4.0 RIPARIAN VEGETATION

4.1 Affected Environment

4.1.1 Mine Dewatering Area

Perennial creeks within the cumulative assessment area typically support a riparian zone ranging in width from a few feet immediately adjacent to the creek channel to relatively wide zones on broad floodplains. Riparian areas are valuable in providing sediment retention, nutrient removal and transformation, increased production (relative to uplands) for livestock and wildlife forage, habitat diversity for aquatic and terrestrial wildlife, and streambank stability.

Two riparian habitat inventories have been conducted in the cumulative assessment area, which includes the cumulative drawdown area and vicinity (Whitehorse Associates 1995a,b; JBR 1993). Riparian habitat described in JBR (1993) also was provided in the SOAP EIS (BLM 1993b). Figure 4-1 illustrates riparian habitat within the cumulative assessment area and the riparian habitat identified during these inventories. Riparian inventories have not been conducted in the northeastern portion of the cumulative assessment area, which includes upper Susie Creek and associated tributaries. Perennial stream reaches in this area also are illustrated in Figure 4-1. Table 4-1 lists the types and acres of riparian/wetland vegetation located in the cumulative assessment area by watershed and creek within each watershed. The inventory reports completed by Whitehorse Associates (1995a,b) and JBR (1993) included other riparian vegetation types in addition to those illustrated on Figure 4-1. The riparian vegetation illustrated in Figure 4-1 and the types and dominant species provided in this discussion only include the riparian vegetation types that supported a prevalence of wetland species and were associated with perennial or ephemeral creeks or wetlands. Approximately 4,337 acres of riparian/wetland habitat occur within the cumulative assessment area, of which 2,025, 1,685, 228, 388, and 10 acres are associated with the Maggie Creek, Rock Creek (including Boulder Flat), Susie Creek, Humboldt River watersheds, and small tributaries to the Humboldt River, respectively.

Table 4-2 lists the riparian/wetland vegetation types present within the cumulative assessment area and the dominant species associated with each type. Eight riparian vegetation types are present including streambar, herbaceous streambar, wet meadow, Salix streambar, Salix/wet meadow, Salix/mesic meadow, Salexi/mesic meadow, and ALNINC/mesic meadow. These types were developed and used during the 1994 riparian habitat inventory conducted by Whitehorse Associates within the Rock and Maggie Creek basins (Whitehorse 1995a,b). Riparian vegetation types and dominant species identified by JBR in the Maggie and lower Susie Creek basins were correlated with appropriate vegetation types identified by Whitehorse Associates. Results from these inventories indicate that the streambar riparian vegetation comprises approximately 42 percent (1,812 acres) of the riparian vegetation present within the cumulative assessment area. Other prevalent types include wet meadow (854 acres), Salexi/wet meadow (376 acres), Salix streambar (331 acres), and ALNINC/mesic meadow (248 acres).

Table 4-1
Acres of Riparian and Wetland Vegetation Within the Cumulative Assessment Area

Watershed (*Stream*)	Area[1]	Streambar	Herbaceous Streambar	Wet Meadow	Salix Streambar	Salix/Wet Meadow	Salix/Mesic Meadow	Salexi/ Wet Meadow	ALNINC/ Mesic Meadow	Total
Maggie Creek										
Beaver Creek	M1	2	1	1	0	0	0	1	47	52
Beaver Creek	M2	121	6	3	22	0	42	0	77	271
Coyote Creek	M3	0	2	0	22	0	0	1	64	89
Coyote/Spring Creeks[2]	M4	87	10	99	1	1	3	24	0	225
Little Jack Creek	M5	41	23	1	9	0	0	0	51	125
Little Jack and Jack[3] *Creeks*	M6	31	32	128	13	0	1	37	0	242
Maggie Creek	--	125	176	464	0	0	0	163	0	928
James Creek	--	1	6	0	0	0	0	2	0	9
Soap Creek	--	0	3	<1	0	0	0	0	0	3
Marys Creek	--	2	12	<1	0	0	0	3	0	17
Mack Creek	--	0	7	0	0	0	0	1	0	8
Lynn/Simon Creeks	--	0	2	29	0	0	0	0	0	31
Cottonwood Creek	--	3	4	0	0	0	0	0	0	7
E. Cottonwood Creek	--	0	<1	6	0	0	0	0	0	6
Fish Creek	--	5	3	0	0	0	0	<1	0	8
Indian Creek	--	<1	1	0	0	0	0	0	0	1
Bob's Creek	--	0	2	0	0	0	0	0	0	2
Subtotal	**--**	**418**	**290**	**732**	**67**	**1**	**46**	**232**	**239**	**2,025**[4]
Rock Creek										
Rock Creek	R1	8	90	0	0	0	0	0	0	98
Rock Creek	R2	23	78	0	0	0	0	0	0	101
Rock Creek	R3	29	171	0	0	0	0	0	0	200
Rock Creek	R4	0	74	0	0	0	0	0	0	74
Willow Creek	R5	0	107	80	12	0	0	139	0	338
Willow Creek	R6	0	102	1	2	0	0	0	0	105
Willow Creek	R7	20	69	7	1	0	0	3	0	99
Willow Creek	R8	0	4	2	0	0	0	0	0	6
Willow Creek	R9	0	70	7	0	0	2	1	0	80
Willow Creek	R10	0	4	0	0	0	0	0	0	4
Willow Creek	R11	0	0	1	0	0	1	1	<1	3
Antelope Creek	R12	0	48	0	0	0	0	0	0	48
Antelope Creek	R13	0	67	0	0	0	0	0	0	67
Antelope Creek	R14	0	75	0	0	0	0	0	0	75

Table 4-1 (Continued)

Watershed (*Stream*)	Area[1]	Streambar	Herbaceous Streambar	Wet Meadow	Salix Streambar	Salix/Wet Meadow	Salix/Mesic Meadow	Salexi/ Wet Meadow	ALNINC/ Mesic Meadow	Total
Antelope Creek	R15	0	98	5	0	0	0	0	0	103
Antelope Creek	R16	0	47	11	1	1	5	0	0	65
Antelope Creek	R17	0	7	0	1	0	20	0	0	28
Boulder Creek	R18	0	118	1	0	0	0	0	0	119
Boulder Creek	R19	0	35	0	1	0	1	0	9	46
Green, Knob, and Sand Dune Springs[5]	R20	0	0	0	0	0	0	0	0	0
Green, Knob, and Sand Dune Springs[5]	R21	0	0	0	0	0	0	0	0	0
Welches Creek	R22	0	24	1	0	0	1	0	0	26
Subtotal	**--**	**80**	**1,288**	**116**	**18**	**1**	**30**	**144**	**9**	**1,685**[4]
Susie Creek										
Cold Creek[6]	--	3	2	0	0	0	0	0	0	5
Blue Basin Creek[6]	--	2	1	0	0	0	0	0	0	3
Adobe Creek[7]	--	1	<1	0	0	0	0	0	0	1
Swales Creek[6]	--	3	2	0	0	0	0	0	0	5
Camp Creek[6]	--	2	1	0	0	0	0	0	0	3
Susie Creek[2]	--	127	77	0	0	0	0	0	0	204
Middle Susie Creek[6]	--	0	<1	1	0	0	0	0	0	1
Hot Springs Drainage	--	2	3	0	0	0	0	0	0	5
Subtotal	**--**	**140**	**87**	**1**	**0**	**0**	**0**	**0**	**0**	**228**[4]
Humboldt River Tributaries										
Primeaux Creek	--	<1	<1	0	0	0	0	0	0	1
Palisade Creek	--	0	<1	0	0	0	0	0	0	<1
Buck Rake Jack Creek	--	0	5	0	0	0	0	0	0	5
Dry Susie Creek	--	0	<1	0	4	0	0	0	0	4
Subtotal	**--**	**0**	**6**	**0**	**4**	**0**	**0**	**0**	**0**	**10**[4]
Humboldt River	--	0	141	5	242	0	<1	0	0	388
Subtotal	**--**	**0**	**141**	**5**	**242**	**0**	**0**	**0**	**0**	**388**[4]
Total	**--**	**638**	**1,812**	**854**	**331**	**2**	**76**	**376**	**248**	**4,337**[4]

Table 4-1 (Continued)

[1]Inventory areas used by Whitehorse Associates 1995a and b.

[2]Riparian acreage for the lower portion of Susie Creek was based on acreages reported in BLM 1993b. Riparian acreage for the upper portion of Susie Creek was based on the assumption stated in footnote 6. Riparian acreage estimates may be low since riparian habitat along upper Susie Creek has not been inventoried, and the area does support several, large wet meadow complexes.

[3]Acreage was based on Whitehorse Associates 1995b and BLM 1993b.

[4]Numbers are approximate due to rounding.

[5]An additional 2,819 acres of Marsh/Transition to Marsh riparian vegetation was identified in R20 and R21 that was associated with the newly formed springs in Boulder Valley. The dominant species present was *Typha latifolia* (cattail).

[6]An average width of 5 feet was assumed for riparian vegetation along these creeks since riparian inventories have not been conducted.

[7]Riparian vegetation associated with this creek has an average width of 35 feet.

Sources: Whitehorse Associates 1995a and b; BLM 1993b; JBR 1993.

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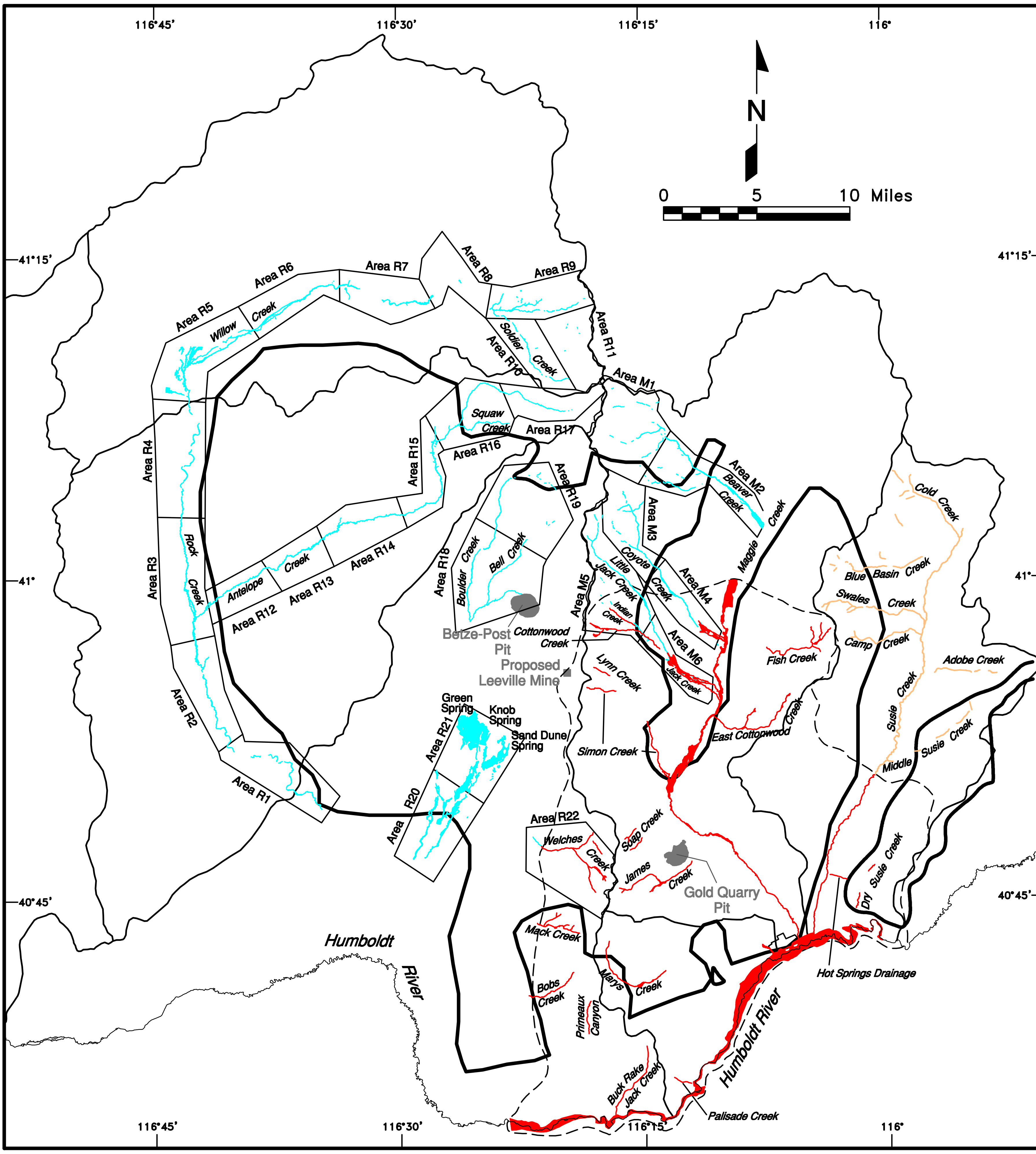

Legend

- Ground Water Basin Boundary
- Cumulative Drawdown Area (≥10 Feet of Drawdown)
- Riparian Inventory Areas [1,3]
- South Operations Area Project-Study Area Boundary [2]
- Riparian Area [2]
- Riparian Area [3]
- Riparian Area [4]

Notes:
1 See Table 4-1
2 Source: BLM 1993b; JBR 1993
3 Source: Whitehorse Associates 1995a,b
4 Source: Newmont Gold Company (perennial reaches - riparian areas have not been inventoried)

Figure 4-1

Riparian Areas Identified in the Project Vicinity

Table 4-2
Wetland and Riparian Vegetation Types and Dominant Species Present Within the Cumulative Assessment Area

Vegetation Type	Site	Dominant Species[1]
Streambar	Above streamside type on stream deposits below ordinary high water mark (OHWM)	Annual muhly (*Muhlenbergia minutissima*), rabbitfootgrass (*Polypogon monspeliensis*), American bulrush (*Scirpus americanus*), coyote willow (*Salix exigua*), silverweed cinquefoil (*Potentilla anserina*), exalted centaury (*Centaurian exaltatum*), Canada horseweed (*Conyza canadensis*)
Herbaceous Streambar[2]	In or immediately adjacent to streams at or below OHWM or within channel or adjacent to stream below OHWM; in low lying oxbows, meanders, and sloughs with standing water or high groundwater throughout or late into the growing season; older relatively, dry meanders and upland terraces.	Fewflowered spikerush (*Eleocharis pauciflora*), American bulrush (*Scirpus americanus*), annual muhly (*Muhlenbergia minutissima*), American speedwell (*Veronica americana*), Kentucky bluegrass (*Poa pratensis*), Baltic rush (*Juncus balticus*), povertyweed (*Iva axillaris*), rabbitfootgrass (*Polypogon monspeliensis*), Canada cocklebur (*Xanthium strumarium*), inland saltgrass (*Distichlis spicata*), fivehook bassia (*Bassia hyssopifolia*), whitetop (*Cardaria draba*), black greasewood (*Sarcobatus vermiculatus*), reed canarygrass (*Phalaris arundinacea*), seepweed (*Suaeda* spp.)
Wet Meadow[3]	Within perennial streams or artesian seeps and springs in broad floodplains ; ponds formed in deeper oxbows, meanders, borrow pits, or other depressions.	Cattail (*Typha latifolia*), hardstem bulrush (*Scirpus acutus*), American bulrush (*Scirpus americanus*), Nebraska sedge (*Carex nebraskensis*), Baltic rush (*Scirpus balticus*), woolly sedge (*Carex lanuginosa*), fowl bluegrass (*Poa palustris*), western mountain aster (*Aster occidentalis*), annual muhly (*Muhlenbergia minutissima*), slim sedge (*Carex praegracilis*), redtop bentgrass (*Agrostis stolonifera*), common yarrow (*Achillea millefolium*), Kentucky bluegrass (*Poa pratensis*), silverweed cinquefoil (*Potentilla anserina*), potentilla (*Potentilla gracilis*), and submerged or floating aquatics in open water
Salix Streambar[4]	Seasonally flooded levees and channels; recently exposed stream-laid deposits, moist to wet soils lining channel banks, newer oxbows and meanders; older stream-laid deposits and older oxbows and meanders and irrigation ditches.	Coyote willow (*Salix exigua*), cheatgrass (*Bromus tectorum*), false yarrow (*Chaenactis douglasii*), hairy willow-herb (*Epilobium cilitatum*), Scotch cotton-thistle (*Onopardum acanthium*), ragweed (*Ambrosis* spp.), rabbitfootgrass (*Polypogon monspeliensis*), Woods rose (*Rosa woodsii*), reed canarygrass (*Phalaris arundinacea*), common reed (*Phragmites australis*), and white sweetclover (*Melilotus alba*)
Salix/Wet Meadow	Seasonally flooded, saturated, or semipermantly flooded wetland	Pacific willow (*Salix lasiandra*), American mannagrass (*Glyceria grandis*), marsh yellow-cress (*Rorripa islandica*)

Table 4-2 (Continued)
Wetland and Riparian VegetationTypes and Dominant Species
Present within the Cumulative Assessment Area

Vegetation Type	Site	Dominant Species[1]
Salix/Mesic Meadow[5]	Banks adjacent to streams or in areas of high water table; moist, subirrigated low areas.	Yellow willow (*Salix lutea*), Kentucky bluegrass (*Poa pratensis*), Douglas sedge (*Carex douglasii*), western mountain aster (*Aster occidentalis*), coyote willow (*Salix exigua*), catchweed bedstraw (*Galium aparine*), Canada thistle (*Cirsium arvense*), fewflowered spikerush (*Eleocharis pauciflora*), creeping wildrye (*Elymus tritichoides*), common yarrow (*Achillea millefolium*), annual muhly (*Muhlenbergia minutissima*), fowl bluegrass (*Poa palustris*), narrowleaf cottonwood (*Populus angustifolia*), black cottonwood (*Populus balsamifera trichocarpa*), and Popular (*Populus* spp.)
Salexi/Mesic Meadow	Intermittently or seasonally flooded channels and levees	Coyote willow (*Salix exigua*), Nebraska sedge (*Carex nebraskensis*), Kentucky bluegrass (*Poa pratensis*), water groundsel (*Senecio hydrophilus*), field mint (*Mentha arvense*)
ALNINC/Mesic Meadow	Seasonally flooded wetland	Pacific willow (*Salix lasiandra*), Booth's willow (*Salix boothii*), slender hairgrass (*Deschampsia elongata*), Kentucky bluegrass (*Poa pratensis*), stinging nettle (*Urtica dioca*), curly dock (*Rumex crispus*), Oregon checker-mallow (*Sidalcea oregana*)

[1]Sources: Whitehorse Associates 1995a and b; BLM 1993b.
[2]Includes Gravel Bar and Bulrush/Cattail and saltgrass vegetation types as described in BLM 1993b.
[3]Includes Cattail/Pond, Sedge Meadow, Baltic Rush Meadow, and Grassy Wet Meadow/Grassy Meadow and Open Water vegetation types as described in BLM 1993b.
[4]Includes Yellow Willow and Coyote Willow thicket and poplar vegetation types as described in BLM 1993b.
[5]Includes Young and Mature Willow as described in BLM 1993b.

The condition of riparian habitats in the Rock Creek and Maggie Creek basins was evaluated by Whitehorse Associates during the 1994 field season (Whitehorse Associates 1995a,b). Five riparian condition classes were developed by Whitehorse Associates, which included very poor (<50 percent), poor (50 to 60 percent), fair (61 to 80 percent), good (81 to 90 percent), and excellent (91 to 100 percent). Riparian condition was based on channel morphology, which directly affects hydrologic attributes and associated riparian vegetation types. Riparian habitat conditions for specific streams within these basins are described in the following sections.

4.1.1.1 Maggie Creek Watershed

Riparian habitat inventories were conducted along Beaver, Coyote, Little Jack, and Jack creeks by Whitehorse Associates in 1995 and along Spring, Jack, lower Maggie, James, Soap, Marys, Lynn/Simon, Bobs, Mack, Cottonwood, East Cottonwood, Fish, and Indian creeks by JBR in 1993 (Whitehorse Associates 1995a,b; JBR 1993). Approximately 46 percent (928 acres) of the riparian habitat present within the watershed occurs along Maggie Creek. Other creeks within the watershed that support substantial riparian habitat include Beaver Creek (323 acres), Coyote/Spring Creeks (314 acres), and Little Jack/Jack Creeks (367 acres). Wet meadow is the predominant riparian vegetation type within this watershed. The average riparian condition within this watershed was classified as poor (53 percent) (Whitehorse Associates 1995a,b). Riparian habitat conditions associated with Beaver (58 percent), Coyote (53 percent), and Jack creeks (50 percent) was classified as poor.

As part of the Mitigation Plan for the development of the SOAP, Newmont Gold Company, in conjunction with the Elko BLM and Elko Land and Livestock Company, developed the MCWRP to improve streams, riparian habitats, and watershed conditions within the Maggie Creek subbasin (BLM 1993b). The MCWRP was designed to enhance 1,982 acres of riparian habitat, over 40,000 acres of upland watershed, and 82 miles of stream channel within the Maggie Creek subbasin (BLM 1993b). Components of the plan included exclosure and pasture fencing for livestock grazing management, conservation easements, water developments, water augmentation, riparian plantings, and other measures. Restoration of LCT habitat was a key consideration in development of the plan.

The MCWRP includes the management and monitoring of stream and riparian habitats associated with Maggie, Coyote, Indian Jack, Little Jack, Lynn, and Simon creeks. An additional 23 spring sites also were fenced and developed where possible to provide alternate sources of water for livestock. Streams and associated riparian habitats are included within 16 pastures (see Figure 8-1 in Chapter 8.0). Changes in grazing management on these areas has included total exclusion of livestock; exclusion of livestock until selected biological standards have been met followed by limited, prescription grazing; and application of various grazing systems. Additional pastures controlled by Maggie Creek Ranch were initially identified for improvement in the MCWRP; however, no changes in management of these areas is known to have occurred.

Since the MCWRP was implemented in 1993, improvement of riparian habitat including streams occupied by LCT has been excellent (BLM 1997a, 1999). Streams that were once characterized by eroding streambanks and a wide, shallow channel profile now support healthy functioning riparian zones and stable, well vegetated streambanks. Where biological criteria have been established for the reintroduction of grazing, standards have been met, and grazing has been applied on a prescription basis since 1997.

4.1.1.2 Rock Creek Watershed

Riparian habitat inventories were conducted along Rock, Willow, Antelope, Boulder, and Welches creeks by Whitehorse Associates in 1995 (Whitehorse Associates 1995a,b). In addition, riparian/wetland habitats associated with Green, Knob, and Sand Dune springs located in Boulder Valley also were delineated. Approximately 89 percent (1,494 acres) of the riparian vegetation present within this watershed was observed along Rock (473 acres), Willow (635 acres), and Antelope creeks (386 acres). Herbaceous streambar is the predominant riparian vegetation type that occurs in this watershed. The average riparian condition within this watershed was classified as very poor (48 percent). Riparian habitat conditions associated with Antelope (35 percent), Boulder (29 percent), Rock (47 percent), Welches (46 percent), and Willow creeks (69 percent) were classified as very poor to fair (Whitehorse Associates 1995a,b).

4.1.1.3 Susie Creek Watershed

Riparian habitat inventories were conducted along lower Susie Creek and the Hot Springs drainage by JBR in 1993 (JBR 1993). Figure 4-1 illustrates the perennial stream reaches that have not been inventoried, including the upper portion of Susie Creek and associated tributaries. Susie Creek supports approximately 89 percent (204 acres) of the riparian habitat observed within the watershed. Streambar is the predominant riparian vegetation type that occurs in this watershed. The condition of riparian habitat within this watershed is unknown.

4.1.1.4 Small Tributaries to the Humboldt River

Riparian habitat inventories along small tributaries to the Humboldt River (i.e., Primeaux, Palisade, Buck Rake Jack, and Dry Susie creeks) were conducted by JBR in 1993 (JBR 1993; BLM 1993b). Approximately 5 and 4 acres of riparian habitat were observed along Buck Rake Jack and Dry Susie creeks, respectively. Primeaux and Palisade creeks support approximately 2 acres of riparian vegetation. Herbaceous streambar is the predominant riparian vegetation type that occurs in this area. The condition of riparian habitat within this area is unknown.

4.1.1.5 Humboldt River

A riparian habitat inventory was conducted along the Humboldt River by JBR in 1993 (JBR 1993; BLM 1993b). Approximately 388 acres of riparian vegetation were observed along the Humboldt River. Salix streambar is the predominant riparian vegetation type (242 acres) that occurs along the Humboldt River. The condition of riparian habitat is unknown.

Based on a series of field investigations, all springs and seeps identified in the cumulative assessment area are illustrated in Figure 3-6 (JBR 1990a; RTi 1994; JBR 1992b; Newmont 1999c). The locations of these springs and seeps represent conditions prior to the initiation of major mine dewatering activities in 1991.

These springs and seeps are primarily associated with perennial streams in the cumulative assessment area and support wetland species commonly associated with riparian areas.

Representative seeps and springs also have been sampled for a number of years in the Goldstrike Mine vicinity to determine whether or not dewatering activities are affecting flows. As part of the monitoring effort, vegetation transects were established in 1993 at several of the sampling sites to assess annual variations in the vegetative structure and species composition of the springs and seeps within the project area (Keammerer 1998). Eight transects at spring, seep, and creek bottom sites located east and west of the Betze Pit have been sampled annually since 1993, and eight additional transects were established in 1995 north and west of the Betze Pit. Table 4-3 lists the types of dominant vegetation associated with each transect and notes regarding grazing impacts on existing vegetation. The optimum areas for evaluating

Table 4-3
Vegetation Associated with Seeps and Springs

Dominant Plant Species in Vegetation Transects Sampled Since 1993	**Documented Grazing Influences**
Cocklebur (*Xanthium strumarium)*, cheatgrass (*Bromus tectorum)*	None noted
Alkali bluegrass (*Poa juncifolia*), alkali cordgrass (S*partina gracilis*), alkali muhly (*Muhlenbergia asperifolia)*	None noted
Red top (*Agrostis alba)*, Kentucky bluegrass (*Poa pratensis),* Nebraska sedge (*Carex nebraskensis*), common spikerush (*Eleocharis sp.)*,	Grazed previously[1]
Three-stamen rush (*Juncus ensifolius)*, Nebraska sedge	Ungrazed until 1998
Kentucky bluegrass, dandelion (*Taraxacum officinale)*, red top	Heavily grazed[1]
Meadow barley (*Hordeum brachyantherum*), bacopa (*Bacopa rotundifolia)*, Kentucky bluegrass	Heavily grazed[1]
Red top, bacopa	Grazed[1]
Meadow barley	Grazed[1]
Dominant Plant Species in Vegetation Transects Sampled Since 1995	
Chairmaker's rush (*Scirpus americanus)*, alkali muhly, scouring rush	Ungrazed
Chairmaker's rush, strawberry clover (*Trifolium fragiferum*) horsetail (*Equisetum laevigatum)*	Heavily grazed[1]
Baltic rush, dandelion	Grazed[1]
Chairmaker's rush, Baltic rush	Grazed in some years[1]
Nebraska sedge	Heavily grazed[1]
Sedge (*Carex* spp.), common spikerush, Nebraska sedge	Grazed
Baltic rush, common spikerush	Grazed
Mat muhly (*Muhlenbergia richardsonis)*, red top, Kentucky bluegrass	Grazed[1]

[1]Year-to-year differences in vegetative cover are likely related to cattle grazing.

Source: Keammerer 1998, as appended to ABC 1998.

potential effects are transects located in seep areas that are not grazed (Keammerer 1997). In 1993, 66 species were observed, compared with 77 species in 1997 and 1998 (Keammerer 1998). Differences in overall species composition have been minor and are most likely not related to mining activities, but rather to grazing intensity, yearly precipitation variations, and differences related to field observations (Keammerer 1998). At most sites, no changes related to dewatering have been observed over the 5-year sampling period; one exception is a site on Brush Creek where flows and vegetation have been affected by dewatering activities.

Following the appearance of the three springs (i.e., Green, Knob, and Sand Dune springs) in Boulder Valley, wetland vegetation developed in the areas of standing water (see areas R20 and R21 on Figure 4-1). In 1995, the Sand Dune drainage area included approximately 885 acres of riparian vegetation primarily consisting of cattails (*Typha latifolia*) and 80 acres of desert saltgrass (*Distichlis stricta*) (Woodward-Clyde 1996). At the time of the study, approximately 1,935 acres were covered with standing water. This area was described as 2,819 acres of Marsh and Transition to Marsh vegetation in the Whitehorse study (Whitehorse Associates 1995a,b). As described in Section 3.2.3.1, the mounding of water in upper Boulder Valley is predicted to gradually subside and dissipate. As water levels subside, the wetland vegetation will decline and likely be replaced by uplands dominated by salt-tolerant species.

4.1.2 Humboldt River

Riparian habitat associated with the Humboldt River supports various riparian vegetation types including willow, cottonwood, bulrush, cattail, saltgrass, and stream deposits (Rawlings and Neel 1989, Ramsey 1988). The majority of riparian vegetation occurs in areas with numerous meanders and oxbows. The riparian habitat survey conducted by Rawlings and Neel (1989) included the Humboldt River and its major tributaries from the Deeth area (approximately 32 miles northeast of Elko) to Rye Patch Reservoir (204 miles). The 53-mile portion of the river that extends from the Dunphy discharge point to the Comus gaging station supports approximately 8,618 acres of riparian vegetation and includes:

Willow – 2,311 acres;
Cottonwood – 16 acres;
Bulrush – 2,810 acres;
Cattail – 330 acres;
Saltgrass – 2,410 acres; and
Stream deposits – 741 acres.

Willow stands typically occur in recent to old stream-laid deposits, moist to wet soils lining channels, oxbows, meanders, and irrigation ditches. This vegetation type is characterized by a dominant shrub layer consisting of coyote willow and Wood’s rose and a subdominant layer of herbaceous species dominated by rabbitsfoot-grass (*Polypogon monspeliensis*), reed canary-grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), cheatgrass (*Bromus tectorum*), and ragweed species (*Ambrosia* sp.). Some of the willow stands include minor populations of tamarisk (*Tamarix ramosissima*), which is considered an invader species. Cottonwood stands are associated with moist, subirrigated low areas that are dominated by narrowleaf cottonwood (*Populus angustifolia*) and black cottonwood (*Populus trichocarpa*) trees and an understory consisting of upland herbaceous species.

Bulrush communities are established in low-lying oxbows, meanders, and sloughs with high ground water late into the growing season. Plant species commonly associated with this vegetation type include various bulrushes, rushes, and sedges. Cattail communities also occur in low-lying oxbows, and meanders and sloughs with standing water or high ground water throughout the growing season. Species that are commonly associated with these communities include common cattail, bulrushes, and rushes. Saltgrass communities are established on older, relatively dry meanders and upland terraces and typically support inland saltgrass, black greasewood (*Sarcobatus vermiculatus*), reed canary-grass, and seepweed (*Suaeda* sp.).

Stream deposits occur along seasonally exposed stream-laid deposits within or adjacent to active channels. These areas are typically devoid of vegetation or sparsely vegetated with annual weed species or young willows.

Riparian habitat studies were conducted by the NDOW at eight sites along this segment of the Humboldt River (Bradley and Neel 1990; Bradley 1992; and Neel 1994). The condition of these sites ranged from poor to excellent including three sites in poor condition; two sites in fair or fair to good condition; two sites in good condition; and one site in excellent condition. Riparian areas in poor condition were characterized by low plant cover, especially willows, and typically support minimal riparian vegetation resulting from flooding or overgrazing. The site in excellent condition was characterized by above average plant cover provided by willows and was located in the Herrin Slough area.

The Humboldt River extends approximately 141 miles from the Comus gaging station to the Humboldt Sink; 21 miles of the river is impounded to form Rye Patch Reservoir. The upper segment of the river extends approximately 71 miles from the Comus gaging station to Rye Patch Reservoir, and the lower segment extends approximately 49 miles from the Rye Patch Reservoir Dam to the Humboldt and Carson sinks.

Riparian habitat studies were conducted by NDOW at eight sites along the segment of the Humboldt River extending from the Comus gaging station to Rye Patch Reservoir (Neel 1994). The condition of these sites ranged from poor to good including one site in poor condition and seven sites in good condition. The riparian area in poor condition was characterized by low plant cover, especially by willows, and supported minimal riparian vegetation resulting from flooding or overgrazing. The seven sites in good condition were characterized by extensive willow and bulrush communities associated with meanders and oxbows.

Based on riparian habitat studies conducted by the NDOW, a net loss of 13.4 miles of river length between Dunphy and Rye Patch Reservoir has occurred during the past 30 years. Substantial loss of river length and sinuosity has occurred in the Dunphy and Argenta area, and downstream to Winnemucca. In other locations, such as near Comus and Winnemucca, the river has both increased and decreased its length.

Prior to the 1950s, a large wetland complex named the “Big Slough” existed along the Humboldt River approximately halfway between Battle Mountain and Dunphy. This complex consisted of wetlands and abandoned channels that supported extensive stands of willow and other riparian and wetland vegetation. During the 1950s, this area was drained by a Federal channelization project, which straightened the course of the river for several miles through the Argenta vicinity and elsewhere along the river. This area is currently referred to as the former Argenta Marsh and primarily supports upland species. NDOW and other public and private organizations are interested in restoration of the former Argenta Marsh with the use of mine discharge water in the river (see Section 3.1.3.3).

The majority of the riparian/wetland vegetation associated with Rye Patch Reservoir is located where the river enters the reservoir. Riparian plant species established in this area primarily include willows and tamarisks. Riparian vegetation is limited along the remainder of the reservoir shoreline due to the deep water near the shoreline, fluctuating water levels, and steep banks. Narrow bands of riparian vegetation, primarily consisting of willows, are established along the shorelines of Upper and Lower Pitt-Taylor reservoirs.

The segment of the Humboldt River extending from Rye Patch Reservoir to the Humboldt Sink is characterized by a well-defined, deeply-incised river channel with low channel sinuosity, which supports narrow, localized bands of riparian vegetation established along the river bank or sandbars. The river channel and the associated extent of riparian vegetation within the floodplain in the Lovelock area is narrower as a result of various water diversions.

Prior to agricultural development in the region, most of the water of the Humboldt River flowed unrestricted to the Humboldt Sink wetlands. At the end of the 19th century the Humboldt Sink supported approximately 58,000 acres of wetland vegetation (Seiler et al. 1993). Wetlands were extensive, and the lower valley was a large meadow (Big Meadow). The most common plants in the wetlands included alkali bulrush (*Scripus paludosus*), cattails, sago pondweed (*Potamogeton pectinatus*), and muskgrass (*Chara* sp.). Dikes were built along the lower Humboldt River, and wetlands were drained for crops. The area formerly known as the Big Meadow became the Lower Valley agricultural area (Seiler et al. 1993). Between 1949 and 1973, wetlands within the Humboldt WMA covered only 12,850 acres, or 22 percent of its original size (Hallock et al. 1981).

Three wetlands units occur in the Humboldt WMA including the Upper Humboldt Lake, Lower Humboldt Lake, and Toulon Lake. Water depth in the Upper and Lower Humboldt lakes typically ranges from 2 to 18 inches; approximate water depth during the 1880s was estimated at 12 feet. Toulon Lake is approximately 4 feet higher than Humboldt Lake and is not directly fed by the Humboldt River. Prior to agricultural development in the Lovelock area, Toulon Lake was intermittently filled by spillover from the Humboldt Lakes (Seiler et al. 1993). During the 1930s and 1940s, prior to the completion of the Toulon Drain, Toulon Lake was an alkali playa.

The Carson Sink is an alkaline playa lake that supports limited wetland vegetation. The high salinity in the water makes it intolerable for most plants except salt-tolerant plants, including seepweed and desert saltgrass.

4.2 Impacts from Mine Dewatering and Localized Water Management Activities

The potential for impacts to riparian areas is based on the 1) predicted ground water drawdown and 2) the connectivity of the perennial streams, seeps, and springs supporting riparian vegetation with the regional ground water aquifer (see Section 3.2.4).

Ground water model simulations suggest that reductions in baseflow could occur in lower Rock Creek, Boulder Creek, Marys Creek, upper and lower Maggie Creek, and lower Susie Creek (Section 3.2.4, Impacts to Perennial Springs and Streams). However, because of the limitations inherent in hydrologic modeling and the uncertainty regarding the hydrologic interconnection between the streams and the regional ground water system, the actual extent and magnitude of impacts to riparian vegetation are uncertain.

The riparian areas within the shaded area in Figure 4-2 are located in areas where perennial waters could be impacted by drawdown; therefore, the potential exists for impacts to some of these riparian areas. Other riparian vegetation areas within the 10-foot drawdown area are unlikely to be affected by ground water drawdown (see Section 3.2.4).

Figure 4-2 illustrates the riparian areas that could be affected by ground water drawdown associated with ground water pumping for mine dewatering. Approximately 600 acres (14 percent) of the 4,337 acres of riparian vegetation occur within the areas where perennial waters could be impacted by ground water drawdown (see Figure 4-2). The remaining 3,737 acres of riparian vegetation within the cumulative assessment area occur outside of these areas and are considered less likely to be affected by ground water drawdown. The following sections provide specific information regarding riparian vegetation that potentially could be affected by ground water drawdown by individual watershed.

4.2.1 Maggie Creek Watershed

The Maggie Creek watershed includes approximately 61 percent of the riparian vegetation within the cumulative assessment area. The watershed supports approximately 2,025 acres of riparian vegetation, of which approximately 366 acres (18 percent) occur within areas where some impacts could occur. The majority of the riparian vegetation that occurs in areas that could be impacted by ground water drawdown is associated with Maggie Creek (246 acres), Lynn/Simon Creek (19 acres), Beaver Creek (35 acres), Coyote/Spring Creeks (15 acres), and Little Jack/Jack Creeks (20 acres). Other smaller parcels of riparian vegetation in these potentially affected areas include James Creek (5 acres), Marys Creek (10 acres), Cottonwood Creek (5 acres), Fish Creek (3 acres), East Cottonwood Creek (6 acres), and Indian Creek (1 acre).

Some of the riparian habitats associated with the MCWRP are located within the area that potentially could be affected by ground water drawdown. However, impacts to these areas are not anticipated since water augmentation projects have been completed and would compensate for the potential loss or reduction of ground water in the area.

4.2.2 Rock Creek Watershed

The Rock Creek watershed includes approximately 38 percent of the riparian vegetation within the cumulative assessment area. This watershed includes approximately 1,685 acres of riparian vegetation, of which approximately 228 acres (14 percent) occur within areas that could be impacted by drawdown. Riparian vegetation that could be affected by ground water drawdown is associated with Boulder Creek (148 acres), Antelope Creek (70 acres), and Welches Creek (10 acres).

4.2.3 Susie Creek Watershed

The Susie Creek watershed includes approximately 228 acres of riparian vegetation, of which approximately 1 acre (<1 percent) potentially could be affected and 227 acres are less likely to be affected by ground water drawdown, respectively. Riparian vegetation that could be affected by ground water drawdown is associated with Middle Susie Creek.

4.2.4 Small Tributaries to the Humboldt River

These tributaries support approximately 10 acres of riparian vegetation, of which approximately 4 acres (40 percent) potentially could be affected and 6 acres have a low probability of being affected by ground water drawdown, respectively. Riparian vegetation that could be affected by ground water drawdown is associated with Dry Susie Creek.

4.2.5 Humboldt River

The Humboldt River includes approximately 388 acres of riparian vegetation with a low probability of being affected by ground water drawdown.

Exposed channel sediments during reduced baseflow periods would be prone to invasion by noxious weeds. Noxious weed species, including Scotch thistle, Canada thistle, leafy spurge, whitetop, water hemlock, diffuse knapweed, and Russian knapweed that have been observed in the SOAPA study area, could become established within these channels (BLM 2000a). Riparian vegetation would likely dominate these areas after water levels returned to premine conditions.

4.2.6 Isolated Springs and Seeps

Approximately 60 isolated springs and seeps, that are not associated with perennial stream reaches, occur within areas where perennial waters could be impacted by drawdown (see Figure 3-15). Based on the SOAPA Draft EIS (BLM 2000a) and the 1993 SOAP EIS (BLM 1993b), the majority of wetlands observed within the Maggie Creek basin range from 0.1 acre to 1.0 acre in size. Assuming that each spring supports

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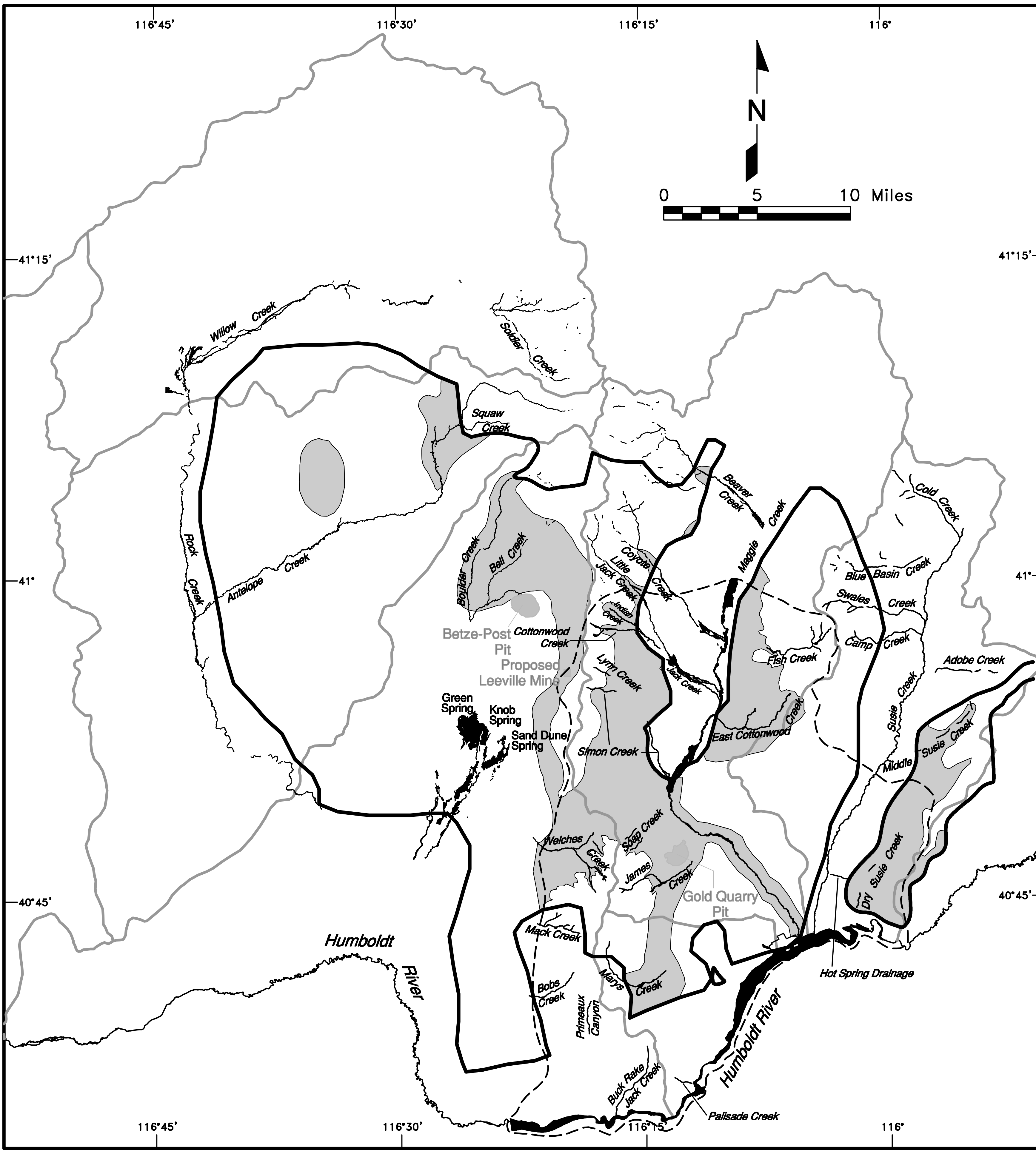

Legend

- Ground Water Basin Boundary
- Cumulative Drawdown Area (≥ 10 Feet of Drawdown)
- South Operations Area Project-Study Area Boundary
- Riparian Area
- 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 4-2

Riparian Areas Potentially Affected by Drawdown

an average of 0.3 acre of wetland vegetation, an estimated 18 acres of wetland vegetation occur within areas where perennial waters could be impacted. Therefore, the amount of wetland vegetation in these areas could be reduced.

In summary, according to ground water modeling and associated water resources analyses, approximately 600 acres of riparian vegetation associated with perennial stream reaches and 18 acres of wetland vegetation associated with isolated seeps and springs are located within areas where some reduction in flow could occur. Therefore, riparian/wetland vegetation within these areas could be reduced.

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

Natural fluctuations in water levels caused by seasonal variations and flood and drought events greatly influence the distribution and extent of riparian vegetation established within the Humboldt River floodplain. As described previously, additional mine discharges would temporarily increase and mine-induced drawdown would then decrease flows in the Humboldt River. These anticipated water level changes potentially could affect channel configuration, depth, and sinuosity that directly affect the distribution and extent of riparian vegetation.

In general, the peak flow months (i.e., May and June) would not be affected by the additional discharge. Relative to the natural fluctuations in river flows during these months, the increases would be small and would have no impact to the flow regime of the Humboldt River during average peak flow months. Water discharges into the river could result in a substantial increase during low-flow periods. During low-flow periods (September to November), the average water depth could increase approximately 1.5 feet (0.7 to 2.2 feet), and channel width could increase approximately 35 feet (45 to 80 feet) under the maximum combined discharge scenario.

Effects from increased water levels during baseflow periods include an increase in elevated water table in low-lying areas located adjacent to the river, increasing the frequency of flooding of stream meanders and oxbows. Riparian/wetland plants could become established in areas where the water table is elevated to the rooting depths needed for riparian/wetland plant establishment. Stream meanders and oxbows could be more frequently subjected to flood events, further enhancing the potential for riparian/wetland plant establishment. Increased baseflows and slightly increased peak flows could facilitate the establishment of willows along the main river channel and side channels since the water levels would be more constant throughout the year. Increases in the extent of riparian vegetation would be most noticeable along segments of the river with gradual banks and low-lying areas located adjacent to the river. These areas could be more frequently flooded during peak flows, and the water table could be shallow due to increased baseflows.

An additional effect resulting from increased water levels during low-flow periods would be the potential for restoring or enhancing specific wetland and marsh habitats in Herrin Slough. Riparian/wetland areas currently present in Herrin Slough, which consists of a series of low-gradient channels, could be enhanced by increased baseflows and slightly elevated peak flows. Water levels in Upper and Lower Pitt-Taylor

Reservoirs could become more consistent, which would improve conditions for wetland and aquatic plant establishment.

Additional effects may include channel instability in the reach extending approximately 3 miles upstream and downstream from the Barrick outfall, deepening of the river channel, and loss of streamside riparian vegetation due to increased erosion and destabilization of stream banks.

The predicted reduction in Humboldt River flows from the cumulative dewatering effects focused on decreases in baseflows through 2095 (see Section 3.3). Impacts to riparian/wetland vegetation from anticipated flow reductions within the Humboldt River could include a long-term reduction in extent of riparian vegetation along the river from 2018 through 2095. 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 that riparian vegetation would begin to re-establish to premining levels upon the eventual recovery of the river's baseflows.

Small, isolated stands of wetland vegetation that occur along the banks of Rye Patch Reservoir would likely be lost if water levels were consistently high within the reservoir during periods of high water discharge. As a result of consistently high water levels, wetland vegetation could be lost to inundation. Steep banks immediately adjacent to the reservoir would make it difficult for wetland vegetation to become re-established. Wetland vegetation would not become established until water levels were comparable to pre-discharge water levels.

Depending on irrigation withdrawals and returns during the period of discharges, the areal extent of wetland vegetation within the Humboldt Sink could increase as a result of higher and more consistent water levels. Consistent high water levels in the Humboldt Sink could flood and kill stands of salt cedar. Portions of the sink that were seasonally flooded would likely be perennially inundated, resulting in the temporary loss of emergent wetland vegetation until it becomes established along the margins of the sink. Dense stands of salt cedar could become re-established on exposed sediments during low-water periods. Increased water levels also would increase the extent of open water habitats that would facilitate aquatic plant establishment. These effects would subside when mine discharges cease. Excess water from the Humboldt Sink may occasionally reach the Carson Sink during high-water periods. The Carson Sink is a shallow, highly alkaline playa lake that primarily supports salt-tolerant upland species. However, the occasional influx of water conveyed to the Carson Sink would not result in the establishment of wetland plants.