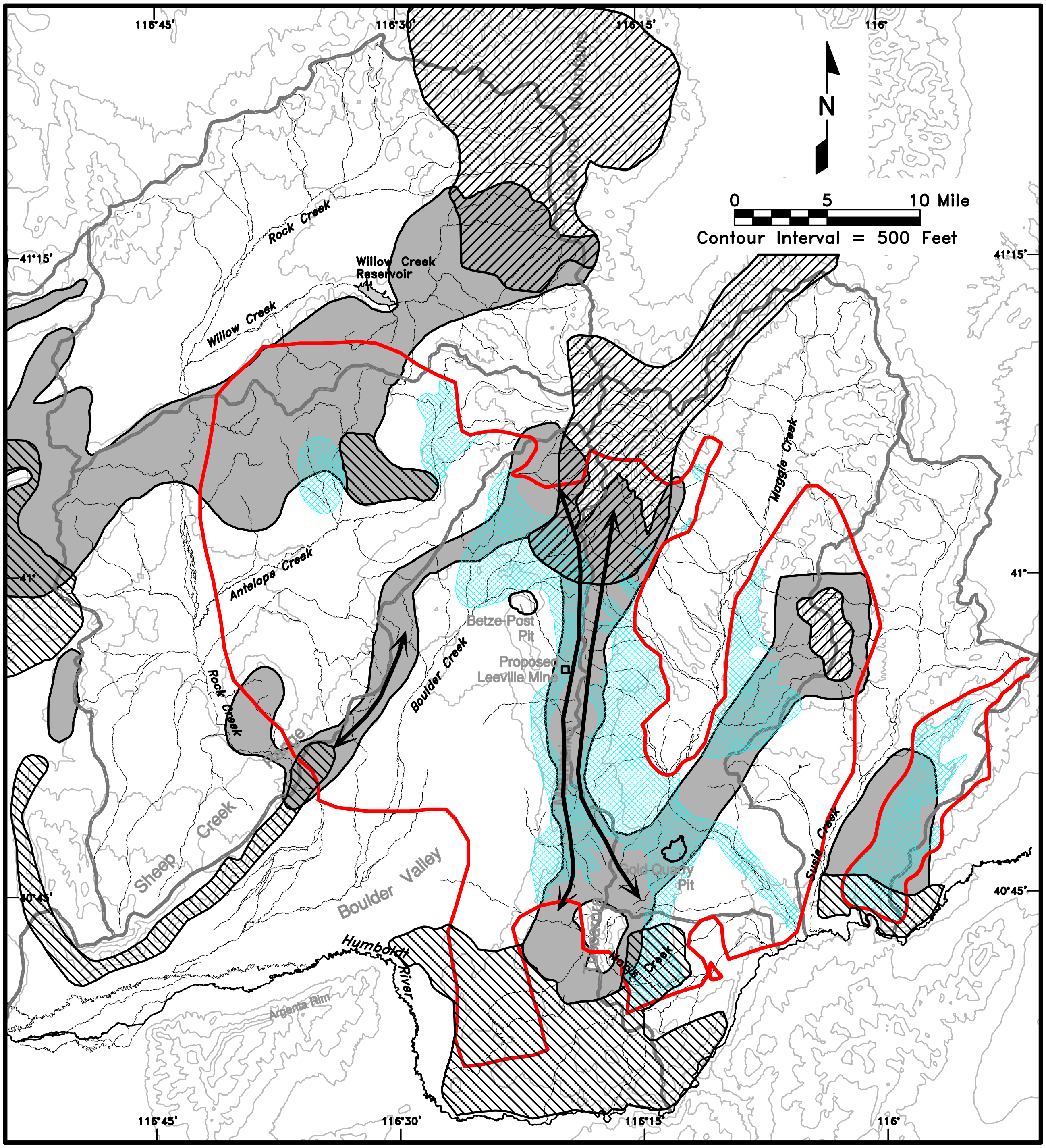

Legend

- Ground Water Basin Boundary
- Stream
- Cumulative Drawdown Area (≥10 Feet of Drawdown)
- Migration Corridors
- Summer Range
- Transitional Range
- Winter Range
- Areas where Perennial Waters could Potentially be Impacted by Drawdown[1]
- Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[1]

[1] Does not include potential impacts to perennial waters located outside the cumulative 10-foot drawdown contour.

Figure 5-1

Mule Deer Designated Seasonal Ranges

Transitional range provides valuable habitat for mule deer between their summer and winter ranges. In years with limited or late snow accumulation, the deer remain on the transitional range until snow depths force them into their winter ranges. The longer the deer remain on these transitional ranges, feeding on higher quality forage, the better condition they are in when they move to the lower quality winter range. In addition, the delay in animals arriving on the winter ranges also reduces the amount of pressure on this winter habitat (NDOW 1993a; BLM 1993b, 1996a).

Mountain lion also is a big game species. The relative presence or absence of lions within the cumulative assessment area is generally regulated by distribution of the mule deer population.

Pronghorn occur throughout the cumulative assessment area (JBR 1995a; BLM 1993b), but have only been recorded in any concentrations since the mid-1980s (BLM 1992; JBR 1995a). The northern portion of Boulder Valley is classified as pronghorn winter range, summer, and transitional ranges (Figure 5-2) (NDOW 1998a; BLM 1993b). The recently developed agricultural fields (i.e., alfalfa) also may be used by pronghorn to a limited extent (JBR 1995a). Increased fawn survival combined with recent mild winters have contributed to an upward trend in the population numbers; however, the limiting factor for resident pronghorn is available winter range (BLM 2000a). The distribution of pronghorn within the cumulative assessment area is dynamic, changing annually, partly because of the effects from wildfires, wildfire rehabilitation, and the increased agricultural uses of Boulder Valley.

California bighorn sheep occur within the region. As depicted on Figure 5-3, a small population of bighorn predominantly occupy portions of the Sheep Creek Range to the west of Boulder Valley (NDOW 1998a).

5.1.2.2 Upland Game Birds

Upland game birds identified in the cumulative assessment area include sage grouse, chukar, gray (Hungarian) partridge, mourning dove, wild turkey, California quail, and ring-necked pheasant (BLM 1993b; JBR 1989, 1990a,b, 1992a; Neel 1994; Teske 1999). Sage grouse are considered a BLM-sensitive species, and are presented in Section 7.1.1.10. Chukar are typically associated with more rugged slopes, canyons, and drainages in fair proximity to open water. The gray (Hungarian) partridge is considered widespread but not common and is associated with grasslands, shrublands, and agricultural areas. Mourning doves are more commonly found near water sources, generally nesting in shrubs and trees (Terres 1991). The NDOW released about 44 wild turkeys near Beowawe in 1997 and approximately 25 birds on the TS Ranch in 1999 (Teske 1999). The current distribution of these birds is unknown, but it is assumed that some individuals currently occupy suitable habitat (e.g., woodland areas). California quail previously occurred along the Humboldt River, but the past declines in habitats used for cover have resulted in a reduction in distribution and population numbers (Teske 1999).

5.1.2.3 Waterfowl

Other game species identified for the cumulative assessment area include a number of waterfowl species associated with the Pacific Flyway. Historically, waterfowl numbers were not high in the Little Boulder Basin (e.g., larger spring complexes, Willow Creek Reservoir, perennial streams); however, the incidence of use

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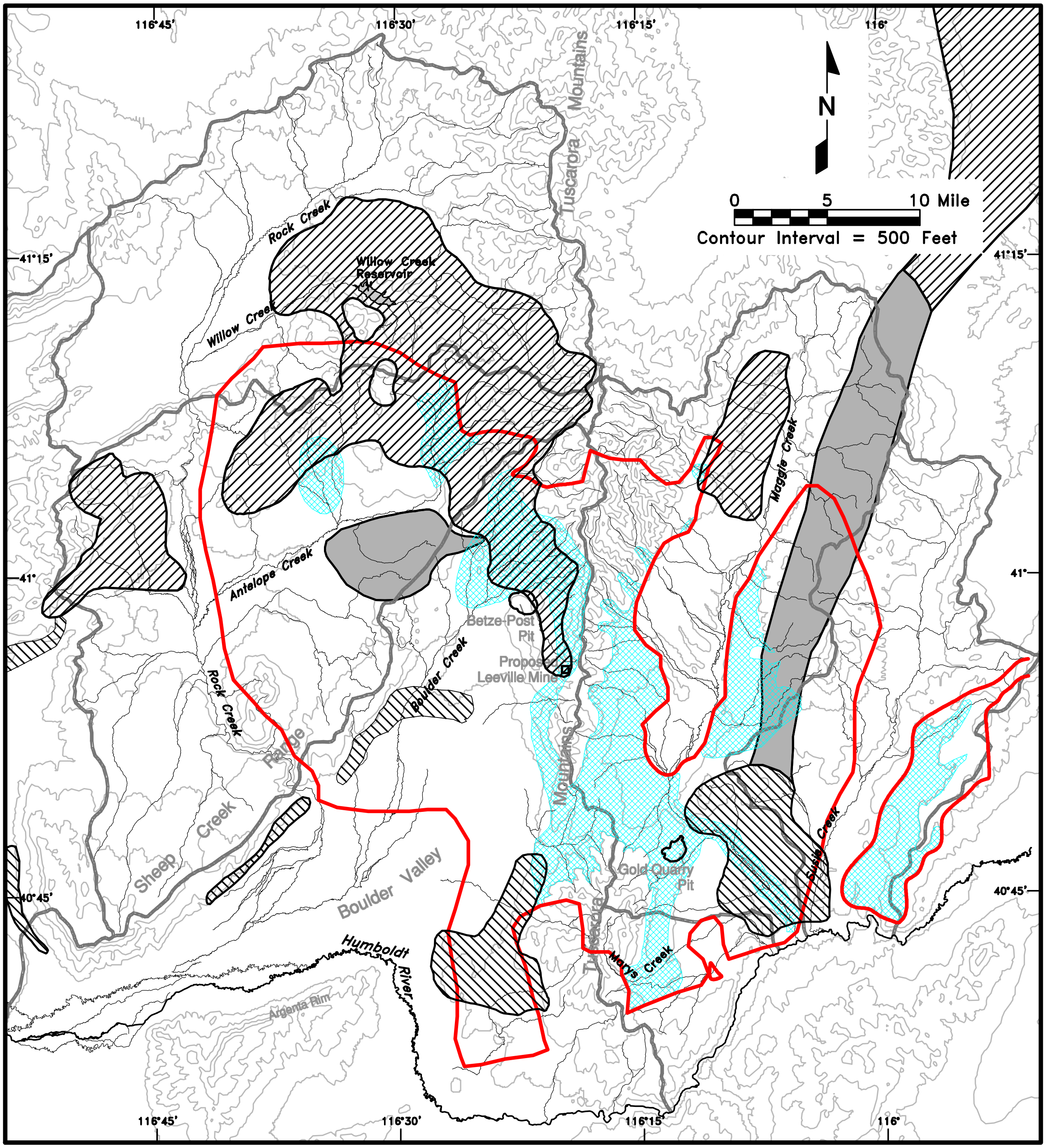

Legend

- Ground Water Basin Boundary
- Stream
- Cumulative Drawdown Area (≥10 Feet of Drawdown)
- Summer Range
- Transitional Range
- Winter Range
- Yearlong Range
- Areas where Perennial Waters could Potentially be Impacted by Drawdown[1]
- Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[1]

[1] Does not include potential impacts to perennial waters located outside the cumulative 10-foot drawdown contour.

Figure 5-2

Pronghorn Designated Seasonal Ranges

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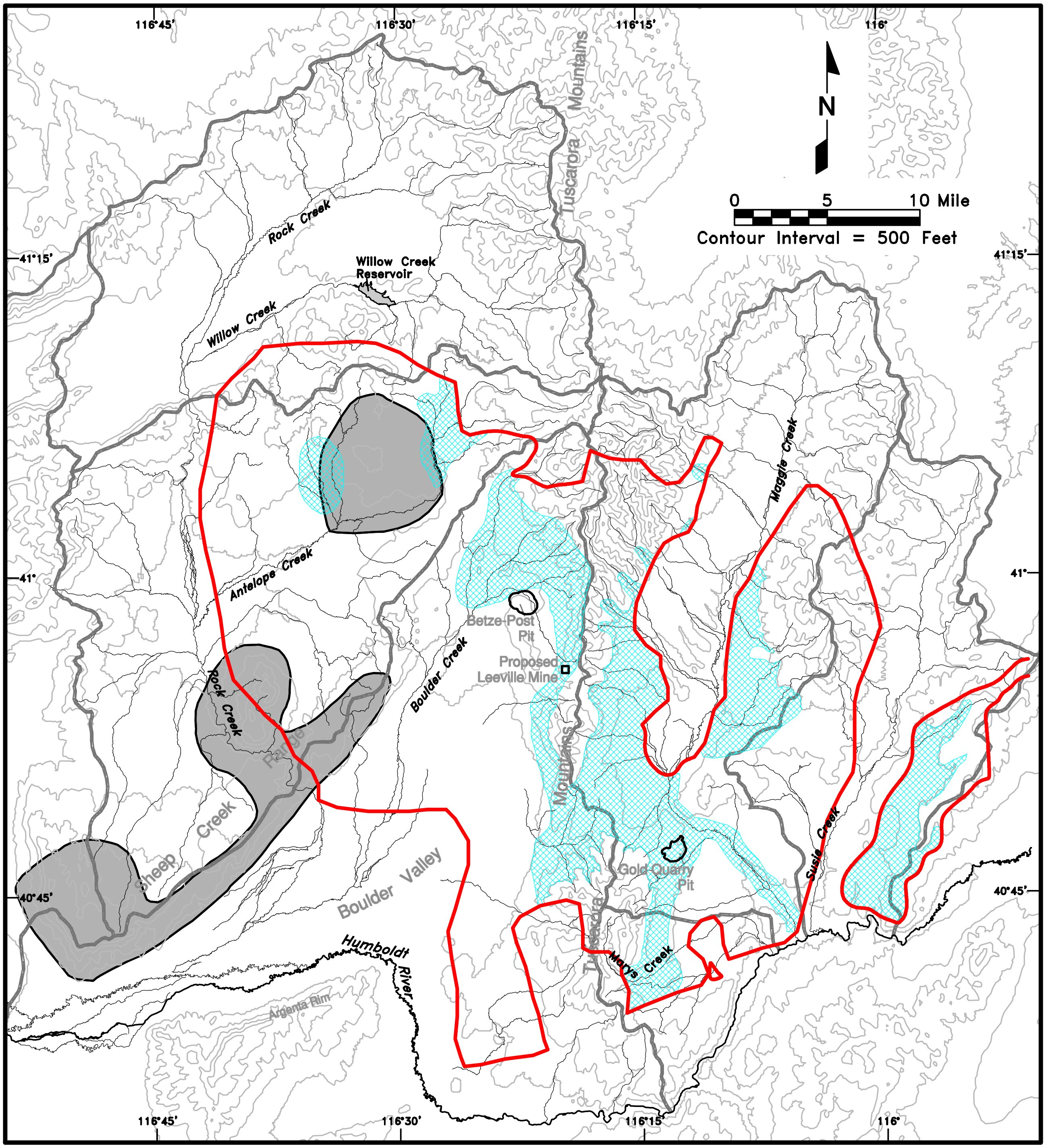

Legend

Ground Water Basin Boundary

Stream

Cumulative Drawdown Area (≥10 Feet of Drawdown)

Yearlong Range

Areas where Perennial Waters could Potentially be Impacted by Drawdown[1]

Areas where Perennial Waters have a Low Probability of Being Impacted by Drawdown[1]

[1] Does not include potential impacts to perennial waters located outside the cumulative 10-foot drawdown contour.

Figure 5-3

Bighorn Sheep Designated Range

and number of birds have increased during the last decade. This increase was attributed to TS Ranch Reservoir and mounding of ground water resulting in the formation and expansion of Green, Sand Dune, and Knob springs (see Figure 3-1). Increased surface water availability and increased emergent and submergent vegetation in Boulder Valley have provided additional foraging, cover, resting, and breeding habitats for bird species, particularly waterfowl and shorebirds.

To record relative levels of avian use in Boulder Valley resulting from the increased water availability, three aerial surveys were conducted in 1995 (ENSR 1995) that focused on TS Ranch Reservoir and the three springs. Bird surveys were conducted during February, April, and August by helicopter and subsequently confirmed by ground visits. These surveys recorded a number of species of waterfowl and shorebirds using these areas. Common waterfowl observed included American coot, green-winged teal, blue-winged teal, mallard, gadwall, ruddy duck, redhead, and eared grebe. Shorebirds are discussed below for nongame species. Bird counts totaled 2,395, 2,422, and 1,815 for February, April, and August, respectively. After 1995, the number and diversity of birds declined as surface water at TS Ranch Reservoir and the springs was reduced (see Section 3.2.3.1 and Chapter 4.0, Riparian Vegetation).

In 1999, water discharges into the reservoir resumed; however, during the first quarter of 1999, spring flows were approximately 25 percent of the levels measured in 1995 (Barrick 1999a). It is assumed that the number of waterfowl using these habitats within Boulder Valley fluctuates according to changing water levels. Waterfowl use in the remainder of the cumulative assessment area is restricted to available surface water (e.g., Willow Creek Reservoir, perennial drainages, isolated springs), which is relatively limited.

Waterfowl use along the Humboldt River has been recorded annually by NDOW (Saake 1998), in addition to a number of studies completed by JBR (1992b); Bradley (1992); Bradley and Neel (1990); and Neel (1994). Historically, wetland habitats along the Humboldt River that are located upstream of Battle Mountain provided high quality forage for migrating ducks and important migrational use areas have been documented along the river. One of the four largest canvasback migration corridors in the United States occurs along the Humboldt River (Bradley 1992).

NDOW has collected waterfowl data for the Humboldt River, Humboldt WMA, Stillwater WMA, and Carson Lake over the last 30 years (Saake 1998). Table E-1 in Appendix E summarizes results from the annual duck breeding pair surveys conducted in Region 1 between 1959 and 1998. The average number of breeding pairs of ducks recorded along the Humboldt River ranged between 154 pairs and 365 pairs, with a 30-year average of 266 pairs observed annually along the river corridor. The Humboldt WMA generally supports a greater number of breeding waterfowl than is recorded along the river. From 1959 to 1998, the average number of breeding duck pairs recorded annually for the Humboldt WMA ranged from 161 to 472, with the highest number of duck pairs being 1,049 recorded in 1977. The average annual number of breeding pairs of ducks in the Stillwater WMA and Carson Lake totaled 1,760 pairs and 1,059 pairs, respectively (Saake 1998).

The average annual waterfowl counts for the Humboldt WMA, Stillwater WMA, and Carson Lake are summarized in Table E-2 in Appendix E. The mean number of waterfowl recorded annually between August 15 and January 30 at the Humboldt WMA, Stillwater WMA, and Carson Lake from 1968 to 1997 totaled 2,232,000; 7,723,000; and 4,428,000 individuals, respectively (Saake 1998). Table E-3 in Appendix E summarizes the average number of waterfowl species recorded for the Humboldt WMA between August 15 and January 30 from 1969 to 1998 (Saake 1998). Assuming an even seasonal distribution, the average yearlong numbers also are shown to represent the annual estimate of use of the Humboldt WMA area by waterfowl. This table also depicts the high number of birds recorded for each species during this 30-year period.

The Humboldt WMA provides valuable breeding, foraging, molting, and resting habitats for waterfowl associated with the Pacific Flyway. These data collected over the last three decades (Saake 1998) aid in characterizing the use of these basin systems by waterfowl and shorebird species. In addition to the species listed in Table E-3, American coots, double-crested cormorants, western and/or Clark's grebes, and American white pelicans also have been documented using the Humboldt WMA (USFWS 1999).

In addition to migrants using these wetland areas along the north-south axis of the Flyway, the wetland systems provide a critical staging area for migratory birds as they move from the Great Salt Lake in Utah west to the Sacramento Valley of California. The terminal wetlands provide resources for birds with depleted energy levels, optimizing the foraging and resting opportunities in the Humboldt and Carson Sinks prior to crossing the Sierra Mountain Range located to the west of the basin (Saake 1998).

Seiler et al. (1993) identified possible indicators of habitat degradation at the Humboldt WMA. These indicators included 1) increased bird mortalities from epizootics that generally affect migratory birds; 2) a decline in native emergent species and an increase in exotic plant species (e.g., tamarisk); 3) a decline in submergent vegetation in upper Humboldt Lake, resulting in less sago pondweed (a good forage plant) and an increase in more salt-tolerant species (e.g., muskgrass); and 4) a reduction in species diversity within the wetlands for both vertebrates and invertebrates.

5.1.2.4 Furbearers

The beaver, an important species for riparian systems, occurs along the Humboldt River. Historically, beaver have been responsible for channel modifications from their dam building activities (Bradley 1992). Another important furbearer along the Humboldt River is the river otter, which is closely associated with the willow community. A limiting factor for otter along the Humboldt River appears to be den-site availability (Neel 1994). Mink and muskrat have been reported along the river corridor (JBR 1992b). Bobcats also occur sporadically along the Humboldt River. Bobcats have been confirmed near the Comus Gage along the river (Neel 1994), indicating a higher quality habitat that can support both the bobcat and its prey species.

5.1.3 Nongame Species

A number of nongame wildlife species (e.g., raptors, passerines, small mammals) are commonly associated with the habitats within the cumulative assessment area. Passerines (songbirds) are numerous and use the entire range of the native habitats (e.g., sagebrush, riparian, grassland, shrubland, wooded uplands) and man-made features (agricultural lands, bridges, abandoned buildings) within the region. The open, arid terrain supports large and varied populations of small mammals that comprise the prey base for the region's mammalian predators and raptor species.

5.1.3.1 Raptors

Area raptor species include the more common buteos (e.g., red-tailed hawk, ferruginous hawk), accipiters (e.g., sharp-shinned hawk, Cooper's hawk), eagles (e.g., wintering bald eagles, nesting golden eagles), falcons (e.g., prairie falcon, American kestrel), the northern harrier, the turkey vulture, and owl species (e.g., short-eared owl, great-horned owl, long-eared owl) (BLM 1993b, 1996a; Herron et al. 1985; JBR 1992a, 1995b, 1996a). In addition to these raptors, the rough-legged hawk is a winter resident in northern Nevada (Herron et al. 1985), and the peregrine falcon may forage along the riparian corridors (e.g., Humboldt River). This falcon also has been documented near the Humboldt Sink (Seiler et al. 1993; Seiler and Tuttle 1997).

A number of raptors have been reported in and around the cumulative assessment area. Species observed include the golden eagle, red-tailed hawk, ferruginous hawk, prairie falcon, northern harrier, burrowing owl, and short-eared owl. Based on the size and diversity of the cumulative assessment area, the overall raptor use spans a number of vegetative communities, geological features, and variable terrain between the basins and ranges of northern Nevada. Several raptor species are both residents and migrants in the cumulative assessment area and may nest, forage, or winter throughout the diverse communities that occur along the Carlin Trend and the Humboldt River downstream to the Humboldt Sink. General raptor species are addressed in this chapter, relative to their habitat associations and foraging preferences. Raptors that are considered special status species by the BLM are discussed in Chapter 7.0 of this cumulative report.

Although a number of raptor nests have been recorded within the cumulative assessment area, including the Humboldt River system, the location of these nest sites are not delineated in this document, in order to protect the sites and their inhabitants. These nesting records are important, since they document presence, historical distributions, and suitable breeding habitats. However, since raptors often maintain alternative nest sites within their respective breeding territories or they may establish new nests in previously unoccupied habitats, these historical records are used as references only, and it is assumed that breeding pairs may occupy any potentially suitable nesting area within the cumulative assessment area.

5.1.3.2 Shorebirds

As discussed for waterfowl, shorebird occurrences within the cumulative assessment area are directly correlated with the availability and amount of surface water resources. In 1995, shorebird use was considered high in the Little Boulder Basin, when additional surface water was available at the TS Ranch Reservoir, at the springs, and along the irrigation ditch located south of the springs. Common shorebirds recorded during the aerial surveys of Boulder Valley included the black-necked stilt, American avocet, Wilson's phalarope, and killdeer. White-faced ibis also were recorded (ENSR 1995) and are discussed further in Chapter 7.0, Threatened, Endangered, Candidate, and Sensitive Species. Subsequent to the surveys, water levels in TS Ranch Reservoir were reduced. This reduction in surface water availability and, therefore, the riparian community in Boulder Valley, reduced the amount of suitable habitat for resident and migratory shorebird species. The decline in suitable habitat at TS Ranch Reservoir, at the three Boulder

Valley springs (i.e., Knob, Green, and Sand Dune), and along the irrigation canal south of the springs reduced shorebird numbers in the valley, as these wetland areas reverted back into more upland communities. As discussed previously, water levels in the reservoir have increased, and measured spring flows in the first quarter of 1999 were approximately 25 percent of the 1995 levels (Barrick 1999a). It is assumed that future shorebird use would correlate with water availability in this valley, as well in the surrounding cumulative assessment area.

A large number and diversity of shorebirds are associated with the Humboldt River and the Humboldt Sink. Several documents summarize shorebird species recorded along the river corridor and at the Humboldt WMA (e.g., great blue heron, black-crowned night-heron, killdeer, spotted sandpiper, American avocet, black-necked stilt, double-crested cormorant, western grebe, Clark's grebe, American white pelican) (JBR 1992b; Bradley 1992; Bradley and Neel 1990; Neel 1994; USFWS 1999). Unique or uncommon species reported along the river include the long-billed curlew, greater sandhill crane, snowy egret, great egret, Virginia rail, white-faced ibis, and black tern. Additional unique shorebird species identified farther downstream include the American bittern, a secretive heron that is typically associated with bulrush-cattail marshes, and the American white pelican, recorded directly upstream of Rye Patch Reservoir. During the 1988 NDOW surveys, one sighting of an American bittern was made downstream of the Lander-Humboldt County line (Neel 1994). Discussions for the American white pelican, white-faced ibis, and black tern are presented in Chapter 7.0, Threatened, Endangered, Candidate, and Sensitive Species.

The long-billed curlew is a large shorebird species that has been declining within the Great Basin. In Nevada, this shorebird is often associated with grazed meadows and wetland pastures. Along the Humboldt River, this species is often recorded feeding in irrigated hay meadows (Neel 1994). In 1987, curlew nesting was confirmed along the Humboldt River in Lander County, and birds were observed near Battle Mountain during the breeding season (Bradley 1992). In 1988, this bird was observed during the breeding season near the Comus Gage (Neel 1994).

In 1987, greater sandhill cranes were observed along the Humboldt River near Battle Mountain in Lander County during the breeding season (Bradley 1992). Snowy egrets have been recorded along the Humboldt River (Bradley and Neel 1990; Bradley 1992; JBR 1992b; Neel 1994). After near extirpation at the turn of the century, egret populations have recovered. Sightings have been recorded upstream of the Comus Gage (Bradley 1992; Bradley and Neel 1990; JBR 1992b) and near the town of Winnemucca downstream of the Comus Gage (Neel 1994). Great egrets also were recorded by the NDOW in 1988 near Golconda and farther downstream near Winnemucca (Neel 1994). Egret species found along the Humboldt River are often closely associated with the hardstem bulrush community, which has been decreasing along the river corridor (Neel 1994).

In 1988, a juvenile Virginia rail was documented along the Humboldt River near the Herrin Slough. This sighting coincided with the presence of significant stands of hardstem bulrush along the river. This shorebird species also was documented in 1988 farther downstream near Winnemucca (Neel 1994).

5.1.3.3 Songbirds

A variety of songbirds occupy a wide range of habitat types in northern Nevada. As discussed above, the riparian-wetland community primarily associated with naturally occurring springs within the cumulative assessment area, the Humboldt River, and the Humboldt Sink supports a greater diversity of species than the surrounding upland communities. The BLM Elko Field Office estimates that approximately 75 percent of the songbirds (185 species) identified for the Field Office area either directly depend on riparian habitats or utilize them to a greater extent than adjacent upland communities. Bradley (1992), Neel (1994), Bradley and Neel (1990), Rawlings and Neel (1989), and JBR (1990b, 1992a,b,g) contain species lists of representative songbirds recorded for the study area and Humboldt River System.

Three uncommon avian species that are closely associated with the habitat types in this system include the yellow-breasted chat, marsh wren, and loggerhead shrike. The chat is considered an indicator species of the relative health and availability of riparian habitat types along the Humboldt River and has been identified as one riparian-associated species that would most likely decline with the removal of riparian vegetation (Sedgwick and Knopf 1987). In 1987 and 1988, yellow-breasted chats were documented during NDOW's Humboldt River studies near Battle Mountain in Lander County (Bradley 1992; Bradley and Neel 1990) and near the Herrin Slough and Golconda in Humboldt County (Neel 1994). The marsh wren also is considered an indicator species, but more for the hardstem bulrush and cattail communities, which are becoming more uncommon in Nevada. This wren species was documented by NDOW along the Humboldt River in 1988 near Battle Mountain in Lander County (Bradley and Neel 1990). Loggerhead shrike populations are reported to be in decline in portions of their range. This bird species was reported by the NDOW in 1988 along the Humboldt River west of Battle Mountain in Humboldt County (Neel 1994).

Other important avian species indicative of high quality riparian habitats (e.g., dense willow, rose thickets) and recorded during NDOW's surveys included the yellow warbler, common yellowthroat, black-headed grosbeak, blue grosbeak, lazuli bunting, and house wren (Neel 1994).

5.1.3.4 Mammals

Numerous nongame mammal species occur throughout the cumulative assessment area, occupying a variety of habitat types and elevations. Representative nongame species that inhabit the sagebrush, juniper woodland, grassland, and riparian communities within the cumulative assessment area include the raccoon, badger, porcupine, skunk, coyote, black-tailed jackrabbit, and a variety of rodent and bat species.

One group of nongame species of concern includes resident and migratory bat species. Bat hibernacula, nursery colonies, and individual roost sites likely occur throughout the cumulative assessment area. Bat surveys were conducted in 1995 and 1996 along selected riparian habitats (e.g., streams, wetlands, stock ponds, riparian corridors) located in Boulder Valley (Ports 1995, 1996). These surveys focused on the potential presence of certain bat species and their use of riparian areas. Surveys also were conducted east of the Tuscarora Mountains (BLM 1993b, 1996a). Bat species documented during these surveys from trapping activities and echolocation recordings included the small-footed myotis, long-eared myotis, western pipistrelle, big brown bat, and Townsend's big-eared bat. Three bat species documented in the

Independence Mountains include the long-legged myotis, long-eared myotis, and small-footed myotis (BLM 1996a). Additional bat species likely to occur within the region include the pallid bat and possibly the silver-haired bat, based on range, distribution, and previous trapping studies (Ports 1995; Ports and Bradley 1996). Additional sensitive bat species are discussed further in Chapter 7.0, Threatened, Endangered, Candidate, and Sensitive Species.

5.1.3.5 Amphibians and Reptiles

Amphibians and reptiles in the region are limited because of the cool, dry climate (BLM 1993b). Amphibians are generally associated with aquatic habitats; reptiles occupy drier upland habitats but use the mesic riparian habitats for foraging. The majority of the reptiles and amphibians recorded for the cumulative assessment area are considered to be common (BLM 1993b), except for the Columbian spotted frog, which is discussed further in Chapter 7.0, Threatened, Endangered, Candidate, and Sensitive Species.

5.2 Impacts from Mine Dewatering and Localized Water Management Activities

This section (5.2) focuses on the potential long-term impacts to terrestrial wildlife species from the cumulative drawdown of ground water and the potential for indirect effects to species from reduced surface water availability and a decrease in associated riparian and wetland communities. The short- and long-term effects from mine water discharges into the Humboldt River and ultimately the Humboldt Sink are addressed in Section 5.3 of this cumulative report.

As discussed in Section 3.2.4, a reduction in the ground water levels from mine-induced drawdown could potentially reduce the surface water availability in certain perennial reaches of area streams and naturally occurring springs and seeps, and reduce the associated riparian/wetland habitats of these sources that are associated with the regional ground water system.

For the cumulative ground water analysis, the results from the ground water modeling scenarios were combined to illustrate the maximum extent of the 10-foot drawdown. The sources of perennial surface water that may be affected by the cumulative dewatering activities are depicted in the shaded portions of Figure 3-15. As discussed in Section 3.2.4.1, it is possible that some springs and other perennial water sources located outside of the 10-foot drawdown contour but within the regional hydrologic study area also could experience changes in flows from ground water drawdown.

Relative to wildlife resources, the following habitat information focuses on potential short- and long-term effects to surface water sources, their associated vegetation, and possible use by both resident and migratory wildlife species. As summarized in Section 3.2.4.2, a total of 537 springs and seeps are located within the predicted cumulative 10-foot drawdown area shown on Figure 3-15. Of these 537 springs and seeps, approximately 182 are located in areas where perennial surface waters could potentially be impacted by drawdown (i.e., shaded areas of Figure 3-15). Of these 182 naturally occurring springs and seeps, 60 are isolated water sources and 122 are directly associated with riparian drainages.

5.2.1 Habitat

The potential loss or reduction in available surface water could result in long-term changes in wildlife habitats throughout the cumulative assessment area. The habitats associated with naturally occurring springs, seeps, and perennial stream reaches encompass riparian vegetation (both woody and herbaceous plant species), wetland areas (emergents and palustrine), and mesic habitats (moist areas or wet meadows not classified as delineated wetlands that transition into the drier upland communities). Estimates of riparian vegetation that could be affected by cumulative ground water drawdown are discussed in Section 4.2. Assuming approximately 0.3 acre of riparian or wetland vegetation for each of the estimated 60 isolated seeps and springs, there are an estimated 18 acres of riparian habitats within the shaded areas in Figure 3-15. Some reduction of this habitat could occur due to cumulative drawdown. In addition to these 60 isolated spring sites, there are an estimated 600 acres of riparian habitat associated with perennial reaches of streams and with springs and seeps (approximately 122 along these perennial reaches). Ground water drawdown also could reduce the amount of riparian habitat along these stream corridors.

Some impacts or loss of riparian habitats could occur during both the mining and postmining periods. Reduction in subsurface flow could result in effects ranging from decreased plant vigor to the total loss of riparian vegetation cover, depending on a number of hydrological and geological factors (Poff et al. 1997; Scott et al. 1999; Richter et al. 1997). Reduction or loss of riparian habitats associated with these perennial sources would impact terrestrial wildlife dependent on these sources, resulting in a possible reduction or loss of cover, breeding sites, foraging areas, and changes in both plant and animal community structure, as discussed below.

Model simulated reductions in baseflows at selected locations along specific perennial drainages are discussed in Section 3.2.4. If the simulated reductions in baseflow in Boulder Creek, lower Rock Creek, Marys Creek, upper and lower Maggie Creek, and lower Susie Creek occur, this would result in an incremental reduction in water availability and riparian habitat in the long term. These drainages would continue to support wildlife use, albeit to a lesser degree than current levels. The actual areal extent and magnitude of impacts to perennial waters are uncertain (see Section 3.2.4.2). The following impact analysis for wildlife resources describes potential short- and long-term effects, based on the assumptions used in the ground water and surface water analyses.

Naturally occurring seeps, springs, and perennial drainages provide important wildlife habitat not otherwise available in the cumulative assessment area. The riparian habitat type and its associated plant communities contribute to a higher wildlife species diversity, compared to the adjacent upland areas. Since surface water and the associated riparian habitat are limiting factors for wildlife in Nevada, the loss of these habitat features would alter the available habitat for species that depend on these riparian areas, resulting in 1) a reduction of available water for consumption; 2) a reduction in riparian vegetation for breeding, foraging, and cover; 3) possible increases in water temperature in declining water sources; 4) a reduction in the overall biological diversity; and 5) a possible long-term impact to the population numbers of some species. The degree of impacts to wildlife resources would depend on a number of variables, such as the existing habitat values and level of use; species' sensitivity (i.e., level of dependency on riparian areas); and the extent of the anticipated water and riparian habitat reductions.

In the event that perennial flows were reduced, the riparian vegetation would likely decrease, reducing the vegetative structure, composition, and diversity. As surface water decreased, herbaceous riparian obligates would be the first to be affected. Continual ground water reduction would result in increasing stresses on riparian-dependent plants, particularly during the late summer and early fall periods. The reduction in ground water levels beneath these perennial water sources would ultimately affect the maintenance and regeneration of woody shrubs and trees, if the ground water levels were to fall below root systems of these plants that are in contact with ground water levels (Scott et al. 1999; Poff et al. 1997; Richter et al. 1997).

Loss or reduction of perennial water sources and associated riparian habitats would reduce the regional carrying capacity for terrestrial wildlife (i.e., the region located within the cumulative drawdown area would support a lower diversity and reduced number of riparian-dependent wildlife species). Animals that use perennial water sources would be displaced as the available water and riparian plants declined.

NDOW assumes that these limited riparian communities are currently at carrying capacity. In other words, the riparian habitat types that typically occur within a desert system support the greatest number of species that is feasible, given the finite resources associated with these communities. Individuals that are displaced may move into adjacent areas, but it is assumed that these adjacent habitat types are already at their full carrying capacity and would not support additional animals. Therefore, these displaced individuals would be lost from the population, concentrating the remaining animals within smaller habitat areas.

Some springs could support genetically isolated populations; therefore, a reduction or loss of springs could result in a loss of genetic diversity and localized populations within the affected area. Possible genetic loss would be limited to less mobile species, such as amphibians.

Species likely impacted by reductions in perennial water sources and associated habitats would include big game, upland game birds, waterfowl, nongame birds (e.g., raptors, passerines), mammals (e.g., bats), reptiles, amphibians, and fish. The extent of these indirect effects from the mines' dewatering activities would depend on the species' use and relative species' sensitivity, as discussed for each group below.

5.2.2 Big Game

Big game species require water during the summer and fall periods (March 16 to November 15), as well as during the winter period, as needed, to satisfy physiological requirements. The reduction or loss of existing water sources could impact big game use and movements. Figure 5-1 depicts the possible loss of perennial surface water that could occur within mule deer summer range in portions of the Tuscarora Mountains. However, the greatest impacts to mule deer would be a reduction or loss of available water on important transitional ranges along the Tuscarora Mountains, the southern Independence Mountains, the upper Boulder Creek area, tributaries east of Maggie Creek, and along lower Susie Creek. Effects to perennial water sources also could occur in a small portion of the winter and transitional ranges located north of Antelope Creek in Rock Creek Valley and in the Adobe Range, and portions of deer winter range along Marys Creek. Since a small number of deer also use these winter and transitional ranges during the summer, water availability for mule deer could be affected in some areas year round. The loss or reduction of available water in these areas would force deer into adjacent areas that are already impacted by mining operations along the Carlin Trend. It is assumed that some deer would be lost from the population; however, this loss cannot be quantified.

The increased water discharge from mining combined with spring runoff could potentially affect deer movements across Maggie Creek between designated winter ranges during the early spring period. However, the magnitude of this potential impact would be less than that described for pronghorn below (BLM 2000a).

Pronghorn ranges that may be affected by the cumulative loss or reduction of perennial water sources would encompass portions of summer range in Boulder and Rock Creek valleys, along the upper portions of Antelope Creek, the west slope of the Tuscarora Mountains, and a small area along the east flank of the Tuscaroras. Winter range that could be affected is located along lower Susie Creek and the southern Tuscarora Mountains. Pronghorn transitional range could be impacted in upper Boulder Valley and in the Southern Independence Mountains (see Figure 5-2). As for mule deer, the effects to available water within pronghorn summer range would incrementally reduce the range's carrying capacity, displacing animals into adjacent ranges that may not support additional herd numbers. Relative to mine discharges, spring runoff coupled with water discharged from mining activities in Maggie Creek could impede movements from winter ranges (north of Carlin area) to summer ranges (north of Susie Creek in the southern Independence Range and Adobe Range).

Only a small portion of bighorn sheep range would likely be affected (see Figure 5-3). The areas potentially impacted by drawdown intersect a small area of yearlong range for bighorn sheep along the upper tributaries of Antelope Creek within Rock Creek Valley. Losses in water and habitat would incrementally reduce the range's carrying capacity for bighorns. It is assumed that the perennial portions of these stream reaches and the nearby springs would be unavailable in the long term, forcing the animals into a smaller portion of their yearlong range.

5.2.3 Upland Game Birds

A reduction in the riparian community would ultimately affect the amount of nesting habitat for mourning doves and both potential brooding and foraging habitat for doves, sage grouse, and chukar. A decline in surface water availability would impact the extent of open water and riparian vegetation along perennial streams. This incremental habitat loss would be long term, and it is assumed that the birds that are closely associated with these riparian areas would be displaced. However, since riparian communities are limited within the cumulative assessment area, it cannot be assumed that displaced individuals would successfully relocate into adequate breeding or foraging habitat in adjacent areas. As discussed in Section 5.2.1, it is likely that these adjacent habitats would be at carrying capacity and these breeding birds could be lost from the population. A reduction in riparian vegetation also could be a limiting factor in brood rearing during the later summer when food sources, such as upland forbs, may decline due to dry conditions. The estimate of riparian or wetland habitat types that could be affected by a possible reduction in surface water and vegetation associated with spring, seep, or riparian areas is approximately 618 acres. The percentage of these areas that may be used by upland game birds cannot be estimated; in addition, the potential impacts to mesic habitat and the potential loss of individuals cannot be quantified. Potential effects to sage grouse are discussed further in Section 7.2.1.10.

5.2.4 Waterfowl and Shorebirds

Short- and long-term effects to waterfowl and shorebird species that may be present within the cumulative assessment area would vary, depending on the vegetative structure and habitat types associated with springs that may support nesting, foraging, or resting birds. As discussed in Sections 5.1.2.3 and 5.1.3.2, waterfowl and shorebird numbers in the study area were not historically high. The increased incidence of use and number of birds recently recorded in Boulder Valley were based on the increased surface water availability in the vicinity of the TS Ranch Reservoir. These areas of open water resulted in artificially high numbers of waterfowl and shorebirds beginning in the early 1990s. These numbers declined in correlation with the reduced surface and subsurface flows at TS Ranch Reservoir; at the Green, Knob, and Sand Dune spring sites; and along the irrigation canal located south of these springs. The number of waterfowl and shorebird species using these habitats fluctuates according to the changing water levels (see Section 5.1.2.3).

The long-term impacts to waterfowl or shorebird species commonly associated with the cumulative assessment area would encompass two separate issues. The artificially created wetlands in Boulder Valley have supported a large number and diversity of waterfowl and shorebirds over the last decade. As the mine discharges diminish in the future, the level of free water that has surfaced within the valley, in addition to the associated riparian and wetland vegetation, would be reduced as well. It is anticipated that the number and species of water birds that use these artificial wetland communities would decline, particularly as the drier, more upland habitats began to re-establish in the Valley. However, based on current anecdotal observations of the soils and vegetation in this area, it appears that the saturated soils are increasing the leaching of minerals and salts into the soil surface and subsurface layers, thereby modifying the associated plant communities. This transition to a vegetative community of more salt-tolerant species would result in a changing wildlife community as well.

The other primary issue would be the water birds associated with the larger spring sites in the foothill regions of the cumulative assessment area, the perennial portions of streams that support adequate riparian habitat and pools for foraging and cover that occur within the shaded areas depicted in Figure 3-15, and any areas that may experience effects to surface water outside the 10-foot drawdown contour. The long-term reduction or loss of available surface water and associated emergent plants in these naturally occurring wetland areas currently used by water birds would result in the displacement or loss of these birds. As discussed for other wildlife species, it is assumed that the riparian communities potentially affected by the mines' dewatering activities are currently at their respective carrying capacities, given their limited availability in the cumulative assessment area. Therefore, loss of surface water and the associated riparian vegetation at historically occupied wetland areas would result in the displacement and/or loss of the individual birds that are dependent on these resources. This loss may affect the breeding potential of certain species.

In summary, isolated birds and breeding pairs may be impacted by the long-term reduction or loss of surface water and riparian or emergent habitat types; however, the extent of this impact cannot be quantified. It is assumed that the ultimate reduction in bird numbers associated with the artificially created wetlands in Boulder Valley to the premining levels (i.e., once mine dewatering has ceased) would not result in population-level impacts. Potential effects to waterfowl and shorebirds from long-term changes along the Humboldt River and into the Humboldt Sink are discussed in Section 5.3.

5.2.4.1 Raptors

As discussed in Section 5.1.3.1, a variety of raptor species may breed, migrate, forage, or roost in or near the cumulative assessment area, including along the Humboldt River corridor and in the Humboldt Sink. The impact analysis focused on the potential short- and long-term impacts to habitats utilized by raptors that could be affected by the cumulative ground water drawdown; possible short- and long-term effects to raptors from ongoing and future mine water discharges into the Humboldt River and the Humboldt WMA are discussed in Section 5.3.

Potential long-term impacts to raptor species could include loss of potential nesting, roosting, and foraging habitat along the perennial drainages and at the seeps and springs identified in Section 3.2.4 within the shaded areas shown in Figure 3-15. These losses would result from an incremental reduction in available habitat for both resident and migratory raptor species. In addition, the regional carrying capacity would be reduced by two factors. The most important factor would be the reduction in the prey base. The availability of riparian-dependent prey species for raptors would be reduced within the area potentially affected by drawdown (see Figure 3-15), possibly forcing birds to forage more within the upland habitats, which are not as diverse as the riparian communities. This anticipated loss of prey is not quantifiable. The second factor associated with the carrying capacity for raptors would be the incremental loss of available nest and roost sites. Some raptor species (e.g., red-tailed hawk, Swainson’s hawk, Cooper’s hawk, sharp-shinned hawk, American kestrel) are closely associated with riparian habitats large enough to support trees and increased shrub density. Other species (e.g., golden eagle, prairie falcon, rough-legged hawk) may use these trees for roosting only, but the cumulative drawdown area has limited vertical diversity in plant structure. Therefore, these roost sites are important, particularly for hunting activity. Potential impacts to sensitive raptor species are discussed in Chapter 7.0.

5.2.4.2 Songbirds

The potential short- and long-term effects to both resident and migratory songbird species (including neotropical migrants) from cumulative ground water drawdown would parallel those discussed for upland game bird and nongame raptor species. Those songbirds that generally depend on open water and riparian habitats for breeding, foraging, or resting during migration would be the most affected. The incremental loss of riparian or emergent habitats would result in bird displacement and possible reduction in local avian population numbers. Breeding birds could be lost from the population, assuming that the regional carrying capacity would not support riparian-dependent birds moving into adjacent habitats. Migrant songbirds also may be displaced. The additional energy required for individuals to find suitable resting or foraging habitat may compromise some birds’ survival during migration. The potential for population-level impacts to occur from cumulative ground water drawdown would depend on the relative species' sensitivity, rarity, and habitat associations. The Migratory Bird Treat Act protects migratory birds from direct loss of individuals, eggs, or young; however, the Act does not protect potential habitat for avian species. Loss of an active nest site, eggs, young, or adult birds from changes in water availability would be in violation of the Act, whereas the potential for long-term loss of potential habitat from cumulative water drawdown would not.

5.3 Impacts to the Humboldt River and Its Tributaries Used for Discharge Conveyance

5.3.1 Humboldt River

Species diversity and habitat characteristics along the Humboldt River have been influenced by past settlement patterns, man-induced channelization projects, and current land uses. These activities have altered the overall landscape, vegetative composition, biological character, and wildlife species along the Humboldt River system (see Section 5.1.1.2). The Humboldt River is classified as perennial; however, as with many river systems throughout the arid, western United States, certain reaches are often dry during the late summer and early fall. The extent and distribution of riparian vegetation along the river are determined by seasonal variations, including water scouring during high-flow periods and water availability during low-flow periods (i.e., baseflow).

Increased flows in the Humboldt River from the mines' discharges would result in a net increase in available water for terrestrial wildlife, including mule deer, waterfowl, shorebirds, songbirds, raptors, beaver, river otter, and other terrestrial species that are closely associated with these river communities (see Sections 3.3.1, 3.3.3, and 3.3.7). Increased flows may better support existing plant communities of willow, wild rose, cottonwoods, and emergent vegetation (e.g., bulrush, cattails) immediately adjacent to the river channel, particularly during the low-flow periods (October through February). Increased riparian vegetation would be site-specific, depending on the existing condition or health of the plant species present, channel geometry and stability, livestock grazing intensity and season of use, and timing of increased flows. Additional water levels along existing river meanders and old oxbows that currently do not receive sufficient water during the high-flow periods (April through June) could help to establish on-channel ponds and support valuable riparian or emergent vegetation. These backwater areas provide important nesting, brooding, foraging, and resting habitat for many terrestrial wildlife species. Conversely, the greater depths and flows could reduce the potential for some isolated pools and natural sloughs to occur in the river during low-flow conditions, limiting the use by breeding or foraging individuals in these areas.

Increased flows also would aid in maintaining wet hay meadows immediately adjacent to the river channel. These meadows provide marsh-like habitat for terrestrial wildlife, which is of greater value than the drier, upland meadows that are dominated by annual grasses. These wet meadows are second highest in avian diversity (as compared to the willow community), particularly when interspersed with either willow or buffaloberry stands.

Increased water availability from mine dewatering discharges may aid in restoring wetland and marsh habitats (e.g., the Herrin Slough). The Herrin Slough is a valuable area for wildlife located within the Humboldt River floodplain upstream of the Comus Gage. Slightly increased water levels in the river would help maintain moisture in the low-gradient network of side channels that provides high quality habitat for a number of important species (e.g., great blue heron, snowy egret, Virginia rail, gadwall, black-headed grosbeak, lazuli bunting). Maintenance of this river segment is particularly important, since it is likely one of the few reaches that is capable of supporting species that require dense cover, such as mountain lions.

No impacts to terrestrial wildlife from increased water levels in Rye Patch Reservoir would be anticipated, based on the limited extent of shallow, littoral habitats that currently exist along the reservoir shoreline. Increased water levels within the Pitt-Taylor Reservoirs may reduce certain areas of shallow-water habitats for waterfowl and shorebird species, as the increased depth would limit plant productivity and food production in those locations. However, as stated in Section 4.3, it also is assumed that additional areas that are temporarily inundated with increased flows may produce additional foraging habitat, as emergent and aquatic plants become established.

Increased water in the river channel downstream of Rye Patch Reservoir may be valuable for terrestrial wildlife resources, since many of the native riverine habitats that historically occurred along this river reach have been compromised by past agricultural practices, increased channelization, and tamarisk invasion. Although portions of this reach still maintain high quality habitat and increased species diversity, increased river flows could help improve habitat values in degraded areas.

The Humboldt River's channel sinuosity varies greatly from human-induced changes (e.g., channelization) along the river corridor, thereby affecting the overall habitat values, species diversity, biodiversity, and species density. Limited additional flooding immediately adjacent to the Humboldt River could occur during high-water periods (see Sections 3.3.3 and 3.3.4). The potential effects to terrestrial wildlife resources from this flooding would include potential loss of site-specific nesting or feeding sites for certain wildlife species (e.g., waterfowl, shorebirds); however the level of these possible impacts would be expected to be low (see Section 3.3.3). Increased yearlong flows would remove some channel habitat along the river corridor that currently provides nesting and foraging habitat. However, additional habitat also could be created in other backwater areas.

Maintaining existing willow stands and enhancing conditions to establish additional willow along the river by increased water flow would improve habitat for a wide diversity of wildlife species. Willows provide both vertical and horizontal structure for breeding sites, escape cover, thermal cover, and bank stability and support the greatest wildlife species diversity along the Humboldt River. Willows are a primary successional species that aid in building and maintaining river floodplains, which are considered high quality wildlife habitat, particularly if mid- and understory species (e.g., wild rose, currant, bulrush, rushes, sedges, meadow grasses) can be maintained.

As described in Sections 3.3.1 and 3.3.3, increased water levels during the mine dewatering discharges would be most apparent during the fall and winter (October through February), which is typically the river's low-flow period. These increased flows could result in more open water during low-flow months. Some river reaches that typically freeze because of low-water conditions could remain open from the increased flows. This open water could provide additional foraging areas for wildlife species that commonly feed along the river during the winter, such as wintering bald eagles (see Section 7.1). The effects to the river during the peak flows (April through June) would be less apparent. As compared to the natural flows during this period, the increased water in the channel would be a relatively small change.

After mine dewatering discharges cease, a predicted eventual reduction in the Humboldt River baseflows from the cumulative drawdown would occur, as discussed in Section 3.3.2. Reduced flows in the Humboldt River could result in a long-term reduction in the amount of available water, possibly affecting the extent of riparian vegetation along the river. The river currently goes dry during periods of low precipitation; therefore, a reduction in water may not be important for terrestrial wildlife, as this system has evolved with dynamic water regimes. However, potential effects from a consistent reduction in baseflows could be an associated decline in the extent and distribution of riparian vegetation along portions of the Humboldt River. The potential reduction in riparian habitat during this period cannot be quantified. It is assumed, however, that riparian vegetation would begin to re-establish to premining levels upon the eventual recovery of the baseflows.

As discussed in Section 3.3.2, Newmont has committed to augmenting low flows in the river using senior water rights that the company owns or controls, in response to the potential effects of decreased river flows (BLM 1993d). This mitigation effort should aid in minimizing potential long-term effects to both plant and animal species that depend on the river system.

In summary, higher flows in the Humboldt River system would likely result in improved maintenance and establishment of riparian vegetation, increased areas of open water during the winter, and improved water quality for both aquatic and terrestrial species during the period of the mines' discharges. These potential effects likely would apply more to birds than other wildlife groups, based on the incidence of avian use (52 percent exclusively associated with the riparian habitat type), the fact that water and its associated habitats are the most limiting factor in northern Nevada, and NDOW survey results from the Humboldt River studies (Bradley 1992; Neel 1994; Bradley and Neel 1990). After mine dewatering discharges cease, the predicted flow reductions in the Humboldt River could affect the long-term availability of water and riparian vegetation for use by terrestrial wildlife. This potential long-term effect to wildlife from an incremental reduction in water availability and possible riparian or wetland vegetation maintenance would parallel those impacts discussed for the cumulative ground water drawdown effects to surface water resources located within the cumulative assessment area. These possible losses could result in an associated reduction in overall species diversity, abundance, and use of the Humboldt River corridor. Potential population-level effects would depend on the relative species' sensitivity that may be affected. Newmont's mitigation plan (BLM 1993d) to augment low flows should minimize the long-term effects from reduced baseflow in the river, thereby minimizing the impacts to wildlife and their associated habitats.

5.3.2 Humboldt Sink

The impact analysis for terrestrial wildlife associated with the Humboldt Sink focused on the effects from increased water quantity and the potential increase in concentrations of inorganic constituents in the sink.

This analysis delineates the differences between the concentration and the increased loading of specific constituents of concern. Because the Humboldt Sink is the closed-basin terminus of the Humboldt River, encompasses the Humboldt WMA (one of the most important wildlife areas in Nevada), and is a primary stopover for waterfowl along the Pacific Flyway, the potential for long-term impacts is a primary concern.

Impacts from increased flows and associated water levels in the Humboldt Sink would parallel those discussed for the Humboldt River (see Section 3.3.1). This dynamic wetland system is characterized by both wet and dry cycles. Additional water flowing into the Humboldt Sink and possibly the Carson Sink would provide additional habitat for wildlife. However, inundation of some habitats also would temporarily reduce the amount of available nesting habitat for some shorebird species, such as the American avocet, black-necked stilt, and other species that nest either on emergent vegetation or along the margins of wetland communities. This potential loss of available nesting habitat for certain bird species would be expected to be short-term, since the water levels would fluctuate and emergent vegetation would re-establish along the wetland borders.

Appendix E provides a summary of waterfowl use recorded in the Humboldt WMA, Stillwater WMA, and Carson Lake over the last 30 years (Saake 1998). Impacts from increased water levels would include improved nesting, foraging, and resting opportunities for both resident and migratory waterfowl and shorebird species. In turn, the improved habitat conditions for these species would increase the relative prey availability for area predators.

Some areas of wetland vegetation within the Humboldt Sink may be flooded with higher water levels, resulting in a temporary loss of potential forage plants and cover for birds. However, emergent wetland vegetation would re-establish along the margins of the sink, resulting in a net increase in the amount of wetland vegetation available for wildlife during the discharge period.

The USFWS and USGS have conducted studies on the water quality of the Humboldt Sink, as discussed in Section 3.3.8. The purpose of these studies was to determine whether the water quality associated with the Humboldt Sink, and specifically the Humboldt WMA, could adversely affect both terrestrial and aquatic wildlife resources, particularly from the irrigation return water flowing into Toulon Lake and Humboldt Lake.

5.3.2.1 Premining Risks to Wildlife

Because the Humboldt Sink is a terminal wetland, concentrations of ions, including trace metals, must naturally increase in some media in the sink unless removed via wind erosion or overflow to the Carson Sink. Materials entering into the sink may be in the dissolved or suspended form. Suspended materials are likely to settle to the sediment, although they may become resuspended during periods of high wind. Dissolved materials also may eventually precipitate out of solution through complexation and ion interactions that often occur in solutions with higher ionic strengths. Some materials may bioaccumulate in local animals and plants that live in the Humboldt Sink. Because large numbers of wildlife species are attracted to the sink and depend on its food resources, these species are also exposed to elements and compounds that have accumulated at the sink.

To determine the potential risk to wildlife utilizing the Humboldt Sink prior to the mines' discharges into the Humboldt River, two methods were employed. First, water concentrations and organism tissue concentrations measured in the sink were compared to concentrations that have been found to potentially cause adverse effects to organisms through water and food ingestion in laboratory and field investigations. Second, to determine the potential cumulative effects of ingesting materials through all routes of exposure (water, food, sediment), a dose to selected receptor organisms was calculated for several chemicals of concern.

Evaluations of risk are often difficult because empirical data are often lacking. Fortunately, the USGS and USFWS have collected information on water, sediment, and tissue concentrations of several constituents for several years near and upstream of the Humboldt Sink (Seiler et al. 1993; Seiler and Tuttle 1997). These data were used in the evaluations presented here. Because the purpose of these evaluations was to examine potential effects prior to mining activity, only data collected prior to November 1990 were used. Also, only data collected from Humboldt Lake were used. Much of the water flowing into Humboldt Lake has passed through an extensive agricultural diversion system upstream of the lake. Water chemistry in Humboldt Lake is, therefore, reflective of the influence of these diversions and more representative of water in the WMA than is water upstream of the diversions.

Screening Against Literature-Based Concentrations

Mean concentrations of several constituents were calculated with Humboldt Lake data collected from 1990, or earlier (see Table 5-1). The mean values were then compared to concentrations found in the literature from toxicity studies of that particular constituent. Both water-borne and tissue concentrations were evaluated. Water concentrations were screened against those studies where organisms were exposed via water only. Tissue concentrations were screened against studies where the route of exposure to the test organisms was through the diet, that is, food ingestion. This was deemed appropriate since the organisms for which tissue levels were measured in the USGS/USFWS studies (i.e., aquatic insects, aquatic plants, waterfowl, and fish) are food items for higher-level consumers in the wetland. Screening values were No Observed Adverse Effect Levels, or NOAEL, (concentrations that had no significant effects) and Lowest Observed Adverse Effect Levels, or LOAEL, (lowest concentrations that did have significant effects). For some of the constituents there were no studies where the chemical was introduced through water, therefore, only dietary screening was used.

All of the mean water concentrations from Humboldt Lake were well below the NOAEL or LOAEL found in the literature (see Table 5-2). Tissue concentrations of boron, selenium, and mercury exceeded one or more threshold values (see Table 5-3). These data suggest that, under premining conditions, some metals could have been in high enough concentrations in the Humboldt Sink to cause adverse chronic effects to wildlife utilizing the sink.

Effects through Food, Sediment, and Water Ingestion

Since initial screening of the chemicals of concern in the Humboldt Sink indicated that some wildlife species could be at risk, additional analysis was undertaken to evaluate the effects of ingesting materials from all

Table 5-1
Surface Water, Sediment, and Tissue Concentrations of Constituents of Concern From Humboldt Lake (1987-1990)

Date of Sample	As	B	Cr	Cu	Li	Hg	Mo	Se	Zn
Surface Water Concentrations (■g/L)									
10/7/87	210	3900	<10	<10	660	0.2	31	2	10
3/17/88	56	3500	<1	<1	560	<0.1	27	<1	20
8/24/88	90	4300	<1	--	700	<0.1	38	<1	10
3/28/89	98	5400	<1	--	710	<0.1	44	<1	10
3/26/90	78	4500	1	2	--	<0.1	26	<1	<10
7/9/90	59	2700	2	1	--	0.2	24	1	<10
11/26/90	76	3800	<1	2	--	<0.1	19	<1	<10
Mean	**95**	**4014**	**1.4**	**2.1**	**658**	**0.09**	**30**	**0.8**	**9**
Sediment Concentrations (■g/g dry weight)									
11/26/90 (<2 mm)	20	21	17	16	45	0.02	4	1.1	43
11/26/90 (<62 µm)	21	10	19	17	46	0.08	5	1.4	46
Mean	**20.5**	**15.5**	**18**	**16.5**	**45.5**	**0.05**	**4.5**	**1.25**	**44.5**
Invertebrate (*Diptera* and *Hemiptera*) Concentrations (■g/g dry weight)									
6/15/90	14	44	4	20	--	0.10	<1	5.0	58
6/15/90	4.7	29	5	16	--	0.15	<2	2.6	73
8/5/86	7.6	<46	20	26	--	<0.44	<0.93	2.5	--
8/5/86	0.87	<27	<1.6	26	--	0.33	1.7	5.1	170
6/15/90	3.0	29	<1	33	--	0.10	1	4.6	163
Mean	**6.0**	**28**	**6.1**	**24**	**--**	**0.18**	**0.93**	**4.0**	**116**
Plant (*Potamogeton*) Concentrations (■g/g dry weight)[1]									
6/15/90	14	620	1	6	--	0.03	3.1	0.5	15
Whole Fish (Carp) Concentrations (■g/g dry weight)									
10/29/86	0.81	<27	6.8	2.6	--	0.46	50	3.9	110
10/29/86	0.96	<23	6.3	1.8	--	0.72	<1	1.9	120
10/29/86	1.2	<26	6.4	3.8	--	0.54	<1	2.4	100
Mean	**0.99**	**12.7**	**6.5**	**2.7**	**--**	**0.57**	**17**	**2.7**	**110**
Bird Liver (Mallard, American Coot, Black-Necked Stilt) Concentrations (■g/g dry weight)									
Mallard									
7/23/88	0.38	3.4	0.62	93	--	0.34	<7	7.2	171
7/23/88	0.40	2.7	0.60	175	--	0.49	<7	7.4	205
7/23/88	0.47	3.9	0.63	189	--	0.35	9	9.8	198
7/23/88	<0.30	3.1	<0.50	117	--	0.27	<7	8.8	188
8/9/88	0.36	9	<2	16	--	0.70	3.8	23	164
8/9/88	0.10	10	<2	46	--	0.71	2	13	167
8/9/88	0.20	9	<2	12	--	0.59	3	20	135
American Coot									
8/9/88	0.30	5	<2	13	--	1.5	4	8.7	93
8/9/88	0.52	8	<2	26	--	0.44	4.7	9.1	96
8/9/88	0.20	5	<2	28	--	0.42	4	11	121

Table 5-1 (Continued)

Date of Sample	As	B	Cr	Cu	Li	Hg	Mo	Se	Zn
8/9/88	0.20	5	<2	27	--	3.2	4.3	13	137
8/9/88	0.41	4	<2	35	--	0.42	6	11	118
8/9/88	0.20	3	<2	33	--	0.27	4.3	11	111
8/9/88	0.20	4	<2	32	--	0.27	3	8.5	111
8/9/88	0.38	6	<2	18	--	0.31	4.6	8.8	98
8/9/88	0.50	3	<2	13	--	0.42	4	9.8	88
8/9/88	0.30	<2	<2	26	--	0.41	4	12	132
8/9/88	0.38	5	<2	17	--	0.62	5.6	7.8	144
8/9/88	0.36	5	<2	15	--	0.21	3	10	81
8/4/86	0.36	11	<1.3	63	--	0.41	5.5	15	220
8/4/86	0.39	39	<1.2	29	--	0.75	3.4	9.3	170
8/4/86	0.40	73	<1.1	80	--	0.35	4.4	11	240
8/4/86	0.65	47	<1.3	77	--	0.68	3.9	12	220
8/4/86	0.36	51	<1.2	110	--	0.53	4.5	9.0	200
Black-Necked Stilt									
8/4/86	<0.17	24	<1.1	18	--	4.4	2.5	34	110
8/4/86	<0.18	25	1.4	18	--	0.51	2.1	31	98
8/4/86	<0.17	190	1.9	17	--	0.44	2.1	29	81
8/4/86	<0.18	110	1.4	18	--	0.61	2.3	42	120
8/4/86	<0.17	45	2.6	19	--	0.38	1.7	29	82
7/30/87	<0.20	2	<1	22	--	2.5	2	11	100
7/30/87	<0.20	<2	<1	24	--	2.4	2	31	97
7/30/87	<0.20	<2	<1	16	--	1.9	2	48	86
8/12/87	<0.20	<2	<1	23	--	2.1	2	32	88
8/12/87	<0.20	<2	<1	33	--	2.4	3	23	94
Mean	0.27	21.1	0.90	44		0.95	3.62	16.95	134.24

[1]Only one premining *Potamogeton* sample was collected from Humboldt Lake.

Note: One-half the detection limit was used to calculated means when the concentration was less than detection.

Source: Seiler et al. 1993.

Table 5-2
Mean Surface Water Concentrations Measured in Humboldt Lake and Threshold Effects Levels from the Literature[1]

Constituent	Concentration (mg/L)	Threshold Value (mg/L)	Notes/Source[2]
Arsenic	0.095	5	LOAEL, rat reproduction (Schroeder and Mitchener 1971)
Mercury	0.00009	100	NOAEL, chicken reproduction (Scott et al. 1975)
		5	NOAEL, mouse lifespan (Schroeder and Mitchener 1975)
Molybdenum	0.03	10	LOAEL, mouse reproduction (Schroeder and Mitchener 1971)
Selenium	0.0008	1.5	NOAEL, rat reproduction (Rosenfeld and Beath 1954)
		0.002	Suggested hazardous concentration in water (Lemly 1993)

[1]Water concentrations from Seiler et al. 1993.

[2]LOAEL = Lowest Observed Adverse Effect Level; NOAEL = No Observed Adverse Effect Level.

Table 5-3
Mean Tissue Concentrations Measured in Organisms Collected in Humboldt Lake and Threshold Effects Levels from the Literature[1]

Tissue/Organism	Constituent	Concentrations (■g/g)	Threshold Value (■g/g)[2]	Notes/Source[3]
Plant (*Potamogeton*)	Arsenic	14	30	LOAEL, growth in female mallards (Camardese et al. 1990)
Plant (*Potamogeton*)	Boron	620	288	NOAEL, mallard reproduction (Smith and Anders 1989)
			120	LOAEL, growth in female mallards (Hoffman et al. 1990)
Fish (carp)	Mercury	0.57	0.5	LOAEL, mallard reproduction (Heinz 1979)
Bird Livers (mallard, american coot, black-necked stilt)	Mercury	0.95		
Fish (carp)	Molybdenum	17	500	LOAEL, chicken reproduction (Lepore and Miller 1965)
			200	LOAEL, growth in chickens (Arthur et al. 1958)
Invertebrate (Diptera & Hemiptera)	Selenium	4.0	5	NOAEL, mallard reproduction (Heinz et al. 1987)
			2.9	LOAEL, avian reproduction (USDI 1998)
Bird Livers (mallard, american coot, black-necked stilt)	Selenium	16.95	8.81	NOAEL, screech owl reproduction (Wiemeyer and Hoffman 1996)

[1]Tissue concentrations from Seiler et al. 1993
[2]Threshold values are dry weight, or as given in report/article if wet or dry weight was not specified
[3]LOAEL = Lowest Observed Adverse Effect Level; NOAEL = No Observed Adverse Effect Level

possible routes of exposure. Four receptor species, mule deer, great blue heron, mallard, and bald eagle, were selected for this evaluation. These species represent organisms that may be found in the Humboldt Sink on a long-term or short-term basis. They are not meant to represent all of the species found at the sink, although they do represent a range of life strategies. Mule deer and the bald eagle are the less frequent visitors, passing through the area on occasion rather than being permanent residents.

For each of the receptor species, the possible routes of exposure were identified. Those routes were:

- Mule deer – water ingestion only
- Great blue heron – water ingestion and fish consumption
- Mallard – after ingestion and consumption of aquatic macrophytes (24.7 percent of diet), invertebrates (72 percent of diet), and incidental sediment (3.3 percent of diet)

- Bald eagle – water ingestion and consumption of fish (58 percent) and waterfowl (14 percent); remainder of diet is assumed to be mammals

Factors used to estimate ingestion included body weight and food and water ingestion rates. These factors were all derived from the literature or calculated using U.S. Environmental Protection Agency (USEPA) equations (USEPA 1993). If necessary, food ingestion rates were adjusted to a dry weight basis, rather than a wet weight basis.

By combining the amount of a chemical that theoretically might be received by a receptor organism via the different sources, a total daily dose is calculated. For this evaluation, two sets of dose calculations were made; one using mean water, sediment, and tissue (premining) concentrations and another using maximum (premining) concentrations. The calculated dose of a constituent for each species was compared to the NOAEL that was derived from laboratory toxicity studies found in the literature.

Since water and dietary intake were combined in this evaluation, the lowest NOAEL found in the literature was used, regardless of whether exposure in the toxicity studies was through water or diet. In the toxicity studies from which the NOAELs were developed, test organisms were generally the common species used in the mammalian or avian studies (e.g., mouse, rat, chicken, mallard). If only a LOAEL was provided for a given study (i.e., the lowest test concentration caused a significant effect), a NOAEL was calculated by dividing the LOAEL by 10. Because toxicity threshold levels may vary with body size in mammals, mammalian NOAELs were adjusted for each of the receptor species according to body weight (Sample et al. 1996). Avian NOAELs were not adjusted. Laboratory-derived NOAELs (prior to body-weight adjustments) are given in Table 5-4. Hazard quotients were calculated by dividing the calculated dose by the NOAEL. Hazard quotients greater than 1 mean that the theoretical dose of a constituent exceeds the dose found, in laboratory toxicity studies, to cause no significant chronic (long-term) effects. Hazard quotients greater than 1 do not necessarily indicate that adverse effects do/would occur, but do indicate that the chemical of concern could pose a risk to wildlife and further investigation could be warranted.

When either the mean or maximum concentrations in water, sediment, and tissue are used in this evaluation of premining conditions, none of the hazard quotients exceeded 1.

These evaluations indicate that some constituents in the Humboldt Sink and WMA could have been at high enough concentrations in certain food items to pose some risk of adverse effects to wildlife that occupy this area on a permanent or temporary basis. Indications of risk are apparent only when comparing measured tissue concentrations to literature-derived threshold values (see Table 5-3). Tissue concentrations of boron, mercury, selenium, and zinc exceeded one or more of the threshold values. However, no risk was indicated when considering the total dose that a receptor organism might receive. In addition, this evaluation is a simplistic and conservative one, and incorporates many factors that may overestimate the potential for adverse effects. First, the concentration data from Seiler et al. (1993) are limited; only a few samples were collected from the Humboldt Lake area, and those samples were not collected over a wide sample area. Had additional samples been collected over a longer period of time and over a wider area, different trends may have been observed and concentrations might have been higher or lower. It was assumed that

Table 5-4
NOAELs from Laboratory Studies Used to Estimate Risks to Wildlife

Constituent	Test Organism	Dose (mg/kg bw/day)[1]	Source
Arsenic	Mouse	0.126[2]	Schroeder & Mitchener 1971
	mallard	5.14	USFWS 1964
Boron	Rat	28	Weir & Fisher 1972
	mallard	28.8	Smith & Anders 1989
Chromium	Rat	17.61	Steven et al. 1976
	black duck	1	Haseltine et al. 1985
Copper	Sheep	0.13[2]	Gopinath et al. 1974
	Chicken	27.5	Jackson & Stevenson 1981
Lithium	Rat	9.4	Marathe & Thomas 1986
Mercury	Mouse	1.25	Schroeder & Mitchener 1975
	Japanese quail	0.45	Hill & Schaffner 1976
Molybdenum	Mouse	0.26[2]	Schroeder & Mitchener 1971
	Chicken	3.53[2]	Lepore & Miller 1965
Selenium	Rat	0.2	Rosenfeld & Beath 1954
	Mallard	0.5	Heinz et al. 1987
Zinc	Mouse	125	Aughey et al. 1977
	Chicken	14.49	Stahl et al. 1990

[1]Dose is based on the body weight (bw) of the test organism.
[2]These NOAELs were calculated by multiplying the LOAELs by an uncertainty factor of 0.1.

100 percent of water or diet came from the WMA. Because the area is very large, this assumption is likely to be true for the great blue heron and the mallard. However, the mule deer and bald eagle probably obtain food and water from areas outside of the WMA.

In summary, based on the study assumptions, available data from the literature, and likelihood of exposure, risks to avian and mammalian wildlife from metals and other constituents associated with premining conditions could occur, but these risks would be minimal. Because of the dynamic nature of the sink, the substantial influence of upstream water demand, potential naturally and artificially induced fluctuations in water level, and bioaccumulative nature of some metals (such as selenium and mercury), conditions in the sink should not be considered static, in terms of water quality or potential impacts to wildlife receptors.

5.3.2.2 Potential Risk from Cumulative Mine Discharge to the Sink

As discussed above, conditions in the Humboldt Sink are such that some risks to wildlife species using the sink could occur, although concentrations measured in water, sediment, and plant and animal tissues indicate the likelihood of impacts is low. Because, under average conditions, there is no outflow from the sink, the total load of chemicals contained in the sink will increase with time. Unless these chemicals are removed from the sink by events such as flushing (e.g., to the Carson Sink) or wind (during dry periods), they will remain, primarily in the sediments. During operation of the mines, additional quantities of some materials would be discharged into the Humboldt River, thus increasing the loads of these materials into the downstream sections of the Humboldt River system, as described in Section 3.3.8. An increase in the loading (measured in total quantity, such as tons) of materials would not necessarily result in an increase in risk to organisms using the sink, since it is the concentration (quantity of a material per unit volume or weight, such as mg/L in water, or milligrams/kilogram [mg/kg] in sediments or tissue) of a chemical, and not its load, that controls risk to receptor organisms.

The anticipated increase in the load of selected constituents of concern as a result of mining activities is described in Section 3.3.8. Estimated loads to Rye Patch Reservoir and the Humboldt Sink were calculated based on historical flows to these areas plus increased loading from the mines. It is recognized that there are numerous factors that can influence the loading and, more importantly, the concentrations, of chemicals in the Humboldt River and associated lentic (lake) systems. This is especially true of the Humboldt River system downstream of Rye Patch Reservoir where water is diverted for agriculture. As water flows through this diversion system, chemicals in the water may be lost through deposition, and additional chemicals may be collected from the soil and any point and non-point discharges. There also is evaporative loss and consumptive use, which permanently removes water from the system. In addition, periods of high rainfall or drought conditions will affect the volume of materials that enter the Humboldt Sink as well as their disposition once in the sink.

Estimates of future concentrations of selected constituents entering the Humboldt Sink were made with the understanding that these are general approximations and that certain factors could cause them to increase or decrease. Concentration estimates were calculated by dividing the estimated loads (converted to milligrams) by the total flow volume (in liters) discharged into the Humboldt Sink (see Table 5-5). The predicted concentrations for arsenic, boron, copper, and zinc were compared to the mean, 1987-1990 surface water concentrations from Humboldt Lake, taken from Table 5-1. Except for zinc, the predicted concentrations are all less than the mean concentration used in the risk evaluation of the premining conditions. When the predicted zinc concentration (0.0114 mg/L, see Table 5-5) is used in the risk calculations, the hazard quotient for all receptor species would not change from premining conditions.

Table 5-5
Estimated Concentrations of Select Constituents in Water Entering the Humboldt Sink
(estimates combine the contribution from mines and baseflow)

Source	TDS (mg/L)	As (mg/L)	B (mg/L)	Cu (mg/L)	F (mg/L)	Zn (mg/L)
Baseflow – No Mine Discharge	2,936	0.0798	1.965	0.0023	1.887	0.0124
Cumulative Mine Discharge	388	0.0284	0.539	0.0034	1.891	0.0096
Combined	2,018	0.0613	1.452	0.0027	1.888	0.0114
Mean pre-1996 Water Concentration in Humboldt Lake	not calculated	0.095	4.014	0.0021	not calculated	0.009

This evaluation of concentrations in the Humboldt Sink influent suggests that the additional loads to the Humboldt Sink associated with mining discharges would not pose additional risk to wildlife using the sink. As discussed under Premining Conditions, the concentrations of some constituents could be high enough to pose a chronic risk to organisms that use the Humboldt Sink; however, that risk would probably not be influenced by mine discharges into the Humboldt River. This conclusion is based on the best information available to date, including hydrogeological models and USGS/USFWS studies. However, the analyses supporting this conclusion have several uncertainties associated with them. For example, even though actual water, sediment, and tissue concentration data were available for the analysis, the samples reported by the USGS (Seiler et al. 1993; Seiler and Tuttle 1997) were collected infrequently and from only a few locations.

One of the most important unknown factors that could influence risks to wildlife in the sink is the effect of weather and associated precipitation. River flows and mine discharges could be affected by annual precipitation, which could increase or decrease water volumes as well as flush materials into the river from the watershed, thus causing alterations in chemical concentrations. Under dry, summer conditions, the total volume of the sink may be substantially reduced. As water evaporates, the concentration of solutes within the sink would increase. Although some materials would be lost to the sediments, the salinity (including trace metals) of the remaining water also would increase. At some point, concentrations of some constituents (including sodium, chloride, sulfate, and other common ions, as well as trace metals) may be high enough to be acutely or chronically toxic to wildlife consuming the water. There also may be a tendency for increased bioaccumulation of some ions, thus increasing risk through food ingestion. These events could occur, regardless of the presence of mine discharge. The presence of additional materials in the sink from mine discharges could result in higher concentrations in the event of dry-weather “lake shrinkage.” However, there are currently no data available to evaluate this possibility. Lake size and weather conditions also could affect the type and number of receptor organisms in the sink. If conditions become too unfavorable, wildlife may leave the area, thus reducing risk through reduced exposure. Finally, conditions in the Humboldt Sink could affect risk to wildlife if the system were flushed with large volumes of water, or if drying and wind erosion removed sediment-bound materials. These physical changes to the environment also could affect the types and quantity of plants that grow in the sink, as well as the amount of time wildlife species spend in the area.

In summary, given the limited amount of information available, additional mine discharges to the Humboldt River are unlikely to cause an increase in risk to wildlife in the Humboldt Sink, beyond what exists under premining conditions. However, it is difficult to predict future conditions in the sink, and, therefore, the possibility exists that risks to wildlife could increase. Some unknown factors that could influence wildlife risks include:

- Precipitation – unusually high precipitation could increase water levels and dilute solutes, resulting in decreased concentrations of certain constituents. It also could encourage use of the area, possibly increasing exposure for some species.
- Drought – unusually low precipitation could decrease water levels and concentrate solutes, resulting in increased concentrations and increased exposure. However, unusually low water levels could force some species to leave the area, thus reducing exposure.
- Effect of agricultural diversions upstream of the sink.

- Potential artificial or natural flushing of the area, which may remove materials.
- Loss of salts due to wind erosion.
- Water and sediment chemistry – ions could become trapped in sediments upstream of the sink or within the sink itself; they may or may not be remobilized if water chemistry changes.