DOE/AL/62350-85
REV. 1

MITIGATION AND MONITORING PLAN FOR IMPACTED WETLANDS AT THE GUNNISON UMTRA PROJECT SITE, GUNNISON, COLORADO

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December 1994

Prepared for
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UMTRA Project Office
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DISCLAIMER

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
BLM	U.S. Bureau of Land Management
CC	canopy coverage
CDOW	Colorado Division of Wildlife
DOE	U.S. Department of Energy
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

The U.S Department of Energy (DOE) administers the Uranium Mill Tailings Remedial Action (UMTRA) Project. The UMTRA Project is the result of the Uranium Mill Tailings Radiation Control Act (UMTRCA), which was enacted into law on November 8, 1978 (42 USC §7901 *et seq.*). This law was passed in response to the public's concern over potential human health and environmental hazards related to uranium mill tailings and associated contaminated material at abandoned or otherwise uncontrolled inactive processing sites throughout the United States. The Gunnison, Colorado, abandoned uranium mill site is one site being cleaned up by the DOE under UMTRCA authority. This site's contaminated material is being transported to a disposal site on U.S. Bureau of Land Management (BLM) land east of Gunnison. The *Gunnison Environmental Assessment* (DOE, 1992a) discusses the remedial action and associated impacts. Remedial action activities have temporarily disturbed 0.8 acre (ac) (0.3 hectares [ha]) of wetlands and permanently eliminated 4.3 ac (1.7 ha).

As required by the Clean Water Act (33 USC §1251 *et seq.*), the U.S. Army Corps of Engineers (USACE) prepared a Section 404 Permit that addresses the loss of wetlands as a result of remedial action at the Gunnison UMTRA Project site. The 404 permit includes this report as an attachment and it describes the wetland mitigation and monitoring plan. The DOE formulated this plan in consultation with the BLM and the USACE. This report represents a revised version of the mitigation and monitoring plan (DOE, 1992b). The first version (referred to as version one) was revised for the following reasons:

- In version one, it was estimated that 5.1 ac (2.1 ha) of wetlands would be permanently destroyed as a result of remedial action. This was an overestimation; the actual number of acres destroyed was 4.3 (1.7 ha).
- The BLM determined the final boundaries of the mitigation wetlands, and the size of three sites was reduced from the version one estimate.
- An additional site (Camp Kettle Spring) was added to the mitigation plan.
- Detailed data regarding existing conditions at the mitigation wetlands were collected.
- The wetlands and surrounding riparian plant communities at the five original mitigation sites were remapped.
- The BLM prepared a final environmental assessment (EA) analyzing the impacts of implementing the wetlands mitigation/monitoring plan.
- Fences, spring developments, stock tanks, and relocated roads are in place at the mitigation sites.

This revised mitigation/monitoring plan describes the wetlands affected by the Gunnison UMTRA Project, the existing wetlands used for mitigation, the mitigation plan, and the monitoring program.

2.0 METHODS AND STUDY SITES

2.1 METHODS

2.1.1 Wetlands delineation

The USACE wetland delineation manual (USACE, 1987) (referred to as the Federal Manual) was used to determine the boundaries of the affected and mitigation wetlands. According to the Federal Manual, an area must meet three criteria before it can be considered a wetland:

- Hydrophytic vegetation.
- Hydric soils.
- Wetland hydrology.

Hydrophytic vegetation is defined as "macrophytic plant life growing in water, soil, or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content" (USACE, 1987). The wetland indicator status of plants was determined under the following scheme: species that occur in wetlands 99 percent of the time are obligate species; those that occur in wetlands 67 to 99 percent of the time are facultative-wet species; those equally likely to occur in wetlands and nonwetlands are facultative species; and those that occur 67 to 99 percent of the time in nonwetlands are facultative upland species (Reed, 1988). An area has hydrophytic vegetation when, under normal circumstances, more than 50 percent of its vegetation is obligate, facultative-wet, or facultative species.

"A hydric soil is a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation" (USACE, 1987). Gleying (containing mostly gray soils) and mottling are the two most common features that reflect wetness in mineral soils when standing water or saturated soil is not present. Prolonged saturation causes mineral soils to become gleyed throughout; this soil feature is especially useful for delineating wetland boundaries when standing water and/or saturated soil conditions are not present and/or when obligate plant species are not in evidence.

An area is said to have wetland hydrology when the soils are inundated or saturated to the surface for a sufficient duration to develop hydric soils and support hydrophytic vegetation (USACE, 1987). Hydrological conditions that form wetlands can be found in floodplains along rivers and lakes, estuaries, isolated depressions surrounded by uplands, surface water drainages, and springs and seeps.

2.1.2 Vegetation analysis

An important aspect of the wetlands mitigation plan is characterizing existing vegetation conditions before cattle were excluded from six mitigation sites. This characterization effort consisted of compiling a plant species list for each site and collecting quantitative data regarding the vegetation structure. Plant species inventories were conducted in late summer of 1992 and early summer of 1993 for each site except Camp Kettle Spring, which was surveyed only during the summer of 1993. Plant species identification was based on Barrell (1969), Cronquist et al. (1972), Harrington (1954), and Weber (1987).

Quantitative vegetation data were collected in September 1993 at each site using the Daubenmire method (Daubenmire, 1959) as described in "Rangeland Monitoring - Trend Studies" (BLM, 1985). Permanent transects were established in each major herbaceous plant community type at the six mitigation sites. A metal stake driven into the ground at each transect end will help locate them in future years. A transect identification code was spray-painted on each metal stake. Most transects were 200 feet (ft) (61 meters [m]) long, although a few were 175 ft (53 m) long and one was 150 ft (46 m) long. Three transects were placed at each site except for Lower Long's Gulch Spring, where only one transect was established. Each transect was placed in areas of homogenous vegetation. To sample the vegetation along the transect, a tape was stretched out and a 20 X 50 centimeter (cm) (8 X 20 inches) sampling frame was placed every 5 ft (1.5 m) along the transect. The percent cover for each plant species and bare ground within the sampling frame were determined; each species was placed into one of the following cover classes:

- Class one - 0 to 5 percent cover.
- Class two - 5 to 25 percent cover.
- Class three - 25 to 50 percent cover.
- Class four - 50 to 75 percent cover.
- Class five - 75 to 95 percent cover.
- Class six - 95 to 100 percent cover.

Bare ground includes litter and rock as well as dirt. The percent cover of standing water was also determined. In addition, the height of most plant species was determined. The height of the tallest plants of each species was used; height was measured with a ruler.

Vegetation occurred in essentially one layer (herbaceous layer) at the study sites. Percent plant cover for a given species consisted of the ground obscured by the plant canopy. Bare ground was that part of the plot where vegetation did not grow and/or the plant canopy does not obscure the ground. With this method, plant cover and bare ground equal 100 percent of the plot. However, these two factors did not always add up to 100 percent because the midpoint of the percent cover class was used to calculate cover. For example, a plot may have 95-percent coverage (class five) of one species and 5 percent (class one) bare ground which equals 87.5 percent coverage using the class midpoints.

In addition, the percent bare ground was not determined at a few plots which also resulted in less then 100 percent coverage.

The data were used to determine frequency, ground cover, and plant species canopy cover percentages; percent bare ground; and average plant height. Frequency percentage was determined for each plant species by dividing the number of plots in which a species was recorded by the total number of plots sampled. Ground cover percentages for each plant species and for bare ground were determined by multiplying the number of times a species or bare ground was recorded in a cover class by the midpoint value for that cover class (e.g., the midpoint value for cover class five is 85 percent). The canopy cover percentage for each plant species and bare ground is the total of the products for all the cover classes divided by the number of sample plots. Percent species composition is determined by dividing the canopy cover for each plant by the total canopy cover for all plants.

Permanent photo monitoring stations were established at each transect as described by the BLM (1985). Close-up photographs of the vegetation at each transect end were taken. A 3 X 3-ft (0.9 X 0.9-m) frame was placed on the ground inside and 10 ft (3 m) from each transect end. These photo monitoring stations were marked with steel stakes at two diagonal corners. General view photographs also were taken from each transect end looking down each transect.

2.2 STUDY SITES

2.2.1 Impacted wetlands

The 0.8 ac (0.3 ha) of temporarily disturbed wetlands consisted of a 15-ft (5-m)-wide strip of vegetation growing in a drainage ditch on the east side of Gold Basin Road (Figure 2.1). Before remedial action, this area had a dense growth of willow (*Salix* sp.) and cottonwood (*Populus angustifolia*), with sedges (*Carex* sp.) as the dominant ground cover.

Of the 4.3 ac (1.7 ha) permanently removed as a result of the Gunnison Project, 3.4 ac (1.4 ha) occurred in the floodplain of Tomichi Creek next to Gold Basin Road (Figure 2.1). Much of this wetland was created by irrigation and was grazed by livestock. Using the livestock forage patterns of Platts and Nelson (1985), this area was heavily used. The wildlife use of this wetland was minimal because it was heavily grazed, it was next to a paved county road, and hundreds of acres of similar wetland habitat adjacent to the impacted area are not next to areas of human disturbance such as roads.

The remaining 0.9 ac (0.4 ha) of permanently removed wetland was part of a 1.5-ac (0.6-ha) wetland adjacent to the Gunnison UMTRA Project tailings pile (Figure 2.1). This wetland exhibited a high degree of plant species richness dominated by obligate wetland species such as mannagrass (*Glyceria* sp.); sedge (*Carex* sp.), water parsnip (*Sium suave*), and sloughgrass (*Beckmannia*

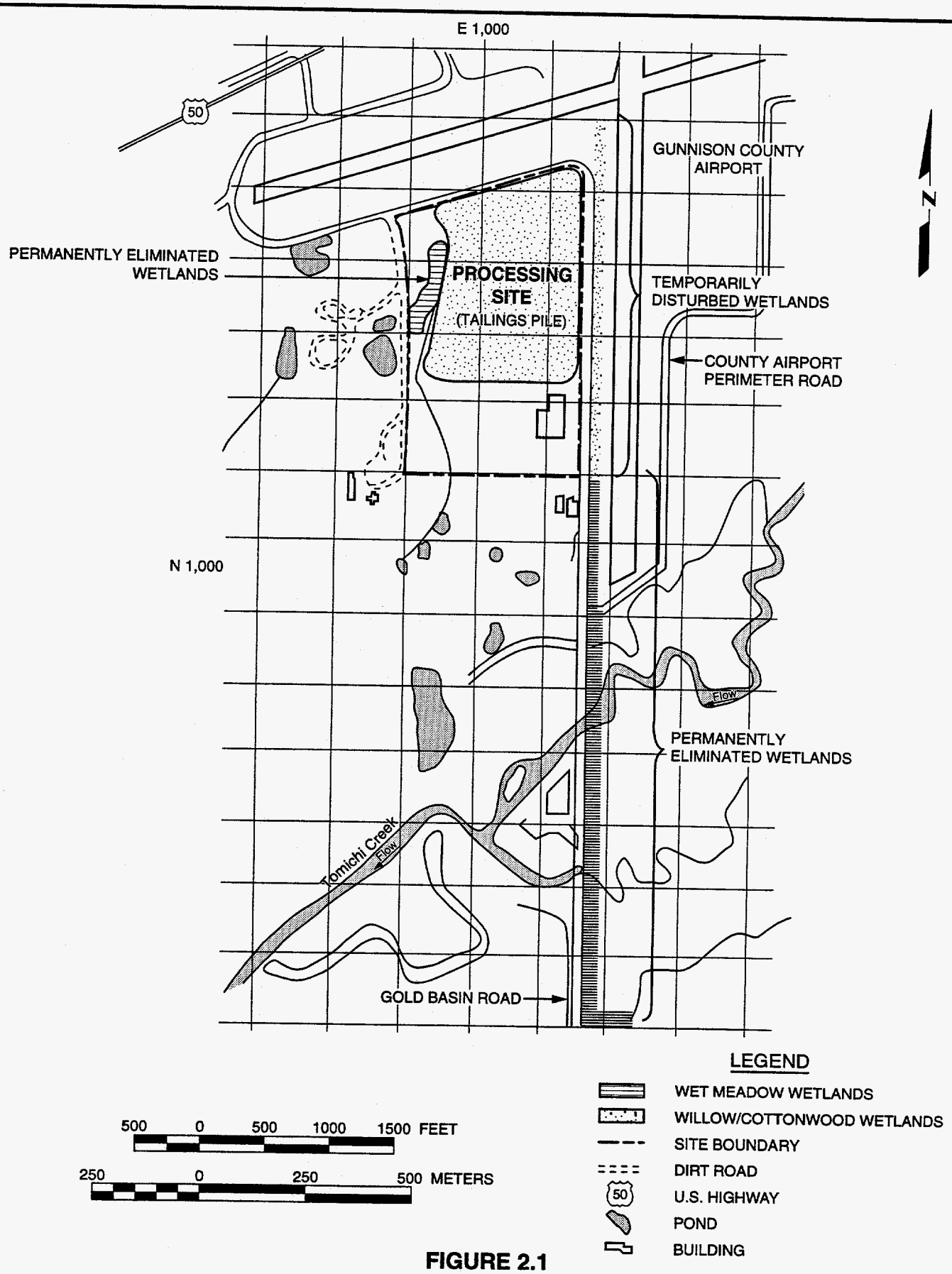

FIGURE 2.1
WETLANDS THAT WERE TEMPORARILY DISTURBED AND PERMANENTLY ELIMINATED BY REMEDIAL ACTION AT THE GUNNISON, COLORADO, SITE

MAC: SITE: GUN/WETLAND/DISTURBEDWET

syzigachne) also are common. A small 0.2-acre (0.1-ha) wetland just north of this wetland was not impacted by remedial action. This site is dominated by sloughgrass. No woody species occur in these two wetlands. These small wetlands supported a population of the striped chorus frog (*Pseudacris triseriata*), occasional migratory waterfowl and other water birds, and other wildlife. These wetlands apparently were created by a leaky irrigation ditch.

In the version one mitigation plan (DOE, 1992b), both wetlands (1.7 ac [0.7 ha]) were predicted to be eliminated due to the reconstruction and rerouting of the irrigation ditch. However, as stated above, the ditch reconstruction only destroyed 0.9 ac (0.4 ha) of wetlands.

The 0.8 ac (0.3 ha) of unaffected wetlands may disappear slowly because the new irrigation ditch was constructed to be watertight. The status of these wetlands will be monitored over the next 5 years and if they disappear, their loss will be mitigated. The wetlands mitigation plan described below should result in the enhancement and creation of enough wetlands to cover the potential disappearance of the 0.8 ac (0.3 ha) of wetlands.

2.2.2 Mitigation wetlands

The six sites that will be used to mitigate the permanent loss of 4.3 ac (1.7 ha) of wetlands are on BLM land south of Parlin, Colorado (Figure 2.2). The mitigation sites exist in the dry sagebrush-dominated plant community in the Gunnison Basin. Wetlands and riparian plant communities are limited in these upland areas. These areas are important as brood-rearing habitat for the sage grouse and as watering areas for the pronghorn antelope and many other wildlife species. The wetlands at these sites are formed by springs, typically exist at or near intermittent drainages, and are classified as the Mountain Meadow Range site by the Soil Conservation Service (SCS, 1975). The sites were subjected to livestock grazing for many years. Most of the vegetated areas in these riparian areas were very heavily grazed, with the herbaceous vegetation grazed to less than 2 inches (5 cm) in many areas and the willow (*Salix* sp.) thickets heavily damaged. According to forage patterns presented by Platts and Nelson (1985), the riparian vegetation at the proposed mitigation sites were heavily used (i.e., livestock grazing use of the riparian vegetation is high and only short stubble remains).

The mitigation sites are on two grazing allotments. The Camp Kettle Spring site is in the Camp Kettle Gulch allotment, which covers 15,855 ac (6417 ha) and is grazed by approximately 200 head of cattle from 15 May through 30 September. The other five sites are in the South Parlin Flats allotment, which covers 15,569 ac (6300 ha). This allotment is grazed by cattle and a few horses from 15 May to 13 September; livestock vary from approximately 200 to 500.

The availability of succulent vegetation, water, and shade at the mitigation sites and other riparian areas attracts numerous cattle. Vegetation in these riparian

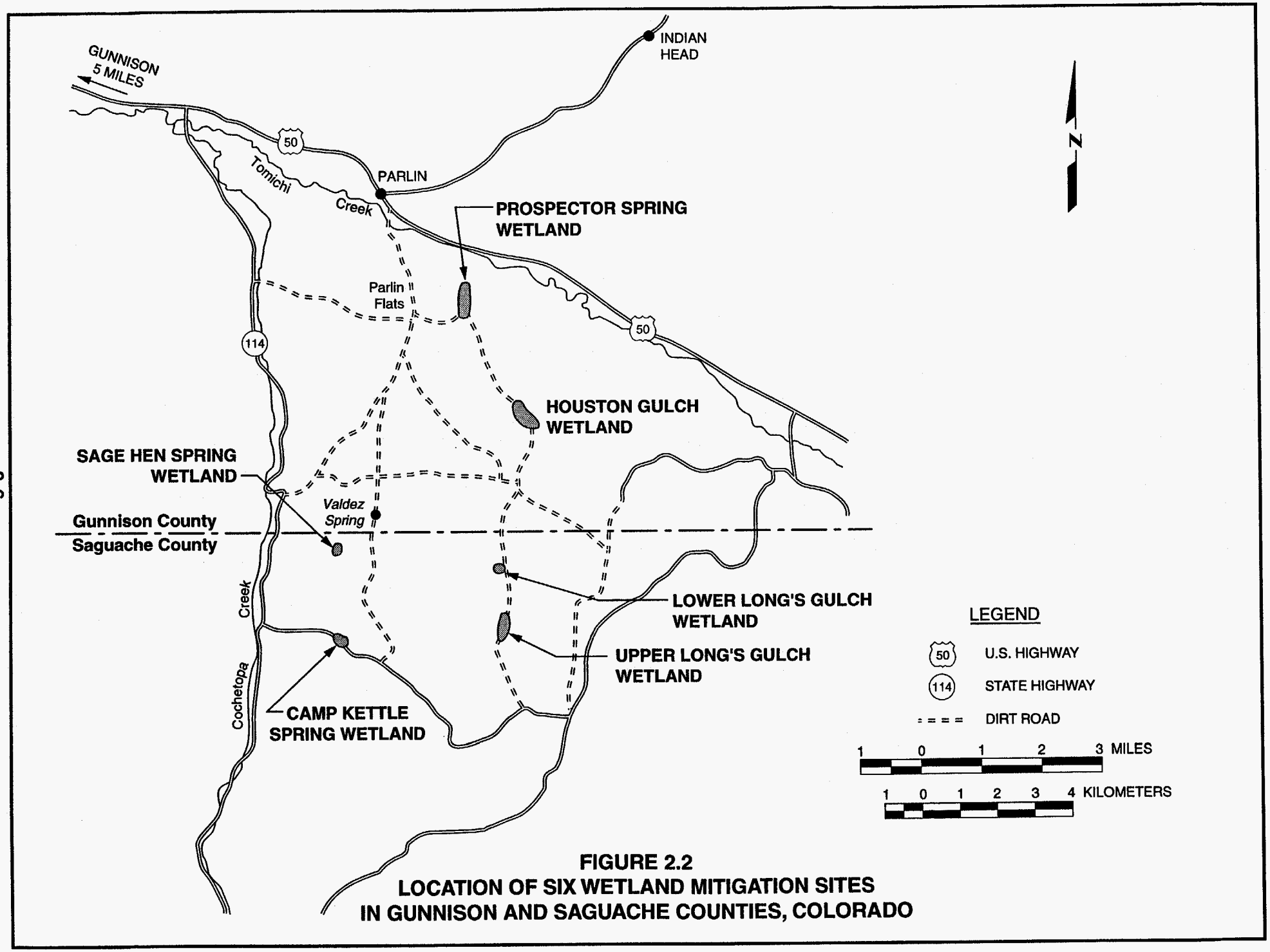

FIGURE 2.2
LOCATION OF SIX WETLAND MITIGATION SITES
IN GUNNISON AND SAGUACHE COUNTIES, COLORADO

MAC: SITE/GUN/WETLAND/SIXWETLANDS

areas 1) provides shade, 2) maintains a moist microclimate, 3) builds organic soil that holds soil moisture, and 4) stabilizes the banks (Stabler, 1984). Cattle grazing and trampling have reduced the riparian vegetation's effectiveness in performing its function because trampling/overgrazing the vegetation reduces shade, leading to greater evaporation from wetlands (Katibah et al., 1981) and a reduction in wetland size. Livestock trampling also causes destabilization of the banks (Marlow and Pogacnik, 1985).

The six mitigation sites have been fenced to exclude livestock. At one site, this fencing required realigning a small segment of road. In addition, stock tanks were provided and springs were developed at some sites to ensure a continued water supply for livestock. The following description of these activities was derived from the EA prepared by the BLM (BLM, 1993) and information received from M-K Ferguson personnel who constructed the facilities. Approximately 200 ac (81 ha) were fenced at the Prospector Spring site using a combination of new and existing fencing; two gates were installed in this fence. A spring south of the site was developed and fenced to provide water for a stock tank outside the exclosure (Figure 2.3).

The Houston Gulch mitigation site was fenced with new material and includes two gates. Cattle guards were installed in the existing road to prevent cattle access to the site. No new water development was required, although a stock tank was placed outside the fence line and hooked to an existing pipe (Figure 2.4).

Lower Long's Gulch was fenced with new material and includes two gates. No road realignment was required and a stock tank was placed outside the exclosure. The water for this tank was provided from an existing spring within the exclosure by attaching a new pipe to existing piping (Figure 2.5).

The construction of the Upper Long's Gulch exclosure required new fencing; two gates were installed. Approximated 0.3 mi (0.5 km) of the existing road was realigned. A spring within the exclosure was developed, water from which was piped to a stock tank outside the exclosure to the west (Figure 2.5).

The Sage Hen Spring mitigation site was surrounded with new fencing and two gates were constructed. The construction of the exclosure did not require road realignment or development of livestock watering facilities (Figure 2.6).

The Camp Kettle site was surrounded by new fencing and two gates. No road realignment was required. Water was piped from an existing pond inside the exclosure to a stock tank outside the exclosure (Figure 2.6).

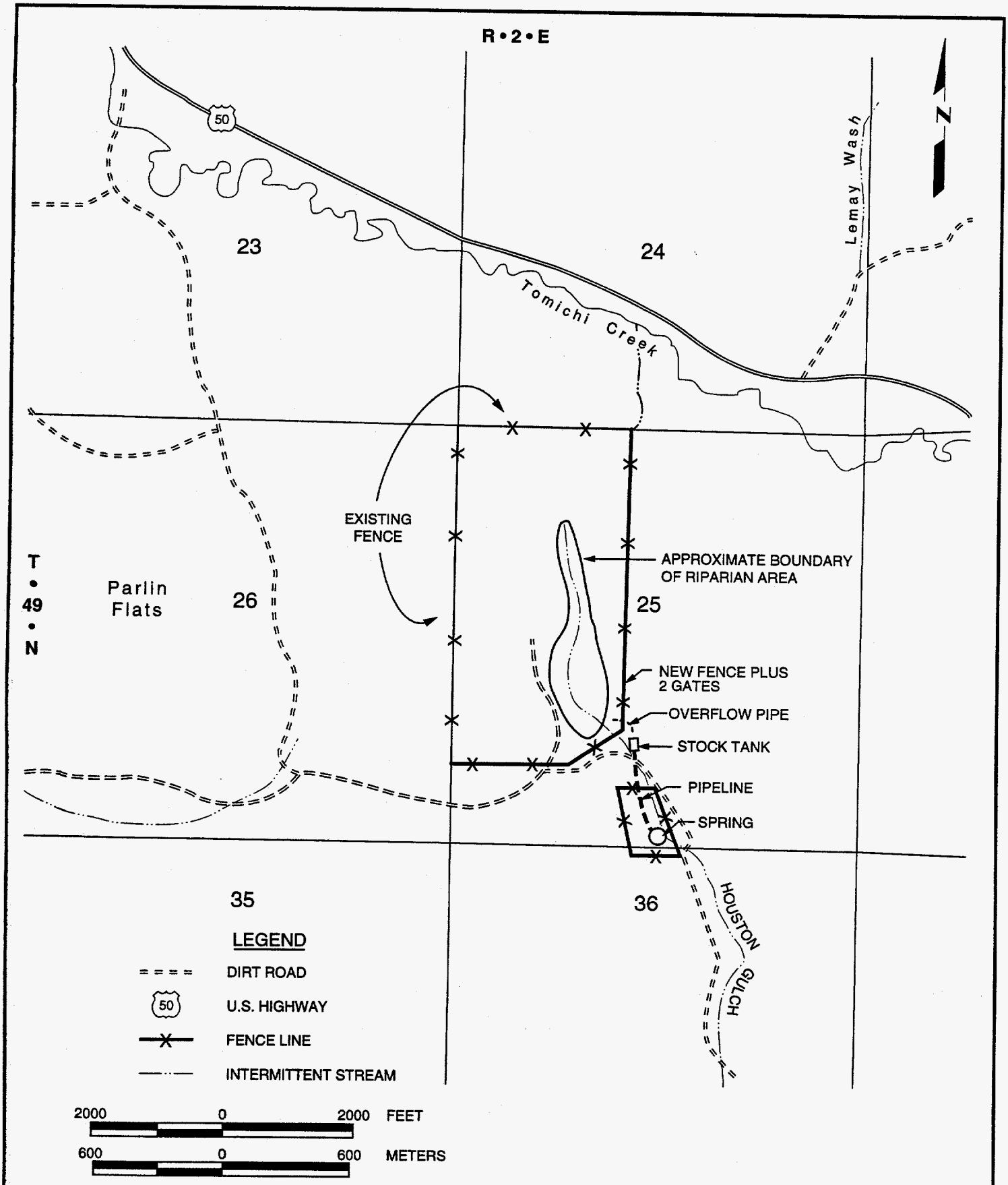

FIGURE 2.3
LOCATIONS OF FENCING AND OTHER DEVELOPMENTS AT THE PROSPECTOR SPRING MITIGATION SITE GUNNISON COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/FIGURE2.3

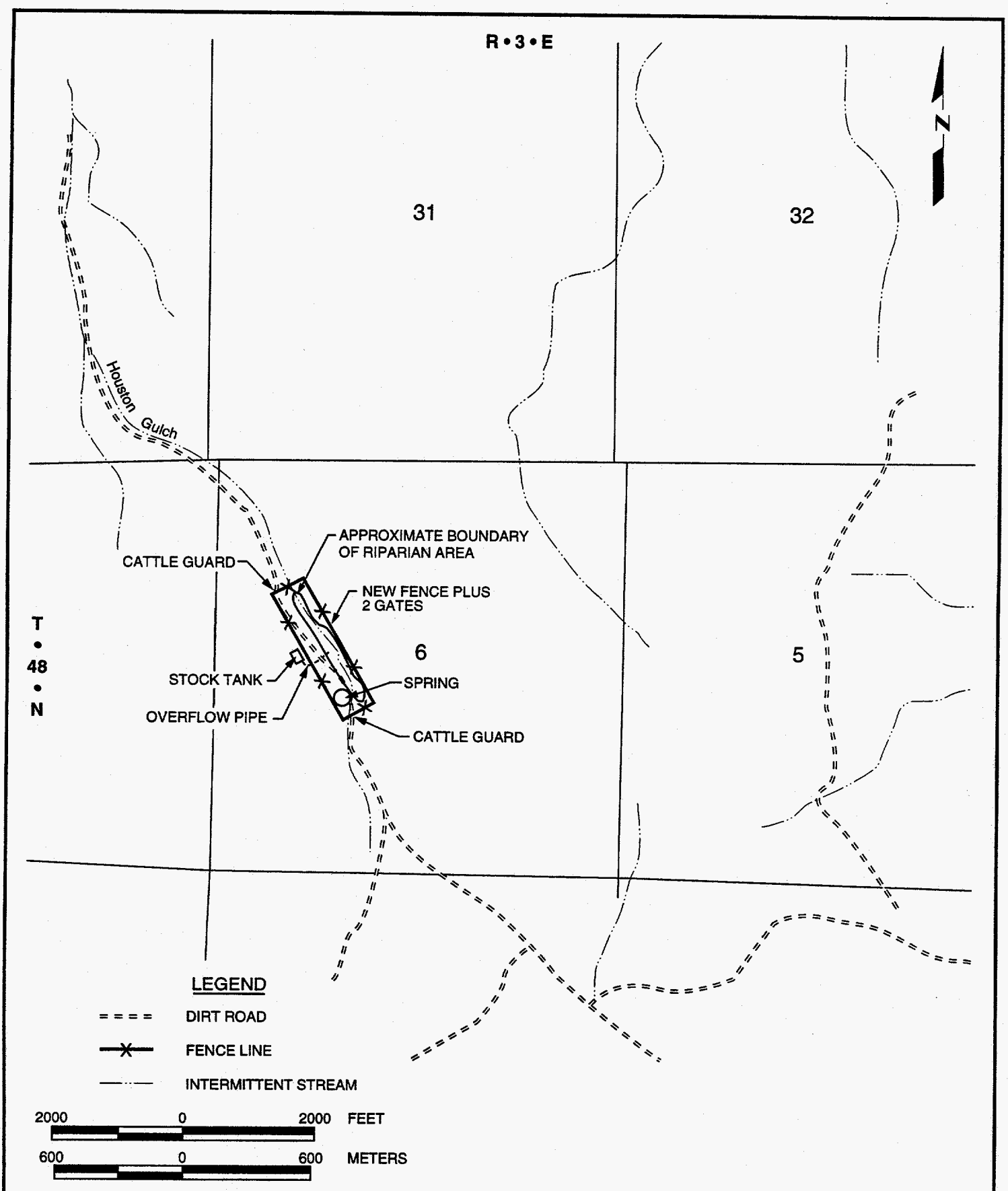

FIGURE 2.4
LOCATIONS OF FENCING AND OTHER DEVELOPMENTS AT THE HOUSTON GULCH MITIGATION SITE GUNNISON COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/FIGURE2.4

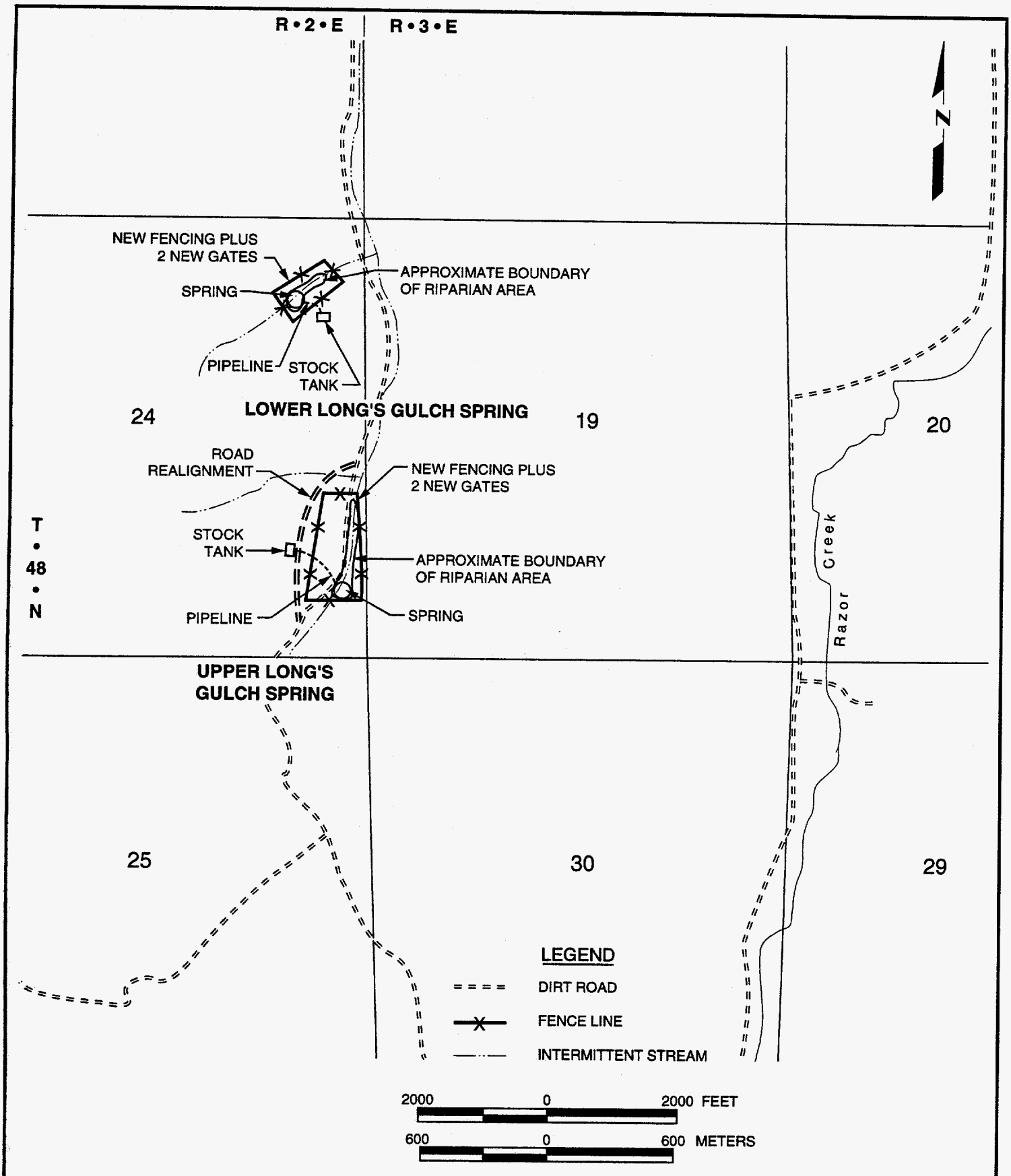

FIGURE 2.5
LOCATIONS OF FENCING AND OTHER DEVELOPMENTS
AT THE LOWER LONG'S AND UPPER LONG'S GULCH MITIGATION SITES
SAGUACHE COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/FIGURE2.5

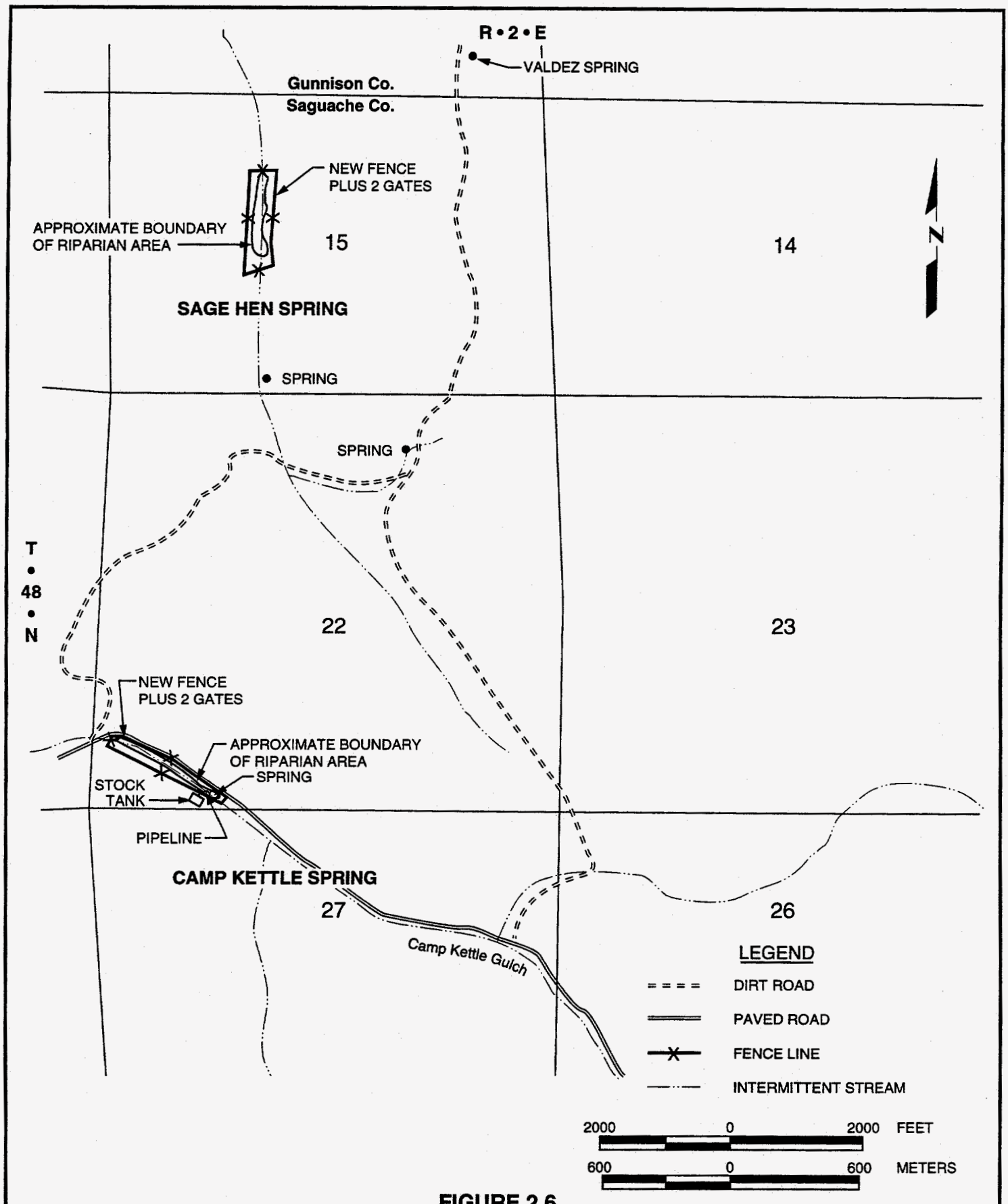

FIGURE 2.6
LOCATIONS OF FENCING AND OTHER DEVELOPMENTS
AT THE SAGE HEN SPRING AND CAMP KETTLE SPRING MITIGATION SITES
SAGUACHE COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/FIGURE2.6

3.0 RESULTS

The following description of the mitigation sites is based on data collected in 1993. The plant species recorded at the six sites appear in Attachment A, and the data collected at the 16 transects appear in Attachment B.

The mitigation sites consist of wetlands formed by springs; all the sites are generally similar in vegetative structure and are all heavily grazed. The plant communities at these sites are a function of elevation above the water supply and grazing pressure. All sites have an upper riparian grassland plant community between the surrounding sagebrush community and lower lying wetlands (Attachment C, Photographic Series 1). This type is dominated by fowl bluegrass (*Poa palustris*) in most areas and baltic rush (*Juncus balticus*) in the others. This plant community type has been heavily grazed, with the average plant height generally less than 2 inches (5 cm). Although the upper riparian plant community meets the hydrophytic vegetation criterion as a wetland (both fowl bluegrass and baltic rush are facultative-wet species), the existence of wetland hydrology could not be demonstrated. Therefore, this type is not considered "wetlands" as defined by the USACE. However, the exclusion of cattle from the six mitigation sites will likely result in expansion of the existing wetlands into the upper riparian grassland plant community. The degree of expansion of these wetlands is difficult to predict and could range from essentially no expansion to an increase of a few acres. The projected maximum increase is presented in Figures 3.1 through 3.6. The wetlands boundaries at the six sites will be determined periodically throughout the monitoring period.

Wetlands dominated by grass, baltic rush, and sedges occur in lower lying areas below the upper riparian plant community (Attachment C, Photographic Series 2). This lower riparian grassland plant community tends to have greater plant species diversity and more dominant plant species than the upper. Wetland hydrological conditions such as standing water, saturated soil, and gleyed soil and/or other indicators such as hummocks created by cattle activity were present.

A sedge-dominate plant community (beaked sedge [*Carex rostrata*] or water sedge [*Carex aquatilis*]) grows in the lowest lying areas at all the mitigation sites except Lower Long's Gulch (Attachment C, Photographic Series 3). This type of plant community consists of a homogenous stand of sedges with few other species. The sedge plant community grows in areas with generally permanent surface water or saturated soil conditions. This type of plant community was typically grazed only around the edges.

Willow thickets occur at three of the six mitigation sites (Attachment C, Photographic Series 4). The willows typically are damaged by cattle and are old plants. No willow reproduction was observed at these sites.

3.1 PROSPECTOR SPRING

The 8.7-ac (3.5-ha) Prospector Spring is the largest mitigation site and consists of three plant community types (Figure 3.1). The upper riparian grassland plant community covers 5.2 ac (2.1 ha) and two wetland community types cover the

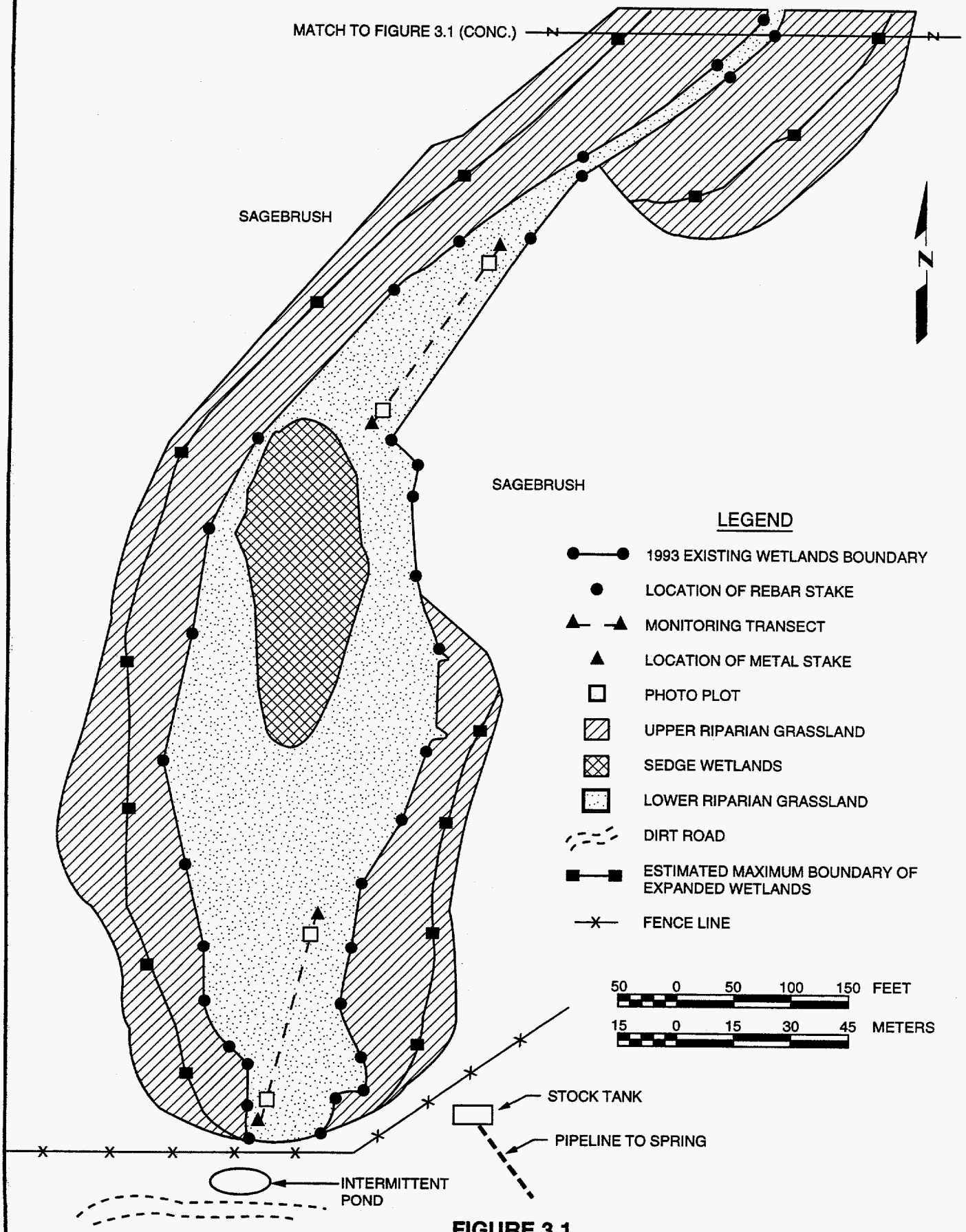

FIGURE 3.1
RIPARIAN PLANT COMMUNITIES AT PROSPECTOR SPRING
GUNNISON COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/GUN3.1

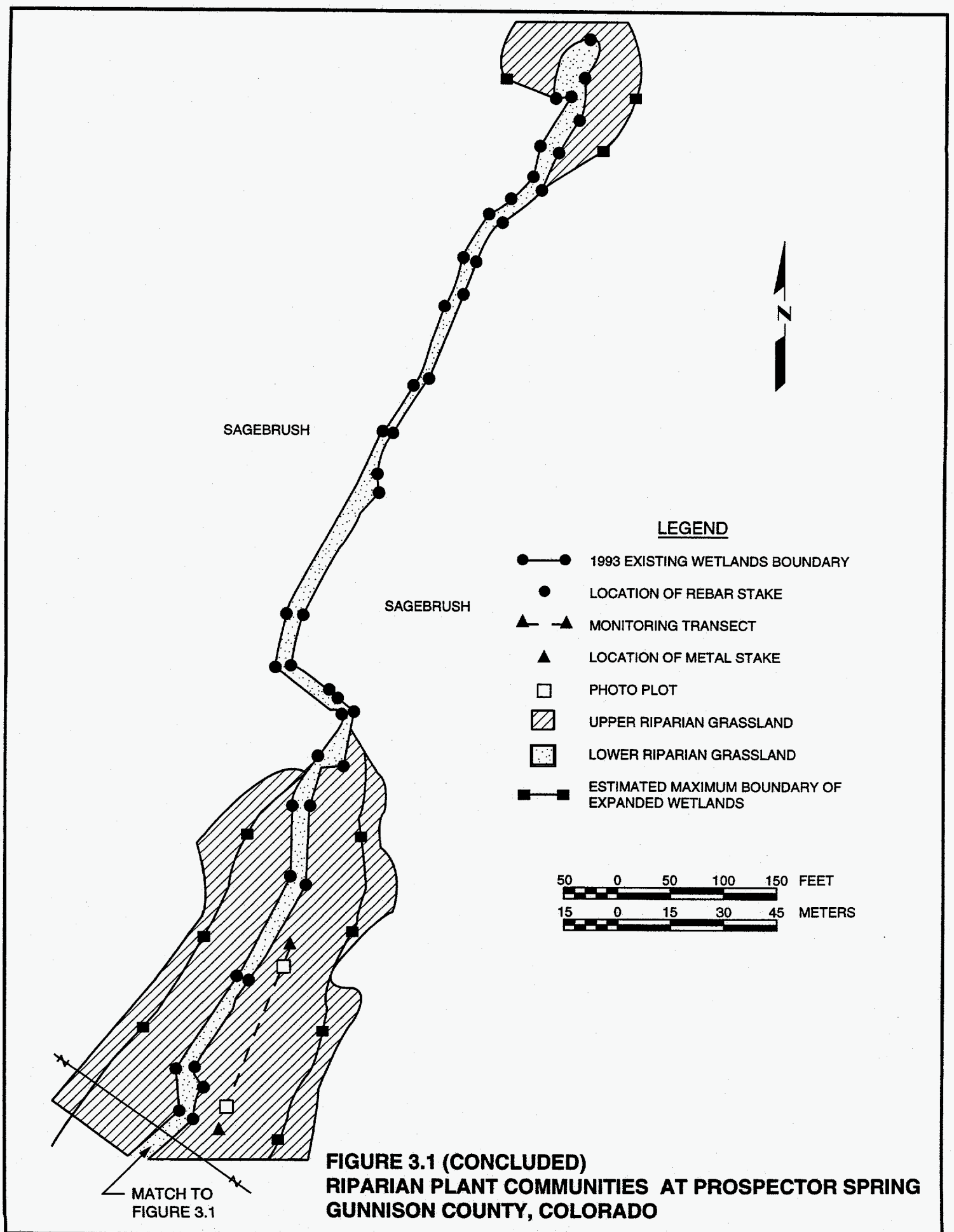

FIGURE 3.1 (CONCLUDED)
RIPARIAN PLANT COMMUNITIES AT PROSPECTOR SPRING
GUNNISON COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/GUN3.1C.

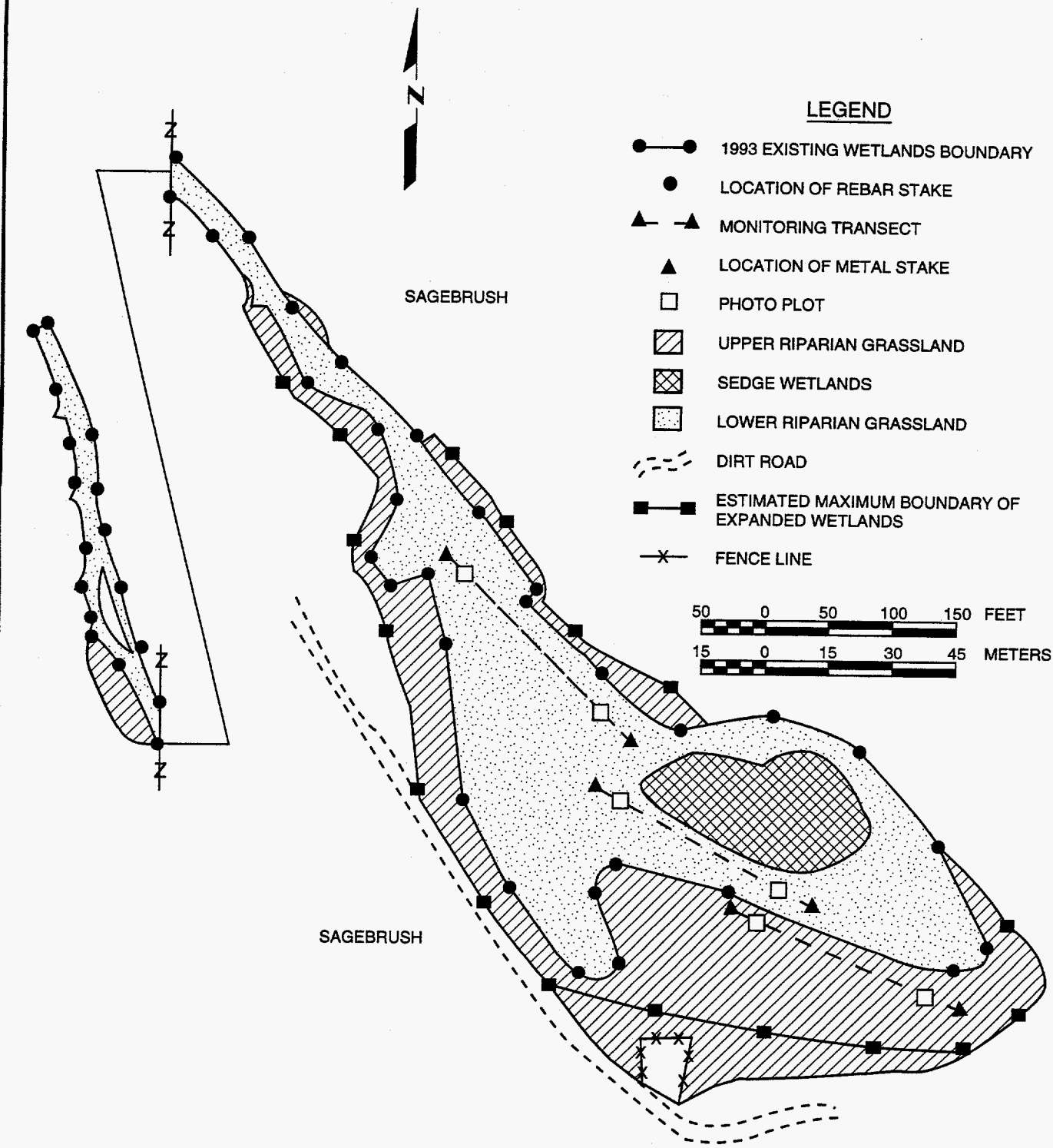

FIGURE 3.2
RIPARIAN PLANT COMMUNITIES AT HOUSTON GULCH SPRING
GUNNISON COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/GUN3.2

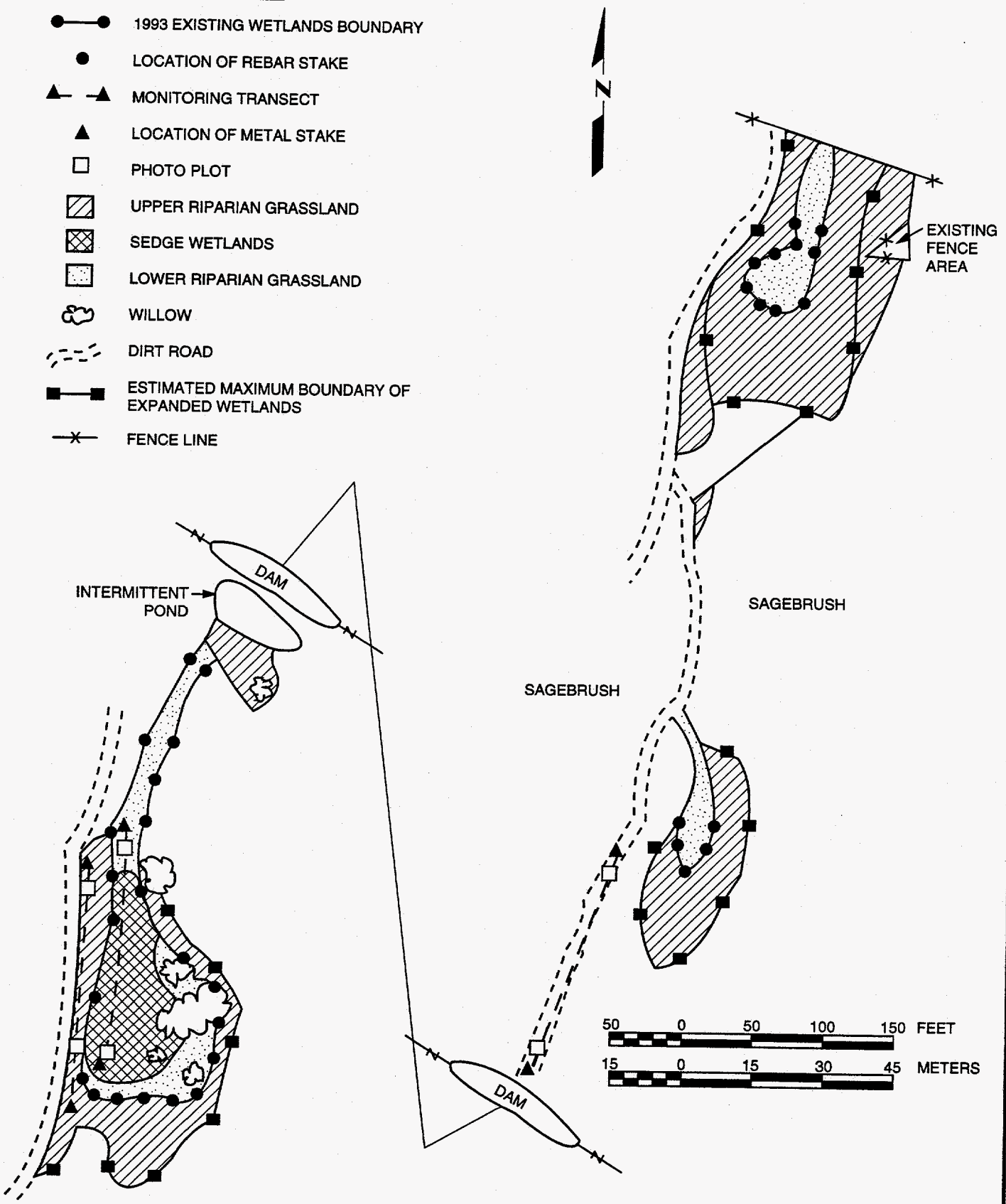

FIGURE 3.3
RIPARIAN PLANT COMMUNITY TYPES IN UPPER LONG'S GULCH SPRING
SAGUACHE COUNTY, COLORADO

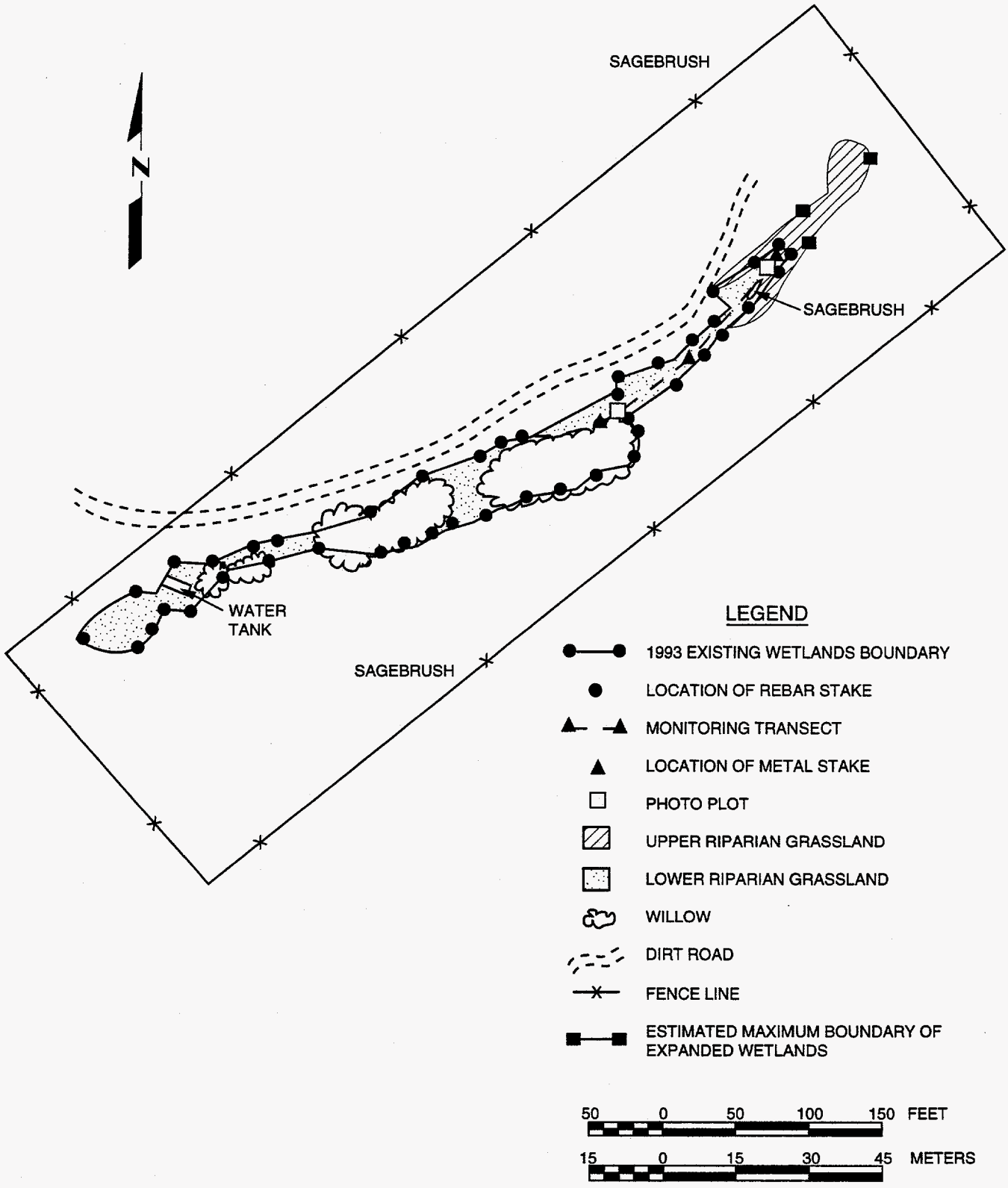

FIGURE 3.4
RIPARIAN PLANT COMMUNITIES IN LOWER LONG'S GULCH SPRING
SAGUACHE COUNTY, COLORADO

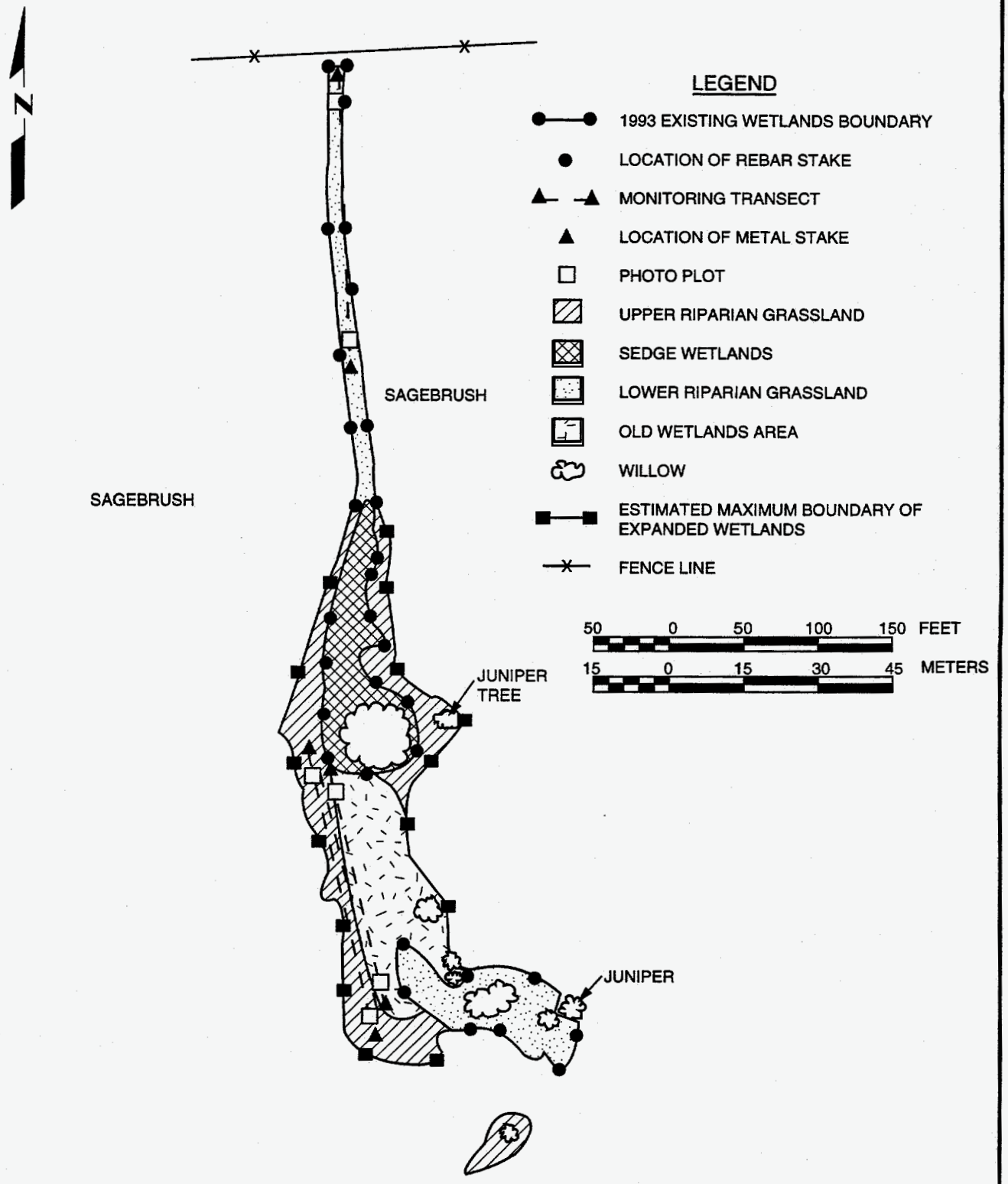

FIGURE 3.5
RIPARIAN PLANT COMMUNITIES IN SAGE HEN SPRING
SAGUACHE COUNTY, COLORADO

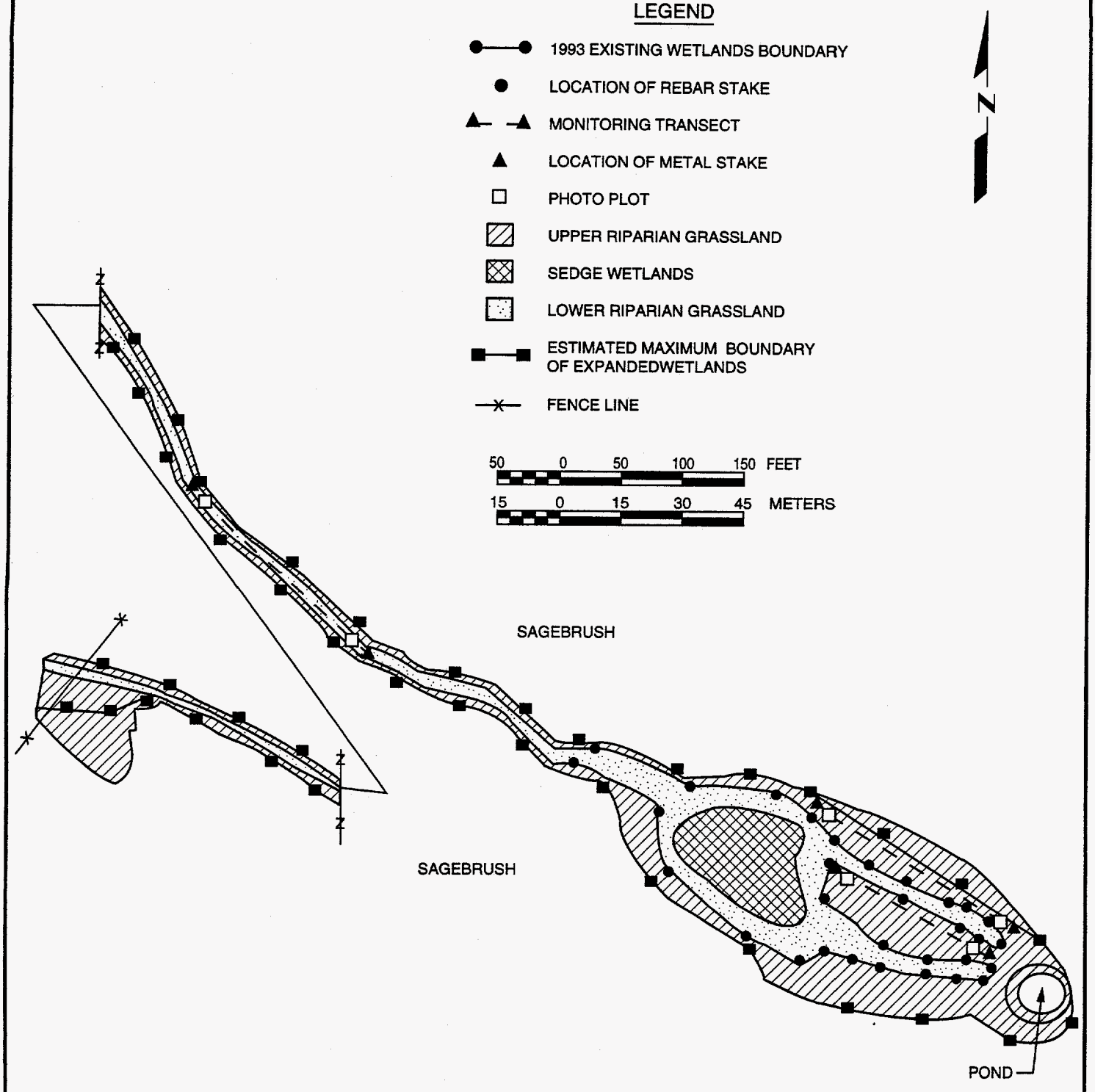

FIGURE 3.6
RIPARIAN PLANT COMMUNITIES AT CAMP KETTLE SPRING
SAGUACHE COUNTY, COLORADO

MAC: SITE/GUN/WETLAND/GUN3.6

remaining area (Table 3.1). The upper riparian plant community areas are dominated by either fowl bluegrass or baltic rush. Transect 3 is in an area dominated by baltic rush. Baltic rush, dandelion (*Taraxacum officinale*), and foxtail barley (*Hordeum jubatum*) were the most frequently encountered species (Table 3.2). Baltic rush accounted for 45 percent of the vegetative cover, while the remaining species covered much less ground (Table 3.2). Bare ground was relatively low (4 percent) in this type. The average plant height for both baltic rush and foxtail barley was 7 inches (18 cm); the remaining species were 3 inches (8 cm) high or less (Table 3.3).

Transect 1 is in a wetland area where baltic rush, foxtail barley, and dandelion were most frequently observed. Baltic rush accounted for 33 percent of the vegetative cover and foxtail barley for 23 percent (Table 3.4). Bare ground in this type was 9 percent. The average height of the dominant species was 9 inches (23 cm) for both baltic rush and foxtail barley (Table 3.5).

Transect 2 is in a wetland area and spikerush (*Eleocharis palustris*), silverweed (*Potentilla anserina*), tufted hairgrass (*Deschampsia cespitosa*), and beaked sedge were the most frequently sampled species (Table 3.4). Spikerush accounted for 33 percent of the vegetative cover, while the other commonly encountered species were only 3 to 7 percent (Table 3.4). Bare ground averaged 21 percent. The average height of the dominant species (spikerush) was 4 inches (10 cm). The average heights of less dominant species were 18 inches (46 cm) for tufted hairgrass and 8 inches (20 cm) for beaked sedge (Table 3.5).

3.2 HOUSTON GULCH

Houston Gulch covers 3.7 ac (1.5 ha) and consists of three plant community types (Figure 3.2). The upper riparian plant community covers 1.6 ac (0.6 ha) and the two wetland types cover 2.1 ac (0.8 ha) (Table 3.1). Transect 1 is in the upper riparian grassland plant community, and fowl bluegrass, dandelion, white clover (*Trifolium repens*); baltic rush were the most frequently sampled species. Bluegrass accounted for 54 percent of the vegetative cover, while the remaining species were 10 percent or less (Table 3.2). An estimated 10 percent bare ground was in this type. The average height of the bluegrass was 1 inch (3 cm); less common species such as baltic rush were 4 inches (10 cm) high (Table 3.3).

Transect 2 is in a wetland area. The ground was mostly dry at the time of sampling but deep hummocks created by cattle walking through the area indicated it was wet earlier in the year. Dandelion, spreading bentgrass (*Agrostis stolonifera*), fowl bluegrass, foxtail barley, silverweed, white clover, tufted hairgrass, yarrow (*Achillea milefolium*), and baltic rush were common species. Bentgrass and bluegrass covered the greatest amount of land (10 percent each). All other species accounted for 7 percent cover or less in this type (Table 3.4). Bare ground averaged 23 percent. The average heights for the two dominant species were 4 inches (10 cm) for fowl bluegrass and

Table 3.1 Number of acres of wetland and upper riparian plant communities at six wetlands mitigation sites in Gunnison and Saguache Counties, Colorado

Mitigation site	Plant community types					
	Wetland				Nonwetland	
	Lower riparian grassland	Sedge	Willow	Total	Upper riparian grassland	Total
Prospector Spring	2.9 (1.2)	0.6 (0.2)	-	3.5 (1.4)	5.2 (2.1)	8.7 (3.5)
Houston Gulch	1.8 (0.7)	0.3 (0.1)	-	2.1 (0.8)	1.6 (0.6)	3.7 (1.5)
Upper Long's Gulch	0.5 (0.2)	0.1 (0.1)	0.1 (0.1)	0.7 (0.3)	1.0 (0.4)	1.7 (0.7)
Lower Long's Gulch	0.2 (0.1)	-	0.2 (0.1)	0.4 (0.2)	0.1 (<0.1)	0.5 (0.2)
Sage Hen Spring	0.2 (0.1)	0.1 (0.1)	0.1 (0.1)	0.4 (0.2)	0.6 (0.2)	1.0 (0.4)
Camp Kettle Spring	1.5 (0.6)	0.2 (0.1)	-	1.7 (0.7)	1.1 (0.5)	2.8 (1.2)
Total	7.1 (2.9)	1.3 (0.5)	0.4 (0.2)	8.8 (3.6)	9.6 (3.9)	18.4 (7.5)

Note: Dash indicates this plant species does not occur at this site.

6 inches (15 cm) for spreading bentgrass. Less dominant species such as baltic rush and foxtail barley averaged 4 inches (10 cm) and 7 inches (18 cm) in height, respectively, while tufted hairgrass averaged 15 inches (38 cm) (Table 3.5).

Transect 3 is in a somewhat wetter area than transect 2, and tufted hairgrass, prostrate knotweed (*Polygonum aviculare*), foxtail barley, baltic rush, silverweed, and yellow cress (*Rorippa islandica*) were commonly encountered species. Tufted hairgrass accounted for 20 percent of the vegetative cover, while the remaining species accounted for 4 percent or less (Table 3.4). This area averaged 30 percent bare ground, which is relatively high for these riparian areas. Much of this bare ground was the result of cattle walking on the hummocks; their feet would slip down the hummocks, dislodging much of the vegetation. The average height of tufted hairgrass was 12 inches (30 cm), while the less dominant baltic rush and foxtail barley were both 7 inches (18 cm) (Table 3.5).

Table 3.2 Percent frequency and percent canopy coverage of common plants in the upper riparian grassland plant community at five mitigation sites in Gunnison and Saguache Counties, Colorado

Plant species (abbreviation)	Mitigation site[a]									
	Prospector Spring		Houston Gulch		Upper Long's Gulch		Sage Hen Spring		Camp Kettle Spring	
	F	CC	F	CC	F	CC	F	CC	F	CC
Bluegrass (Popa)	-	-	100	54	100	41	93	33	100	35
Dandelion (Taof)	85	7	95	10	83	5	10	0.3	78	5
Aster (Asoc)	15	0.4	43	2	70	5	85	7	85	10
Baltic rush (Juba)	98	45	50	5	-	-	15	1	58	6
Foxtail barley (Hoju)	53	2	13	0.3	-	-	-	-	10	0.3
White clover (Trre)	25	1	60	10	-	-	-	-	-	-
Knotweed (Poav)	5	0.4	-	-	5	0.1	3	0.1	3	0.1
Silverweed (Poan)	18	1	3	0.1	-	-	-	-	25	0.6
Yarrow (Acmi)	23	1	13	0.3	-	-	5	0.1	13	2

[a]Data from transect 3 at Prospector Spring and transects 1 at Houston Gulch, Upper Long's Gulch, Sage Hen Spring, and Camp Kettle Spring.

F- percent frequency.
CC - canopy coverage.

Note: Dash indicates this plant species does not occur in this transect.

Table 3.3 Average height of plants in the upper riparian grassland plant communities at five mitigation sites in Gunnison and Saguache Counties, Colorado

Plant species (abbreviation)	Mitigation site[a]				
	Prospector Spring	Houston Gulch	Upper Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Bluegrass (Popa)	-	1	2	1	3
Dandelion (Taof)	<1	<1	<1	<1	<1
Aster (Asoc)	3	<1	<1	1	<1
Baltic rush (Juba)	7	4	-	3	5
Foxtail barley (Hoju)	7	4	-	-	-
White clover (Trre)	<1	<1	-	-	-
Knotweed (Poav)	-	-	-	-	-
Silverweed (Poan)	1	-	-	-	<1
Yarrow (Acmi)	<1	<1	-	<1	<1

[a]Data from transect 3 at Prospector Spring and transects 1 at Houston Gulch, Upper Long's Gulch, Sage Hen Spring, and Camp Kettle Spring.

Notes: 1. < indicates value is less than the number shown.
2. Measurements are reported in inches.
3. Dash indicates this plant species does not occur in this transect.

Table 3.4 Percent frequency and percent canopy coverage of common plants in the wetlands plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado

Plant species (abbreviation)	Mitigation sites									
	Prospector Spring		Houston Gulch		Upper Long's Gulch		Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring	
	T1	T2	T2	T3	T2	T3	T1	T3	T2	T3
Baltic rush (Juba)										
F	95	20	35	38	-	38	23	48	33	8
CC	33	2	2	2	-	2	2	7	5	0.2
Foxtail barley (Hoju)										
F	93	-	45	40	-	-	-	73	38	-
CC	23	-	3	2	-	-	-	12	3	-
Bluegrass (Popa)										
F	39	30	48	25	65	100	91	95	100	68
CC	10	6	10	4	18	37	44	45	50	6
Dandelion (Taof)										
F	85	5	85	23	21	89	69	18	63	28
CC	5	0.1	6	0.6	0.9	9	6	0.4	14	0.7
Silverweed (Poan)										
F	34	58	40	35	47	9	3	23	87	28
CC	1	3	2	2	2	0.2	0.1	0.9	14	1
Aster (Asoc)										
F	34	30	8	25	62	74	14	3	30	18
CC	1	0.8	0.2	0.6	6	3	0.4	0.1	5	0.4
Witchgrass (Paca)										
F	20	8	-	-	-	-	-	-	-	-
CC	0.5	0.5	-	-	-	-	-	-	-	-

Table 3.4 Percent frequency and percent canopy coverage of common plants in the wetlands plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado (Continued)

Plant species (abbreviation)		Mitigation sites									
		Prospector Spring		Houston Gulch		Upper Long's Gulch		Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring	
		T1	T2	T2	T3	T2	T3	T1	T3	T2	T3
Yarrow (Acmi)											
	F	10	5	35	8	3	29	3	5	-	5
	CC	0.2	0.1	1	0.2	0.1	0.7	1	0.1	-	0.1
White clover (Trre)											
	F	20	-	38	8	6	44	3	-	3	35
	CC	1	-	5	0.5	0.1	7	0.1	-	1	5
Spikerush (Elpa)											
	F	-	90	-	-	32	-	-	3	10	-
	CC	-	33	-	-	2	-	-	0.1	0.7	-
Tufted hairgrass (Dece)	F	-	55	38	90	-	-	9	-	-	-
	CC	-	5	7	20	-	-	4	-	-	-
Beaked sedge (Caro)											
	F	-	55	13	5	-	-	-	-	-	-
	CC	-	7	0.6	0.1	-	-	-	-	-	-
Creeping buttercup (Rare)	F	-	33	-	-	32	-	26	13	-	38
	CC	-	1	-	-	0.8	-	0.6	0.3	-	2
Knotweed (Poav)											
	F	-	23	3	45	21	-	3	3	-	-
	CC	-	0.6	0.1	1	0.5	-	0.1	0.1	-	-

Table 3.4 Percent frequency and percent canopy coverage of common plants in the wetlands plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado (Continued)

Plant species (abbreviation)		Mitigation sites: Prospector Spring T1	Prospector Spring T2	Houston Gulch T2	Houston Gulch T3	Upper Long's Gulch T2	Upper Long's Gulch T3	Lower Long's Gulch T1	Sage Hen Spring T3	Camp Kettle Spring T2	Camp Kettle Spring T3
Spreading bentgrass (Agst)	F	2	20	68	15	-	-	-	13	20	-
	CC	0.1	0.4	10	1	-	-	-	2	2	-
Yellow cress (Rois)	F	-	-	-	33	3	-	-	-	-	-
	CC	-	-	-	1	0.1	-	-	-	-	-
Willow-herb (Epad)	F	-	-	-	23	6	-	-	3	-	-
	CC	-	-	-	0.6	0.1	-	-	0.1	-	-
Water sedge (Caaq)	F	-	-	-	-	53	-	-	-	-	-
	CC	-	-	-	-	8	-	-	-	-	-
Field milkvetch (Asag)	F	-	-	-	-	-	26	-	-	-	-
	CC	-	-	-	-	-	1	-	-	-	-
Common plantain (Plma)	F	5	-	-	-	-	-	23	-	7	5
	CC	0.7	-	-	-	-	-	0.9	-	0.2	0.1
Purslane speedwell (Vepe)	F	-	3	-	-	12	-	6	23	-	-
	CC	-	0.1	-	-	0.3	-	0.1	0.6	-	-

Table 3.4 Percent frequency and percent canopy coverage of common plants in the wetlands plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado (Concluded)

Plant species (abbreviation)	Mitigation sites									
	Prospector Spring		Houston Gulch		Upper Long's Gulch		Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring	
	T1	T2	T2	T3	T2	T3	T1	T3	T2	T3
Carex sp. 1 (Caur)										
F	-	-	-	-	-	-	-	18	-	-
CC	-	-	-	-	-	-	-	3	-	-
Carex sp. 2 (Casp)										
F	-	-	-	-	-	-	-	-	-	100
CC	-	-	-	-	-	-	-	-	-	47

F - percent frequency.
CC - canopy coverage.

Notes: 1. T plus number indicate transect numbers.
2. Dash indicates this plant species does not occur in this transect.

Table 3.5 Average height of plant species in the wetlands grassland plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado

Plant species (abbreviation)	Mitigation sites									
	Prospector Spring		Houston Gulch		Upper Long's Gulch		Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring	
	T1	T2	T2	T3	T2	T3	T1	T3	T2	T3
Baltic rush (Juba)	9	11	4	7	-	4	-	3	5	-
Foxtail barley (Hoju)	9	-	7	7	-	-	-	12	3	-
Bluegrass (Popa)	6	11	4	2	3	2	2	10	3	2
Dandelion (Taof)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silverweed (Poan)	<1	<1	<1	<1	<1	-	-	<1	<1	<1
Aster (Asoc)	1	3	-	2	<1	<1	-	-	<1	1
Witchgrass (Paca)	2	-	-	-	-	-	-	-	-	-
Yarrow (Acmi)	<1	-	<1	<1	-	<1	-	-	-	-
Spikerush (Elpa)	-	4	-	-	2	-	-	-	-	-
Tufted hairgrass (Dece)	-	18	15	12	-	-	-	-	-	-
Beaked sedge (Caro)	-	8	3	-	-	-	-	-	-	-
Creeping buttercup (Rare)	-	<1	-	-	<1	-	<1	<1	-	<1
Knotweed (Poav)	-	<1	-	1	<1	-	-	-	-	-

Table 3.5 Average height of plant species in the wetlands grassland plant communities at six mitigation sites in Gunnison and Saguache Counties, Colorado (Concluded)

Plant species (abbreviation)	Mitigation sites									
	Prospector Spring		Houston Gulch		Upper Long's Gulch		Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring	
	T1	T2	T2	T3	T2	T3	T1	T3	T2	T3
Spreading bentgrass (Agst)	-	10	6	4	-	-	-	-	7	-
White clover (Trre)	<1	-	<1	-	-	<1	-	-	-	<1
Yellow cress (Rois)	-	-	-	<1	-	-	-	-	-	-
Willow-herb (Epad)	-	-	-	1	-	-	-	-	-	-
Water sedge (Caaq)	-	-	-	-	4	-	-	-	-	-
Field milkvetch (Asag)	-	-	-	-	-	<1	-	-	-	-
Common plantain (Plma)	-	-	-	-	-	-	<1	-	-	-
Purslane speedwell (Vepe)	-	-	-	-	-	-	-	2	-	-
Caur	-	-	-	-	-	-	-	2	-	-
Curly dock (Rucr)	-	-	-	-	-	-	-	<1	-	-
Carex sp. 2	-	-	-	-	-	-	-	-	-	4

Notes: 1. T plus number indicate transect numbers.
2. Dash indicates this plant species does not occur in this transect.

3.3 UPPER LONG'S GULCH

Upper Long's Gulch covers 1.7 ac (0.7 ha) and has three herbaceous and one woody riparian plant community types (Figure 3.3). The upper riparian grassland plant community grows between the sagebrush plant community and the lower lying wetlands. Fowl bluegrass, dandelion, and aster (*Aster occidentalis)* were commonly observed while 41 percent of the vegetative cover was bluegrass (Table 3.2). An estimated 39 percent of this type was bare ground, mostly due to cattle trampling. The average height of bluegrass was 2 inches (5 cm); the remaining species were less than 1 inch (3 cm) (Table 3.3).

Transect 2 is in the lower riparian grassland plant community next to the sedge plant community. Bluegrass, aster, silverweed, spikerush, and creeping buttercup (*Ranunculus repens*) were the most frequently observed species. Of these species, bluegrass was dominant (18 percent); the remaining species accounted for 6 percent cover or less (Table 3.4). Bare ground coverage was 4 percent, rock was 17 percent, and standing water was 13 percent. The average height of bluegrass was 3 inches (8 cm) and water sedge 4 inches (10 cm); the average height of other frequently encountered species was 2 inches (5 cm) or less.

Transect 3 is in the lower riparian grassland plant community in a narrow drainage and bluegrass, dandelion, and aster were frequently recorded. Bluegrass accounted for almost 37 percent of the plant cover while the remaining species were 9 percent or less (Table 3.4). Ten percent was bare ground and 7 percent was ground covered with rock or wood. The average height of bluegrass was 2 inches (5 cm), while other frequently observed species were less than 1 inch (3 cm). The few baltic rush had an average height of 4 inches (10 cm) (Table 3.5).

Clumps of willow were intermixed among the sedge and lower riparian grassland plant community.

3.4 LOWER LONG'S GULCH

Lower Long's Gulch is the smallest mitigation site (0.5 ac [0.2 ha]) (Table 3.1). The dominant wetland type is willow (Figure 3.4). This site had a small amount of upper riparian grassland plant community (0.1 ac, or less than 0.1 ha) not large enough to establish a transect. One transect was placed in a narrow strip of lower riparian grassland wetlands. Bluegrass and dandelion were the most frequently encountered species, accounting for 44 percent and 6 percent of the plant cover, respectively (Table 3.4). Nine percent of the ground was bare, 10 percent was covered with water, and 2 percent was covered with rock or wood. The average height of the heavily grazed plants in this type was 2 inches (5 cm) or less (Table 3.5).

3.5 SAGE HEN SPRING

Sage Hen Spring consists of four riparian plant community types (Figure 3.5) totalling 1.0 ac (0.5 ha) (Table 3.1). Three transects were sampled at this site. Transect 1 is in the upper riparian plant community. Bluegrass and aster were the most frequently encountered species, accounting for 33 and 7 percent of the vegetative cover, respectively. All other species covered less than 1 percent of the ground (Table 3.2). There was 38 percent bare ground in the sample plots, which is one of the highest levels measured. The average height of the bluegrass was 1 inch (3 cm), while most other species were less than 1 inch (3 cm). The few baltic rush averaged 3 inches (8 cm) in height (Table 3.3).

Transect 2 is in an area dominated by early successional plant species. This area was a wetland plant community until water from the spring feeding this area was diverted north about 200 ft (61 m) to a stock tank (Capodice, 1993). Hummocks are still visible from when the area was a wetland. The most frequently sampled species in this area were spreading knotweed, weedy lamb's quarter (*Chenopodium berlandieri*), fringed sagebrush (*Artimisia frigida*), and stickseed (*Lappula occidentalis*). Knotweed accounted for 20 percent of the vegetative cover followed by fringed sagebrush (6 percent) and bluegrass (4 percent). This area had 44 percent bare ground, which is the highest for all the transects sampled. Most of the plants in this type were less than 1 inch (3 cm) high, although the lamb's quarter averaged 8 inches (20 cm) and fringed sagebrush averaged 7 inches (18 cm).

Transect 3 is in a narrow strip of lower riparian grassland wetlands following a drainage flowing north from the site. Bluegrass, foxtail barley, and baltic rush were the most common species sampled. Bluegrass was the dominant species of vegetative cover (45 percent), while foxtail barley was 12 percent and baltic rush was 7 percent (Table 3.4). Only 9 percent of the ground was bare. The grass was still relatively high in this type, with bluegrass and foxtail barley averaging 10 inches (25 cm) and 12 inches (30 cm), respectively. This area was less heavily grazed than other areas at Sage Hen Spring. Foxtail barley, which is avoided by cattle and fairly common in this area, may have discouraged the cattle from grazing the other species as heavily.

Sage Hen Spring has a small homogeneous stand of sedge wetland (Figure 3.5). Due to an alteration in the water supply, this area no longer contains standing water. The cattle moved into this area and grazed all the sedge down to 2 to 3 inches (5 to 8 cm). This indicates that the sedge wetlands at the other mitigation sites are not heavily grazed because the soil is too saturated for cattle to walk into the areas.

3.6 CAMP KETTLE SPRING

Camp Kettle Spring comprises three riparian plant community types (Figure 3.6) and encompasses 2.8 ac (1.1 ha) (Table 3.1). Transect 1 is in the upper riparian grassland plant community, and bluegrass, aster, dandelion, and baltic

rush were the most frequently observed species. Bluegrass accounted for 35 percent of the plant cover, while aster was 10 percent, baltic rush was 6 percent, and dandelion was 5 percent (Table 3.2). The amount of bare ground was relatively high at 28 percent. The average height of the bluegrass was 3 inches (8 cm) and the baltic rush 5 inches (13 cm); all other plant species were less than 1 inch (3 cm) high (Table 3.3).

Transect 2 is in the lower riparian grassland plant community and the most frequently sampled species were bluegrass, silverweed, and dandelion. Bluegrass accounted for 50 percent of the plant cover, while silverweed and dandelion each accounted for 14 percent (Table 3.4). Very little bare ground (3 percent) was in this type. The average height of the bluegrass was 3 inches (8 cm) while baltic rush was 5 inches (13 cm) (Table 3.5).

Transect 3 is in a narrow drainage west of the sedge plant community (Figure 3.6). This area was dominated by sedge for which a species determination could not be made because the area was so heavily grazed. Standing water was evident during sampling. The most frequently sampled species were *Carex* sp., bluegrass, creeping buttercup, and white clover. *Carex* sp. accounted for 47 percent of the vegetative cover, bluegrass accounted for 6 percent, and white clover accounted for 5 percent (Table 3.4). Bare ground was 41 percent. The average height of the *Carex* sp. was 4 inches (10 cm) while all other species were shorter (Table 3.5).

4.0 MITIGATION AND MONITORING PLAN

4.1 MITIGATION PLAN

The major component of this mitigation plan was fence construction around the mitigation sites to exclude livestock. Livestock exclusion from riparian areas can result in dramatic recovery of vegetation along with increased wildlife use (Platts and Wagstaff, 1984; Platts and Nelson, 1985; Platts and Rinne, 1985). In addition, studies show that livestock exclusion from riparian vegetation along streams results in greater flow in the streams, with some intermittent streams becoming perennial (Stabler, 1984). Duff (1980) reported that riparian habitat attained good condition after 4 years of livestock exclusion, while Skovlin (Platts and Wagstaff, 1984) showed that riparian vegetation recovered 5 to 7 years after grazing ceased.

An EA of the impacts of implementing this mitigation plan was prepared (BLM, 1993). The EA determined that no significant environmental impacts would result from this project. Archaeological resources were found at and near some of the sites, but project structures such as fences were situated to avoid these resources. The EA also determined that fencing these sites would not cause economic hardship to the ranchers who graze livestock in the site allotments. The ranchers were consulted regarding this mitigation plan and they support this project (BLM, 1993).

Grazing may be allowed on two of six mitigation sites. Studies show that proper grazing management can result in maintaining the long-term productivity of most riparian areas (Chaney et al., 1990), although Clary and Webster (1990) state that no grazing system has been devised to ensure the proper use of small riparian areas within extensive arid-to-semiarid upland range.

The two mitigation sites where limited grazing may be allowed are Prospector Spring and Houston Gulch. Such grazing would not be allowed until the plant height and bare-ground recovery criteria are met as described in Section 4.1.1. The BLM would consult with the DOE and the USACE before allowing grazing during the monitoring period. It is expected that the criteria outlined in Section 4.1.1 will not be met for 3 to 4 years after cattle exclusion.

The six mitigation sites provide water sources for cattle; water sources are in short supply in the sagebrush habitat in the Gunnison Basin. As part of the mitigation plan, several springs were developed and stock tanks were provided for livestock outside the fenced areas at the six sites.

4.1.1 Wetlands enhancement

The six mitigation sites were fenced during the fall of 1993 to exclude cattle. As a result, the existing 8.8 ac (3.6 ha) of wetlands and 9.6 ac (3.9 ha) of upper riparian grassland (Table 3.1) at the six mitigation sites will start to

recover from years of overgrazing. As shown in Section 3.0, "Results," livestock grazed vegetation down to near-ground level in most of these wetland areas and cattle walking through the areas created bare ground. Following fencing, the changes in vegetation growth and other factors will be used to determine the success of this wetlands mitigation plan.

Information from published studies indicates that riparian areas show fast and significant improvement once cattle are excluded. Observations at Valdez Spring (Figure 2.2) in September 1993 give an indication of the changes that will occur at the mitigation sites.

A cattle exclosure was placed around an approximate 0.3-ac (0.1-ha) area at Valdez Spring 10 to 12 years ago (Capodice, 1993). A marked difference between the plant growth inside and outside the fence was noted in September 1993 (Attachment C, Photographic Series 5). The plant community outside the fence looked like the heavily grazed upper and lower riparian grassland plant communities at the mitigation wetland sites. Fowl bluegrass grazed down to 1 to 2 inches (3 to 5 cm) was dominant. Inside the fence directly adjacent to this heavily grazed grassland was a dense growth of baltic rush 12 to 15 inches (30 to 38 cm) high. Very little bluegrass was observed; other frequently observed species in the upper riparian grassland type of the mitigation sites such as dandelion, aster, and yarrow were greatly reduced within the exclosure. Elsewhere inside the fence, a healthy stand of *Carex* sp. (probably beaked or water sedge) had developed. This sedge was not restricted to saturated ground; it grew in moist soil conditions. Willows of various ages also were scattered throughout the fenced area. Foxtail barley, which is fairly common in the six mitigation sites, was very limited; it grew only in soil disturbed by gopher activity (TAC, 1993). The exclosure at Valdez Spring probably was not planted and the plant growth observed here established itself naturally. The Valdez Spring exclosure was not monitored so no information is available on how long it took this area to recover from heavy cattle grazing. However, the conditions observed at this site provide significant information regarding the vegetational changes that will occur at the mitigation sites.

Based on this information, significant changes are projected for most of the plant communities at the mitigation site. Major changes are not projected at the sedge-dominated wetlands because these plant communities generally have not been impacted. However, based on observations at Valdez Spring, the sedge wetland type will likely expand into the lower riparian grassland community. Changes in the upper and lower riparian plant community will include increased plant height, decreased bare ground, and a change in plant species composition. The following changes will occur during the 5-year monitoring program and are considered performance criteria against which the success or failure of this wetlands enhancement will be judged.

- Increased plant height: An obvious impact of grazing at these mitigation sites was the very short vegetation in most areas. As indicated in Section 3.0, the height of the dominant species was typically 2 to 5 inches (5 to

8 cm). A dramatic increase in plant height is expected during the first year of cattle exclusion, with the dominant species increasing over the 5-year monitoring period as follows:

1. Baltic rush - more than 12 inches (30 cm).
2. Fowl bluegrass - more than 12 inches (30 cm).
3. *Carex* sp. - more than 8 inches (20 cm).
4. Tufted hairgrass - more than 15 inches (38 cm).

- Decreased bare ground: Bare ground in 11 transects in the lower riparian grassland plant community at the six mitigation sites ranged from 3 percent to 44 percent with an average of 20 percent. That percentage is predicted to decrease significantly, with no more than 15 percent bare ground at the end of the 5-year monitoring period. Bare ground in five transects in the upper riparian grassland averaged 24 percent and ranged from 4 to 39 percent. As with the lower riparian grassland, the average percent bare ground is predicted to be 15 percent at the end of the monitoring period.

- Change in species composition: A change in plant species composition is predicted in the lower riparian grassland plant community over the 5-year monitoring period. Specifically, the dominant plant species, as measured by percent vegetative cover, will change from grasses to rushes and sedges. Fowl bluegrass and foxtail barley will become less dominant and baltic rush and *Carex* sp. will become more dominant. In addition, the frequency of occurrence of species such as dandelion, aster, and yarrow will decrease as the vegetation species composition and structure changes.

- Increase in willow: Based on observations at the exclosure at Valdez Spring, willow reproduction will occur at the mitigation sites that presently harbored a willow plant community. In addition, willow may be planted to supplement existing stands of willow, if natural reproduction does not occur. No quantitative estimate of the increase in willow density will be provided in this mitigation plan, but this increase will be monitored yearly during the 5-year monitoring phase.

4.1.2 Wetlands creation

As indicated in Section 3.0, the upper riparian grassland plant community type is not a wetland because the existence of wetland hydrology could not be demonstrated. However, several changes will occur in this plant community as a result of cattle exclusion. These changes will be similar to those in the lower riparian grassland plant community, such as increased plant height and change in plant species composition. An increase in plant height will occur and species composition may change in that the dominance of fowl bluegrass may give way to baltic rush, *Carex* sp., and willows. This change in species composition will occur first in areas closest to the wetland plant communities. The plant species composition of the upper riparian grassland will show a less dramatic change near the interface with the upland sagebrush plant community.

As the vegetational structure changes in this plant community type, conditions more indicative of wetlands, such as increased soil moisture and the predominance of obligate plant species, are expected. As indicated in Section 3.0, the extent of wetland expansion could range from zero to a few acres. Figures 3.1 through 3.6 show the maximum area of wetlands expansion. The actual expansion of wetlands will be measured during the monitoring program.

4.1.3 Mitigation for temporarily disturbed wetlands

The 0.8 ac (0.3 ha) of temporarily disturbed wetland will be covered with stockpiled topsoil and contoured to predisturbance elevations following remedial action. The topsoil will be obtained from the floodplain of Tomichi Creek from the area cleared to widen Gold Basin Road. This soil is currently wetland soil and contains the seeds and other propagules of wetland plants that will likely sprout once the soil is applied. If the seeds and propagules do not produce the required growth, applying a seed mix to the areas will be considered in consultation with the USACE.

4.1.4 Mitigation for permanently eliminated wetlands

The mitigation of the permanently lost 4.3 ac (1.7 ha) of wetlands will be accomplished by enhancing the riparian plant communities at the six mitigation sites. According to guidance received from the U.S. Environmental Protection Agency (EPA) (EPA, 1990), the use of wetlands enhancement for wetlands mitigation requires that 3.0 ac (1.2 ha) of wetland be enhanced for every 1.0 ac (0.4 ha) of wetlands eliminated. This mitigation plan will result in enhancing 18.4 ac (7.5 ha) of wetlands and upper riparian plant communities. In addition, this mitigation plan may result in the creation of additional wetlands in the riparian plant communities that currently are not wetlands. Creation of wetlands represents a potential added benefit of this mitigation plan but is not a requirement for successful completion of this plan. As mentioned in Section 2.2, wetlands enhancement will also compensate for the potential loss of 0.8 ac (0.3 ha), which presently occurs near the Gunnison UMTRA Project processing site.

4.1.5 Additional mitigation measures

Willows may be interplanted within the 0.4 ac (0.2 ha) of existing degraded willow stands at the Upper Long's Gulch, Lower Long's Gulch, and Sage Hen Spring mitigation sites. These willow stands were severely damaged by livestock and many dead and partially dead willows were in evidence. Willows do not currently occur at the Prospector Spring, Houston Gulch, and Camp Kettle Spring mitigation sites and willows will not be planted at these areas.

Willow reproduction is expected to occur naturally and such reproduction will be recorded during the monitoring program. If willow reproduction does not occur during the first year or two of the monitoring program, the procedures below will be followed to establish willows:

- In late March or April, willow sprigs ranging from 0.25 to 0.5 inch (0.6 to 1.3 cm) in diameter and approximately 18 inches (46 cm) long will be cut from shrubs in riparian habitats of the three mitigation sites or other nearby riparian areas.

- The sprigs will be planted as soon as possible after snow melt and before bud break. The sprigs will be planted on approximately 4.5-ft (1.4-m) centers from the closest living willows and deep enough to ensure they are in water year-round.

Wildlife use patterns will be determined as part of the mitigation plan and the following activities will occur:

- Bird surveys for each site will be conducted from 6 a.m. to 10 a.m. during the nesting season each survey year. The species and habitat use of each bird observed will be recorded.

- Sage grouse brood counts will be conducted at each site in July or August of each survey year. Brood size, growth pattern, and habitat use will be recorded.

- Other wildlife use of the mitigation sites will be recorded during each site visit.

The enhancement of 18.4 ac (7.5 ha) of riparian plant communities will provide adequate mitigation for the impacted wetlands, especially since most of the impacted wetlands have been highly altered by grazing and the enhancement potential at the mitigation sites is great. For this reason, this mitigation plan will be very beneficial to wildlife, resulting in wetlands that will support a greater diversity of wetland plants and wildlife species than existed at the impacted wetlands or mitigation sites.

4.2 MITIGATION COST

The DOE provided funding for constructing fences, developing springs, moving stock tanks, and relocating dirt roads where necessary. Funds for constructing these facilities were made available to DOE's remedial action contractor and all work conducted was approved by the BLM.

The DOE will fund the monitoring study described below. The USACE is the chief cooperating agency with the DOE regarding the success of the proposed wetlands mitigation plan and will be kept informed of the progress of the monitoring studies. The BLM and the Colorado Division of Wildlife also will be apprised of the monitoring studies' results and may take part in some future work at the six mitigation sites.

4.3 MONITORING

The DOE will implement a monitoring program to determine if the mitigation plan is progressing as planned. Vegetation at the mitigation sites will be sampled using the same methods and transects used to collect the baseline data in 1993 and described in this report. This vegetation sampling will be conducted for the next 5 years (1994 through 1998), and the results will be provided to interested agencies and other parties in annual progress reports.

If willow plants are required, their growth will be monitored twice during their first growing season to determine if wildlife damage is excessive and survival rates are acceptable. If required, additional willow sprigs will be planted during the following spring.

The occurrence of wildlife at the mitigation sites will be monitored during the project. Early morning bird use surveys of these sites will occur along with sage grouse brood use surveys. Other wildlife use of these sites also will be recorded.

Permanent photo monitoring points were established at the six mitigation sites. Photographs will be taken at these points in the same manner as in 1993.

Data collected during each sampling season will be recorded in field notes and summarized in annual reports. Each year, the results will be compared to baseline conditions to determine the mitigation plan's effectiveness. In addition, the results will be compared to performance standards as described in Section 4.1.1.

If these performance standards are not attained within the 5-year monitoring period, the probable causes will be evaluated. If necessary, corrective action, including consultation among the DOE, USACE, and BLM, will be implemented to ensure predicted improvements in the riparian sites.

If the performance standards at a specific site are attained before the completion of the 5-year monitoring program, the monitoring program may be terminated at that site and the site would then be managed by the BLM. Early termination of the monitoring program at a specific site would require concurrence from the BLM and USACE.

Further, if the performance standards are met at Prospector Spring and Houston Gulch before the end of the monitoring period, limited controlled grazing may be allowed at these sites. Such grazing would not occur until the BLM has approval from with the DOE and USACE. If grazing is approved, DOE monitoring responsibility will be terminated and the BLM will become responsible for monitoring the sites.

4.3.1 Monitoring and mitigation schedule

The monitoring program as described above will occur annually for 5 years. The duration of this monitoring plan is consistent with the observations of Duff (1980) and Platts and Wagstaff (1984), who reported riparian vegetation recovered after 4 years and 5 to 7 years, respectively, after exclusion of livestock grazing. Following this period, monitoring may occur every few years. The need for additional monitoring will be determined in consultation with the BLM and USACE. Furthermore, cattle may once again be allowed to graze some riparian areas. The levels of grazing should be limited by the number of cattle allowed in the areas and the duration of grazing.

Specific monitoring studies will occur during the approximate time frame given below.

1994

Plant and wildlife species inventory	May or June
Sage grouse brood use surveys	June or July
Collect quantitative vegetation and wildlife use data	August

1995 through 1998

Collect willow sprigs if necessary	March or April
Plant willow sprigs	April or May
Plant and wildlife species inventories	May or June
Sage grouse brood use surveys	July or August
Check willow sprigs for survival	July or August
Collect quantitative vegetation and wildlife use data	July or August

4.4 MAINTENANCE OF MITIGATION SITES

Fences surrounding the mitigation sites, spring developments, and stock tanks constructed to standard BLM specifications will be inspected and maintained throughout the life of the project; repairs will be made on an as-needed basis. Once the BLM has agreed that the fences and other structures are constructed and working properly, the BLM will be responsible for all inspection and maintenance activities.

5.0 LONG-TERM USE AND MONITORING

The six mitigation wetland sites are in remote rangelands far from areas of human habitation or areas of potential development. These rangelands are expected to remain within the jurisdiction of the BLM. In addition, hunting and livestock grazing are expected to continue as the major land uses, much as they have been for the last 100 years. If the six wetland mitigation sites remain fenced and livestock use is strictly controlled, the sites should retain their wetland and wildlife values for many decades.

Over the long term, three issues should be considered to maintain the integrity of the enhanced wetlands: 1) maintenance of the mitigation site structures, 2) monitoring, and 3) grazing. Wetlands maintenance would include upkeep of the fences, stock tanks, and water supply systems at the six mitigation sites. It is expected that the BLM would be responsible for conducting long-term monitoring of these sites, because the land is BLM-owned. The BLM would benefit from maintaining these sites because wetlands enhancement will benefit both wildlife and livestock.

6.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this report.

Name	Contribution
C. Burt	Data collection and report preparation
S. Cox	Data collection and review of report
K. Heil	Data collection and plant identification
L. Sanchez, WordCenter Inc.	Text processing
J. Torline, D. Thalley, K. Walston	Technical editing

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ATTACHMENT A

PLANT SPECIES OBSERVED AT SIX SPRINGS IN GUNNISON AND SAGUACHE COUNTIES, COLORADO

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Achillea millefolium	common yarrow	X	X	X	X	X	X
Aconitum columbianum	monkshood			X			
Agoseris glauca	false dandelion			X			
Agropyron smithii	western wheatgrass		X	X	X		
Agropyron trachycaulum	slender wheatgrass	X				X	
Agrostis scabra	bentgrass		X				
Agrostis stolonifera	red top	X	X	X	X	X	
Agrostis tenuis	bentgrass	X	X			X	
Alopecurus aequalis	wetland foxtail		X	X	X	X	
Androsace occidentalis	rock jasmine				X		
Androsace septentrionalis	rock jasmine			X	X		
Antennaria corymbosa	plains pussytoes	X	X				
Antennaria parvifolia	pussytoes	X	X	X	X	X	X
Antennaria rosea	rosy pussytoes			X	X	X	
Arabis crandallii	Weber rockcress			X			
Arabis divaricarpa	rockcress					X	
Arabis drummondii	Arabis			X			
Arabis holboellii	Fendler rockcress			X	X		
Arctostaphylos ura-ursi	kinnikinnick			X			
Artemisia frigida	fringed sagebrush	X				X	X

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Artemisia tridentata	big sagebrush	X	X	X	X	X	X
Aster occidentalis	Western Mountain aster	X	X	X	X	X	X
Astragalus brandegei	Brandegee milkvetch				X		
Astragalus convallarius	lesser rushy milkvetch				X		
Astragalus dasyglottis	milkvetch		X	X	X	X	
Astragalus hallii	hall milkvetch				X		
Astragalus leptaleus	park milkvetch	X	X		X	X	X
Astragalus pattersonii	Patterson milkvetch	X		X			X
Beckmannia syzigachne	sloughgrass	X	X				
Brachyactis frondosa	gray riparian aster	X	X	X	X		
Bromus sp.	brome grass				X		
Bromus anomalus	nodding brome		X				
Bromus ciliatus	brome grass				X		
Capanula parryi	harebell			X	X	X	
Capsella bursa-pastoris	shepherds purse			X	X	X	
Carex aquatilis	water sedge	X		X			X
Carex bebbii	sedge	X		X			
Carex douglasii	sedge				X	X	X
Carex kelloggii	sedge	X					

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Carex nebrascensis	Nebraska sedge	X	X	X	X	X	X
Carex praegracilis	sedge					X	
Carex rostrata	beaked sedge	X	X	X	X	X	
Castilleja integra	Indian paintbrush			X			
Castilleja linariifolia	Indian paintbrush			X	X		
Castilleja miniata	Indian paintbrush				X		
Cerastium fontanum	mouse ear			X			
Chenopodium capitatum	strawberry blite		X		X	X	
Chenopodium fremontii	Chenopodium			X	X	X	
Chenopodium sp.	goosefoot				X		
Chrysothamnus nauseosus	rubber rabbitbrush		X		X		
Chrysothamnus viscidiflorus	green rabbitbrush	X	X	X	X	X	
Cirsium arvense	Canada thistle	X	X		X	X	
Cirsium drummondii	thistle	X	X	X	X	X	
Cleome serrulata	Rocky Mountain beeplant		X				
Conium maculatum	poison hemlock				X		
Corydalis aurea	corydalis			X	X		
Crepis acuminata	mountain hawksbeard						
Crepis occidentalis	hawksbeard		X			X	

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Crepis runcinata	crepis					X	
Cryptantha fendleri	cryptantha				X		
Cryptantha longiflora	long-flower cryptanth			X			
Cryptantha watsonii	cryptantha					X	
Deschampsia cespitosa	tufted hairgrass	X	X				X
Descurainia pinnata	tansy mustard				X	X	
Descurainia richardsonii	Richardson tansy-mustard			X			
Dodecatheon pulchellum	pretty shooting-star			X			
Dracocephalum parviflorum	dragonhead mint				X		
Eleocharis palustris	creeping spikerush	X	X	X	X	X	
Eleocharis acicularis	eleocheris						X
Eleocharis pauciflora	eleocheris						X
Epilobium adenocaulon	willow-herb	X	X	X	X	X	
Epipactis gigantea	helleborine			X			
Equisetum laevigatum	smooth scouringrush						X
Equisetum sp.	horsetail				X		
Erigeron flagellaris	trailing daisy			X	X		
Erigeron pumilus	fleabane					X	
Eriogonum cernuum	nodding buckwheat				X		

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Erigeron umbellatum	wild-buckwheat				X		
Eriogonum racemosum	redroot buckwheat				X		
Erysimum cheiranthoides	treacle			X	X		
Gayophytum ramosissimum	gayophytum				X	X	
Gentianella heterosepala	gentian	X	X	X			
Geum triflorum	purple avens			X			
Gilia aggregata	gilia				X		
Gilia pinnatifida	gilia				X		
Glyceria borealis	mannagrass	X		X	X	X	
Glyceria striata	fowl mannagrass			X			
Hippuris vulgaris	maretail						X
Hordeum brachyantherum	meadow barley	X	X	X	X	X	
Hordeum jubatum	foxtail barley	X	X	X	X	X	
Hymenoxys acaulis	Parker actinea					X	
Hymenoxys richardsonii	cockerell			X	X		
Hyoscyamus niger	henbane				X		X
Iris missouriensis	Rocky Mountain iris	X	X	X	X	X	X
Juncus balticus	baltic rush	X	X	X	X	X	X
Juncus confusus	rush					X	

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Juncus longistylis	rush	X	X		X	X	
Juniperus communis	dwarf juniper		X	X	X		
Juniperus scopulorum	Rocky Mountain juniper		X			X	
Lappula occidentalis	stickseed				X	X	X
Lemna minuscula	duckweed			X	X	X	X
Lepidium densiflorum	peppergrass			X			
Lepidium montanum	peppergrass	X				X	
Leptodactylon pungens	spiny gilia			X	X		
Lesquerella montana	bladderpod			X	X		
Lupinus argenteus	silvery lupine			X			
Lupinus caespitosus	low lupine				X		
Lupinus floribundus	lupine			X			
Machaerantha canescens	machaerantha				X		
Mahonia repens	holly grape				X		
Mentha arvensis	common mint	X	X			X	
Mertensia lanceolata	lanceleaf bluebells			X	X	X	
Monolepis nuttalliana	nuttall monolepis	X		X	X	X	X
Nasturtium officinale	watercress		X				
Oenothera caespitosa	evening primrose					X	

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Oenothera flava	yellow evening primrose				X		
Orobanche fasciculata	clustered broomrape				X		
Orthocarpus luteus	yellow owl clover				X		
Oxytropis deflexa	dropped crazyweed	X	X	X		X	
Panicum capillare	witchgrass	X					
Penstemon linarioides	Penstemon					X	
Penstemon rydbergii	Rydberg penstemon			X			
Phleum pratense	timothy grass		X	X			
Phlox austomontana	desert phlox				X		
Phlox hoodii	Hood's phlox				X		
Plantago major	common plantain	X	X		X	X	
Poa palustris	fowl bluegrass	X	X	X	X	X	X
Poa pratensis	Kentucky bluegrass	X	X	X	X	X	
Polemonium delicatum	delicate Jacobs ladder					X	
Polygonum aviculare	prostrate knotweed	X	X	X	X	X	X
Potamogeton filiformis	Potamogeton			X	X		
Potentilla anserina	silverweed	X	X	X	X	X	X
Potentilla fruticosa	shrubby cinquefoil	X	X	X	X	X	
Potentilla hippiana	hipp cinquefoil	X	X				

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Prunus virginiana	chokecherry			X			
Ranunculus cymbalaria	buttercup		X	X			
Ranunculus macounii	buttercup		X	X	X		
Ranunculus natans	aquatic buttercup	X	X	X	X	X	X
Ranunculus sceleratus	blister buttercup				X		
Ribes cereum	ribes			X	X		
Ribes inerme	whitestem gooseberry			X	X	X	X
Ribes lacustre	prickly current			X	X	X	
Rorippa islandica	yellow cress	X	X		X	X	
Rosa woodsii	Wood's rose				X	X	
Rumex crispus	curly dock	X	X	X	X	X	X
Salix bebbiana	willow			X	X	X	
Salix geyeriana	Geyer willow			X	X		
Salsola iberica	Russian thistle				X		
Schoencrambe linifolia	Schoencrambe	X			X	X	
Scrophularia lanceolata	figwort		X			X	
Senecio integerrimus	wet-the-bed			X			
Sidalcea neomexicana	checkers	X	X	X		X	
Sisymbrium altissimum	tumble mustard	X					

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Sisynchrium montanum	blue-eyed grass	X					
Sitanion hystrix	squirrel-tail	X	X	X	X	X	
Smilacina stellata	false Soloman seal			X	X	X	
Sphaeralcea coccinea	globemallow	X			X	X	
Stellaria graminea	chickweed		X				
Stellaria jamesiana	chickweed	X				X	
Stellaria longifolia	long-leaved starwort					X	
Stellaria longipes	long-stalked starwort			X			
Stellaria obtusa	chickweed	X					
Stipa nelsonii	needlegrass	X			X		
Symphoricarpos oreophilus	coralberry		X		X	X	
Taraxacum officinale	common dandelion	X	X	X	X	X	X
Thelypodium integrifolium	Endlicher thelypodium	X					
Trifolium gymnocarpon	clover				X		
Trifolium hybridum	alsike clover	X	X				
Trifolium longipes	Rydberg clover					X	
Trifolium repens	white clover	X	X	X	X	X	X
Triglochin palustris	marsh arrowgrass	X	X				
Urtica dioica	Selander stinging nettles			X	X	X	

Table A.1 Plant species observed in the riparian plant communities at six springs in Gunnison and Saguache Counties, Colorado (Continued)

Plant species		Spring					
Scientific name	Common name	Prospector Spring	Houston Gulch	Upper Long's Gulch	Lower Long's Gulch	Sage Hen Spring	Camp Kettle Spring
Veronica americana	American brooklime		X	X			X
Veronica anagallis-aquatica	speedwell	X					
Veronica peregrina	Purslane speedwell		X		X	X	X
Viola adunca	blue violet			X			
Viola nephrophylla	northern bog violet		X				
Total		61	64	87	104	79	32

ATTACHMENT B

PLANT SPECIES DATA COLLECTED AT SIX SPRINGS IN GUNNISON AND SAGUACHE COUNTIES, COLORADO

LIST OF TABLES

LIST OF TABLES (Concluded)

Table B.1 Plant species observed and wetland status along 16 transects in six wetlands in Gunnison and Saguache Counties, Colorado

Scientific name (abbreviation)	Common name	Wetland status[a]
Achillea milefolium (Acmi)	Common yarrow	FACU
Agropyron smithii (Agsm)	Western wheatgrass	FACU
Agropyron trachycaulum (Agtr)	Slender wheatgrass	FACU
Agrostis stolonifera (Agst)	Spreading bentgrass	FACW
Antennaria parvifolia (Anpa)	Pussytoes	NA
Artemisia frigida (Arfr)	Fringed sagebrush	UPL
Artemisia tridentata (Artr)	Big sagebrush	UPL
Aster occidentalis (Asoc)	Western mountain aster	FAC
Astragalus agrestis (Asag)	Field milkvetch	FAC
Astragalus leniginosus (Asle)	Specklepod loco milkvetch	NA
Astragalus leptaleus (Asle)	Park milkvetch	NA
Brachyactis frondosa (Brfr)	Gray riparian aster	NA
Carex aquatilis (Caaq)	Water sedge	OBL
Carex rostrata (Caro)	Beaked sedge	OBL
Carex sp. (Casp)	Blue carex	OBL(?)
Chenopodium berlandieri (Chbe)	Weedy lamb's quarter	NA
Chrysothamnus nauseosus (Chna)	Rubber rabbitbrush	UPL
Cirsium arvense (Ciar)	Canada thistle	FACU
Cirsium sp. (Cisp)	Thistle	NA
Deschampsia cespitosa (Dece)	Tufted hairgrass	FACW
Dracocephalum parviflorum (Drpa)	Dragonhead mint	FACU
Eleocharis palustris (Elpa)	Creeping spikerush	OBL
Epilobium adenocaulon (Epad)	Willow-herb	OBL(?)
Equisetum arvense (Eqar)	Field horsetail	FAC+
Hordeum brachyantherum (Hobr)	Meadow barley	FACW
Hordeum jubatum (Hoju)	Foxtail barley	FAC
Iris missouriensis (Irmi)	Rocky Mountain iris	OBL
Juncus balticus (Juba)	Baltic rush	FACW
Lappula occidentalis (Laoc)	Stickseed	NA
Lepidium densiflora (Lede)	Peppergrass	FACU
Lupinus argenteus (Luar)	Silvery lupine	NA

Table B.1 Plant species observed and wetland status along 16 transects in six wetlands in Gunnison and Saguache Counties, Colorado (Concluded)

Scientific name (abbreviation)	Common name	Wetland status[a]
Panicum capillare (Paca)	Witchgrass	FACU
Plantago major (Plma)	Common plantain	FAC
Poa palustris (Popa)	Fowl bluegrass	FACW
Polygonum aviculare (Poav)	Prostrate knotweed	NA
Potentilla anserina (Poan)	Silverweed	OBL
Potentilla fruticosa (Pofr)	Shrubby cinquefoil	FACW
Ranunculus repens (Rare)	Creeping buttercup	FACW
Rorippa islandica (Rois)	Yellow cress	OBL
Rosa woodsii (Rowo)	Wood's rose	FAC-
Rumex crispus (Rucr)	Curly dock	FACW
Salix geyeriana (Sage)	Geyer willow	OBL
Taraxacum officinale (Taof)	Common dandelion	FACU
Trifolium hybridum (Trhy)	Alsike clover	FAC
Trifolium repens (Trre)	White clover	FACU
Triglochin palustris (Trpa)	Marsh arrowgrass	OBL
Veronica peregrina (Vepe)	Purslane speedwell	FACW
Viola nephrophylla (Vine)	Northern bog violet	FACW

[a]From Reed (1988).

OBL = Obligate plant species that occur in wetlands 99 percent of the time.
FACW = Facultative wetland plant species that usually occur in wetlands (67 to 99 percent of the time).
FAC = Facultative plant species that are equally likely to occur in wetlands or nonwetlands.
FACU = Facultative upland plant species that usually occur in nonwetlands (67 to 99 percent of the time).
UPL = Upland plant species that occur in uplands (nonwetlands) 99 percent of the time.
NA = Not given in Reed (1988); probably UPL species because Reed (1988) does not list all UPL species.

\+ species tends toward the next wettest category.
\- species tends towards the next driest category.
? status unknown.

Table B.2 Plant species percent cover in 41 sample plots in transect 1 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Juba	6	13	10	3	7		33	43
Hoju	6	18	9	5			23	30
Taof	27	8					5	7
Popa	4	5	5	2			10	13
Poan	12	2					1	1
Asoc	14						1	1
Paca	8						0.5	0.6
Trre	6	2					1	1
Acmi	4						0.2	0.3
Plma		2					0.7	0.9
Arfr	1						0.1	0.1
Agst	1						0.1	0.1
Unknown grass	3	2					0.9	1
Total	NA	NA	NA	NA	NA		76.5	99
Bare ground	15	12	1				9.1	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA = not applicable.

Table B.3 Plant species frequency of occurrence and plant height in 41 sample plots in transect 1 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Juba	95	37	3-15	9
Hoju	93	36	5-14	9
Taof	85	35	-	<1
Popa	39	15	2-12	6
Poan	34	14	<1-2	<1
Asoc	34	14	<1-4	1
Paca	20	6	<1-3	2
Trre	20	8	<1-1	<1
Acmi	10	3	<1-1	<1
Plma	5	2	<1	<1
Arfr	2	1	-	-
Agst	2	1	-	-
Unknown grass	12	3	2-24	12

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.4 Plant species percent cover in 40 sample plots in transect 2 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Elpa	2	9	17	7	1		33	54
Poan	18	5					3	5
Dece	16	4	1	1			5	8
Caro	10	10	1	1			7	11
Rare	12	1					1	2
Asoc	12						0.8	1
Poav	9						0.6	1
Agst	7		1				0.4	0.6
Popa	3	7	1	1			6	10
Rucr	5						0.3	0.5
Juba	6	1	1				2	3
Trpa	4						0.3	0.5
Paca	2	1					0.5	0.8
Acmi	2						0.1	0.2
Taof	2						0.1	0.2
Rois	2						0.1	0.2
Vepe	1						0.1	0.2
Plma	1						0.1	0.2
Trre	4	2					1	2
Hoju	1						0.1	0.2
Total	NA	NA	NA	NA	NA		61.5	100
Bare ground	10	17	7	4			20.9	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%)+...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.5 Plant species frequency of occurrence and plant height in 40 sample plots in transect 2 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Elpa	90	23	1-8	4
Poan	58	23	<1-2	<1
Dece	55	21	8-24	18
Caro	55	15	2-18	8
Rare	33	11	<1-2	<1
Asoc	30	9	<1-6	3
Poav	23	7	<1-3	<1
Agst	20	6	8-18	10
Popa	30	4	4-24	11
Rucr	13	5	<1-3	1
Juba	20	4	8-12	11
Trpa	10	3	8-10	9
Paca	8	1	-	-
Acmi	5	2	<1-2	1
Taof	5	2	<1	<1
Rois	5	1	-	-
Vepe	3	1	-	-
Plma	3	1		
Trre	15	6	<1	<1
Hoju	3	1		

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.6 Plant species percent cover in 40 sample plots in transect 3 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Juba	4	4	13	13	5		45	63
Taof	21	12	1				7	10
Hoja	19	2					2	3
Casp	11	5					3	4
Paca	9	4					2	3
Asle	4	3	2	2			6	8
Agtr	8	2	1				2	3
Trre	8	2					1	1
Acmi	7	2					1	1
Poan	4	3					1	1
Asoc	6						0.4	0.6
Poav	1	1					0.4	0.6
Plma	1	1					0.4	0.6
Rucr	1						0.1	0.1
Anpa	1						0.1	0.1
Ciar	1	1					0.4	0.6
Total	NA	NA	NA	NA	NA		71.8	99.6
Bare ground	35	3					3.5	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.7 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Prospector Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Juba	98	28	1-10	7
Taof	85	33	<1-1	<1
Hoja	53	15	1-10	7
Casp	40	14	1-8	4
Paca	33	7	2-4	3
Asle	28	6	1-3	2
Agtr	28	6	6-30	12
Trre	25	10	<1	<1
Acmi	23	9	<1-1	<1
Poan	18	7	<1-6	1
Asoc	15	4	<1-4	3
Poav	5	2	-	-
Plma	5	2	-	-
Rucr	3	1	-	-
Anpa	3	1	-	-
Ciar	5	2	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.8 Plant species percent cover in 40 sample plots in transect 1 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	3	13	14	9		54	66
Taof	14	24					10	12
Trre	10	7	7				10	12
Juba	7	13					5	6
Asoc	14	3					2	2
Acmi	5						0.3	0.4
Hoju	5						0.3	0.4
Poan	1						0.1	0.1
Hobr	1						0.1	0.1
Asag	1						0.1	0.1
Anpa	1						0.1	0.1
Irmi	1						0.1	0.1
Arfr	1						0.1	0.1
Total	NA	NA	NA	NA	NA		82.2	99.4
Bare ground	31	3	2	3			9.9	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.9 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	100	35	1-3	1
Taof	95	38	<1-1	<1
Trre	60	22	<1-1	<1
Juba	50	17	1-10	4
Asoc	43	15	<1-2	<1
Acmi	13	5	<1	<1
Hoju	13	5	3-6	4
Poan	3	1	-	-
Hobr	3	1	-	-
Asag	3	1	-	-
Anpa	3	1	-	-
Irmi	3	1	-	-
Arfr	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.10 Plant species percent cover in 40 sample plots in transect 2 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Taof	23	11					6	13
Agst	13	7	7				10	21
Popa	4	8	7				10	21
Hoju	12	6					3	6
Poan	14	2					2	4
Trre	6	7	2				5	11
Dece	5	5	5				7	15
Acmi	13	1					1	2
Juba	9	5					2	4
Caro	4	1					0.6	1
Hobr	4						0.3	0.6
Asoc	3						0.2	0.4
Irmi	1						0.1	0.2
Poav	1						0.1	0.2
Total	NA	NA	NA	NA			47.3	99.4
Bare ground	9	13	14	2			22.8	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.11 Plant species frequency of occurrence and plant height in 40 sample plots in transect 2 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Taof	85	31	-	<1
Agst	68	20	2-12	6
Popa	48	7	1-10	4
Hoju	45	10	1-10	7
Poan	40	16	-	<1
Trre	38	18	-	<1
Dece	38	12	10-24	15
Acmi	35	14	<1-1	<1
Juba	35	9	1-8	4
Caro	13	5	2-5	3
Hobr	10	4	-	-
Asoc	8	3	-	-
Irmi	3	1	-	-
Poav	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.12 Plant species percent cover in 40 sample plots in transect 3 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Dece	4	18	14				20	54
Poav	18						1	3
Hoju	13	3					2	5
Juba	11	4					2	5
Poan	12	2					2	5
Rois	12	1					1	3
Asoc	10						0.6	2
Popa	3	6	1				4	11
Taof	9						0.6	2
Epad	9						0.6	2
Hobr	3	3					1	3
Agst	3	3					1	3
Trre	2	1					0.5	1
Acmi	3						0.2	0.5
Caro	2						0.1	0.3
Rucr	1						0.1	0.3
Total	NA	NA	NA	NA			36.7	100.1
Bare ground	6	10	16	4	2		30	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.13 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Houston Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Dece	90	34	3-18	12
Poav	45	12	<1-3	1
Hoju	40	13	2-10	7
Juba	38	12	1-11	7
Poan	35	14	-	<1
Rois	33	6	<1-1	<1
Asoc	25	6	<1-3	2
Popa	25	6	1-3	2
Taof	23	9	-	<1
Epad	23	6	<1-3	1
Hobr	15	6	-	-
Agst	15	6	2-6	4
Trre	8	3	-	-
Acmi	8	3	-	<1
Caro	5	2	-	-
Rucr	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.14 Plant species percent cover in 40 sample plots in transect 1 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	3	10	13	8	6		41	80
Taof	25	8					5	10
Asoc	17	11					5	10
Poav	2						0.1	0.2
Asag	1						0.1	0.2
Artr	1						0.1	0.2
Astragalus sp.	1						0.1	0.2
Total	NA	NA	NA	NA	NA		51.4	100.8
Bare ground	5	11	12	9	2	2	39	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.15 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	100	38	1-6	2
Taof	83	33	-	<1
Asoc	70	17	<1-2	<1
Poav	5	2	-	-
Asag	3	1	-	-
Artr	3	1	-	-
Astragalus sp.	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.16 Plant species percent cover in 34 sample plots in transect 2 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	4	6	10	2			18	46
Asoc	10	11					6	15
Caaq	8	6	4				8	20
Poan	14	2					2	5
Rare	11						0.8	2
Elpa	9	1	1				2	5
Taof	6	1					0.9	2
Poav	7						0.5	1
Vepe	4						0.3	0.8
Trre	2						0.1	0.3
Epad	2						0.1	0.3
Anpa	1						0.1	0.3
Acmi	1						0.1	0.3
Rowo	1						0.1	0.3
Rois	1						0.1	0.3
Total	NA	NA	NA	NA			39.1	98.6
Moss	4						0.3	
Rock and wood	5	14	3	4			17	
Water	2	10	6	1			13	
Bare ground	10	5	1				4	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%)+...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.17 Plant species frequency of occurrence and plant height in 34 sample plots in transect 2 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	65	18	1-10	3
Asoc	62	12	<1-3	<1
Caaq	53	16	2-10	4
Poan	47	9	-	<1
Rare	32	11	-	<1
Elpa	32	8	<1-4	2
Taof	21	7	-	<1
Poav	21	4	-	<1
Vepe	12	4	-	-
Trre	6	2	-	-
Epad	6	2	-	-
Anpa	3	1	-	-
Acmi	3	1	-	-
Rowo	3	1	-	-
Rois	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.18 Plant species percent cover in 35 sample plots in transect 3 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	9	19	3	3		37	59
Taof	15	13	3				9	14
Asoc	21	4					3	5
Trre	7	5	2	1			7	11
Juba	11	2					2	3
Acmi	10						0.7	1
Asag	8	1					1	2
Poan	3						0.2	0.3
Luar	3						0.2	0.3
Irmi	1	1					1	2
Anpa	1	1					1	2
Artr	1						0.1	0.2
Pofr	1						0.1	0.2
Total	NA	NA	NA	NA	NA		62.3	100.00
Rock and wood	7	10	2				7	
Bare ground	12	8	4	1			10	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.19 Plant species frequency of occurrence and plant height in 35 sample plots in transect 3 at Upper Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	100	29	1-3	2
Taof	89	30	-	<1
Asoc	74	13	-	<1
Trre	44	15	-	<1
Juba	38	5	2-6	4
Acmi	29	10	-	<1
Asag	26	4	-	<1
Poan	9	3	-	-
Luar	9	3	-	-
Irmi	6	2	-	-
Anpa	6	2	-	-
Artr	3	1	-	-
Pofr	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.20 Plant species percent cover in 35 sample plots in transect 1 at Lower Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	7	10	6	7	1	44	65
Taof	13	11					6	9
Rare	9						0.6	0.9
Plma	7	1					0.9	1
Juba	4	4					2	3
Asoc	5						0.4	0.6
Sage						3	8	12
Dece		1	1		1		4	6
Vepe	2						0.1	0.1
Brfr	1						0.1	0.1
Poav	1						0.1	0.1
Casp	1						0.1	0.1
Trre	1						0.1	0.1
Acmi			1				1	1
Luar	1						0.1	0.1
Poan	1						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	67.6	99.2
Moss	10	1					1	
Water	1	3	8				10	
Rock and wood	2	4					2	
Bare ground	13	7	1	2			9	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +...+ (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.21 Plant species frequency of occurrence and plant height in 35 sample plots in transect 1 at Lower Long's Gulch Spring, Gunnison County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	91	29	1-6	2
Taof	69	24	<1-<1	<1
Rare	26	9	<1-<1	<1
Plma	23	8	<1-<1	<1
Juba	23	8	-	-
Asoc	14	5	-	-
Sage	9	3	-	-
Dece	9	3	-	-
Vepe	6	2	-	-
Brfr	3	1	-	-
Poav	3	1	-	-
Casp	3	1	-	-
Trre	3	1	-	-
Acmi	3	1	-	-
Luar	3	1	-	-
Poan	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.22 Plant species percent cover in 40 sample plots in transect 1 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	2	12	15	4	4		33	74
Asoc	20	14					7	16
Agsm	4	5					2	4
Juba	4	2					1	2
Laoc	6						0.4	0.9
Chbe	4	1					0.6	1
Taof	4						0.3	0.7
Acmi	2						0.1	0.2
Ciar	1						0.1	0.2
Poav	1						0.1	0.2
Total	NA	NA	NA	NA	NA		44.6	99.2
Bare ground	3	13	10	12	2		38.3	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.23 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	93	35	1-2	1
Asoc	85	21	<1-4	1
Agsm	23	7	2-12	7
Juba	15	3	3-4	3
Laoc	15	6	-	-
Chbe	13	4	3-8	5
Taof	10	3	-	<1
Acmi	5	2	-	-
Ciar	3	1	-	-
Poav	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.24 Plant species percent cover in 30 sample plots in transect 2 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Poav	7	9	5	3	1		20	49
Chbe	9	3					2	5
Arfr	3	3	2	2			6	15
Laoc	5	2					1	2
Taof	5						0.4	1
Popa	1	3		1			4	10
Ciar	2		2				3	7
Caro	1	2					1	2
Asoc	2						0.2	0.5
Drpa	2						0.2	0.5
Juba	1						0.1	0.2
Irmi			1				2	5
Lede		1					0.5	1
Seedlings	3	1					0.8	2
Total	NA	NA	NA	NA	NA		41.2	100.2
Bare ground	1	9	9	11	2		44	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.25 Plant species frequency of occurrence and plant height in 30 sample plots in transect 2 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Poav	83	11	<1-<1	<1
Chbe	40	6	<1-2	1
Arfr	33	7	2-24	7
Laoc	23	5	6-10	8
Taof	17	4	<1-<1	<1
Popa	17	4	1-2	1
Ciar	13	4	-	-
Caro	10	3	-	-
Asoc	7	2	-	-
Drpa	7	2	-	-
Juba	3	1	-	-
Irmi	3	1	-	-
Lede	3	1	-	-
Seedlings	13	4	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.26 Plant species percent cover in 40 sample plots in transect 3 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	3	7	10	10	7	1	45	62
Hoju	10	14	3	2			12	16
Juba	7	8	4				7	10
Vepe	9						0.6	0.8
Poan	8	1					0.9	1
Taof	7						0.4	0.5
Caro	5		1	1			3	4
Agst	1	4					2	3
Rucr	4	1					0.6	0.8
Rare	5						0.3	0.4
Rowo	3						0.2	0.2
Chbe	1	1					0.1	0.1
Acmi	2						0.1	0.1
Epad	1						0.1	0.1
Asoc	1						0.1	0.1
Poav	1						0.1	0.1
Elpa	1						0.1	0.1
Casp	1						0.1	0.1
Mustard sp.	2						0.1	0.1
Total	NA	NA	NA	NA	NA	NA	72.8	99.5
Moss	5	2					1	
Bare ground	21	14	3				9	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.27 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Sage Hen Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	95	35	2-24	10
Hoju	73	23	2-20	12
Juba	48	16	1-10	3
Vepe	23	6	<1-6	2
Poan	23	8	<1-<1	<1
Taof	18	7	<1-<1	<1
Caro	18	5	1-2	2
Agst	13	5	-	-
Rucr	13	5	-	<1
Rare	13	5	-	<1
Rowo	8	3	-	-
Chbe	5	2	-	-
Acmi	5	2	-	-
Epad	3	1	-	-
Asoc	3	1	-	-
Poav	3	1	-	-
Elpa	3	1	-	-
Casp	3	1	-	-
Mustard sp.	5	2	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.28 Plant species percent cover in 40 sample plots in transect 1 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	4	16	7	10	3		35	54
Asoc	17	12	5				10	16
Taof	21	10					5	8
Juba	12	9	2				6	9
Poan	10						0.6	0.9
Eqar	8	2					1	2
Ciar	5	3					1	2
Acmi		5					2	3
Hoju	4						0.3	0.5
Asle	1		2				2	3
Chna	1	1	1				1	2
Lede	2						0.1	0.2
Agst	1						0.1	0.2
Arfr	1						0.1	0.2
Poav	1						0.1	0.2
Total	NA	NA	NA	NA	NA		64.3	101.2
Bare ground	4	16	11	7			28	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) + ... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.29 Plant species frequency of occurrence and plant height in 40 sample plots in transect 1 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	100	39	1-12	3
Asoc	85	18	<1-3	<1
Taof	78	31	<1-<1	<1
Juba	58	20	2-8	5
Poan	25	6	<1-<1	<1
Eqar	25	10	-	-
Ciar	20	4	<1-2	<1
Acmi	13	5	<1-2	<1
Hoju	10	4	-	-
Asle	8	3	-	-
Chna	8	3	-	-
Lede	5	2	-	-
Agst	3	1	-	-
Arfr	3	1	-	-
Poav	3	1	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.30 Plant species percent cover in 40 sample plots in transect 2 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Popa	1	3	11	10	5		50	53
Poan	11	10	4		1		14	15
Taof	8	12	4	1			14	15
Hoju	10	5					3	3
Juba	3	6	1				5	5
Asoc	2	6	1				5	5
Agst	3	3					2	2
Elpa	2	1					0.7	0.7
Plma	2						0.2	0.2
Trre			1				1	1
Casp	3						0.3	0.3
Total	NA	NA	NA	NA	NA		95.2	100.2
Bare ground	27	2					3	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +... + (number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.31 Plant species frequency of occurrence and plant height in 40 sample plots in transect 2 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Popa	100	30	1-8	3
Poan	87	13	<1-<1	<1
Taof	63	23	<1-1	<1
Hoju	38	11	<1-10	3
Juba	33	9	3-10	5
Asoc	30	6	<1-2	<1
Agst	20	4	6-8	7
Elpa	10	3	-	-
Plma	7	2	-	-
Trre	3	1	-	-
Casp	10	3	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

Table B.32 Plant species percent cover in 40 sample plots in transect 3 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Canopy cover class						Canopy coverage (%)[b]	Species composition (%)[c]
	Class 1 0 to 5%	Class 2 5 to 25%	Class 3 25 to 50%	Class 4 50 to 75%	Class 5 75 to 95%	Class 6 95 to 100%		
Casp	1	5	14	19	1		47	75
Popa	18	6	3				6	10
Rare	12	3					2	3
Trre	8	4	1	1			5	8
Poan	10	1					1	2
Taof	11						0.7	1
Asoc	7						0.4	0.6
Brfr	6						0.4	0.6
Juba	3						0.2	0.3
Acmi	2						0.1	0.2
Plma	2						0.1	0.2
Total	NA	NA	NA	NA	NA		62.9	100.9
Moss	1						0.1	
Rock and bare ground	3	4	20	13			41	

[a]See Table B.1 for abbreviation definitions.
[b]Σ (number plants in Class 1)(midpoint percent of Class 1 = 2.5%) + (number plants in Class 2)(midpoint percent in Class 2 = 15%) +...+(number of plants in Class 6)(midpoint percent in Class 6 = 97.5%)/number of frames sampled.
[c]Percent canopy coverage by species/total canopy coverage.

NA - not applicable.

Table B.33 Plant species frequency of occurrence and plant height in 40 sample plots in transect 3 at Camp Kettle Spring, Saguache County, Colorado

Plant species[a]	Frequency (%)[b]	Plant height		
		N	Range	Mean
Casp	100	39	2-6	4
Popa	68	25	1-6	2
Rare	38	15	<1-<1	<1
Trre	35	14	<1-<1	<1
Poan	28	5	<1-<1	<1
Taof	28	11	<1-<1	<1
Asoc	18	5	<1-3	1
Brfr	15	6	<1-<1	<1
Juba	8	3	-	-
Acmi	5	2	-	-
Plma	5	2	-	-

[a]See Table B.1 for abbreviation definitions.
[b](number of frames in which a species occurs ÷ number of frames sampled) x 100.

N - Number of times species was tallied in transect.

Notes: 1. Plant heights are reported in inches.
2. Dash indicates range and mean cannot be calculated for this species.

REFERENCE

Reed, P. B., 1988. "National List of Plant Species That Occur in Wetlands: Intermountain (Region 8)," Biological Report 88 (26.8), National Wetlands Inventory, U.S. Fish and Wildlife Service, Washington, D.C.

ATTACHMENT C

PHOTOGRAPHIC SERIES

Photographic Series 1

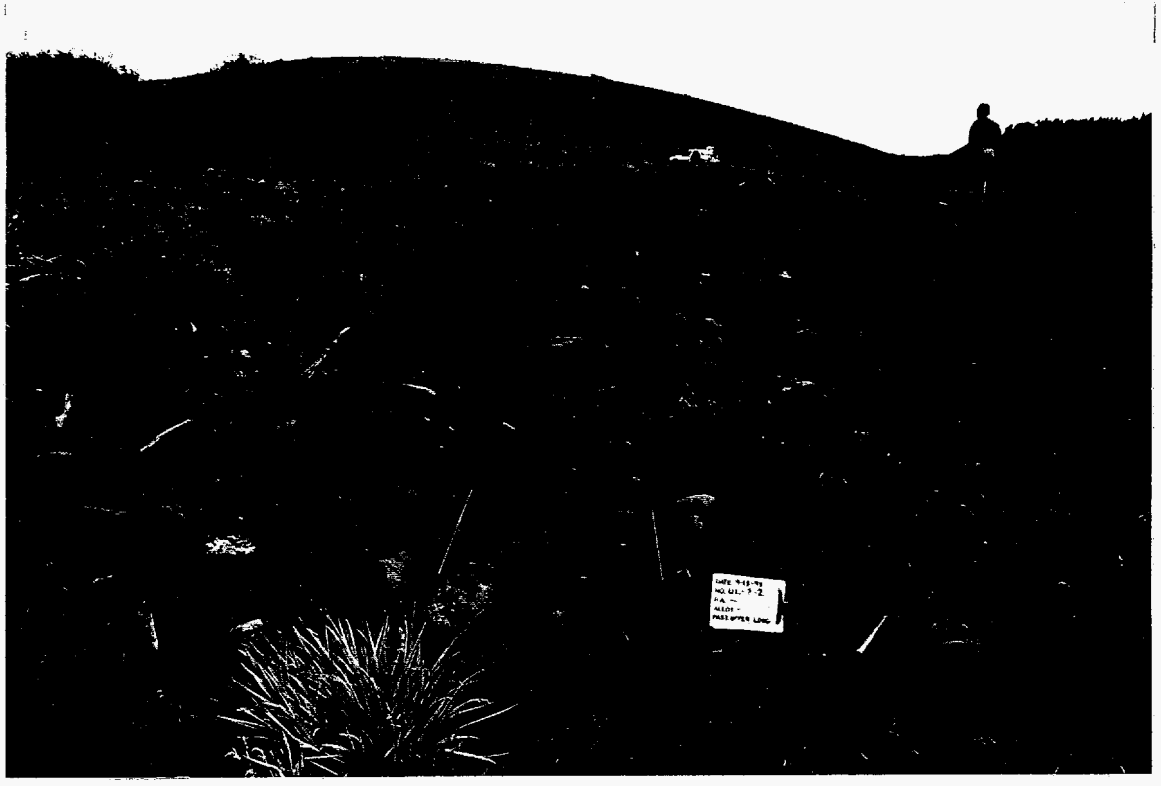
Grazed Upper Riparian Grassland Plant Community

UPPER RIPARIAN GRASSLAND PLANT COMMUNITY, HOUSTON GULCH
SEPTEMBER 1993

UPPER RIPARIAN GRASSLAND PLANT COMMUNITY, CAMP KETTLE SPRING
SEPTEMBER 1993

Photographic Series 2

Grazed Lower Riparian Grassland Plant Community



LOWER RIPARIAN GRASSLAND PLANT COMMUNITY, UPPER LONG'S GULCH
SEPTEMBER 1993

LOWER AND UPPER RIPARIAN GRASSLAND PLANT COMMUNITY, HOUSTON GULCH
SEPTEMBER 1993

Photographic Series 3

Grazed and Ungrazed Sedge Wetlands

***CAREX* PLANT COMMUNITY, UPPER LONG'S GULCH, SEPTEMBER 1993**

GRAZED *CAREX* PLANT COMMUNITY, SAGE HEN SPRING, SEPTEMBER 1993

Photographic Series 4

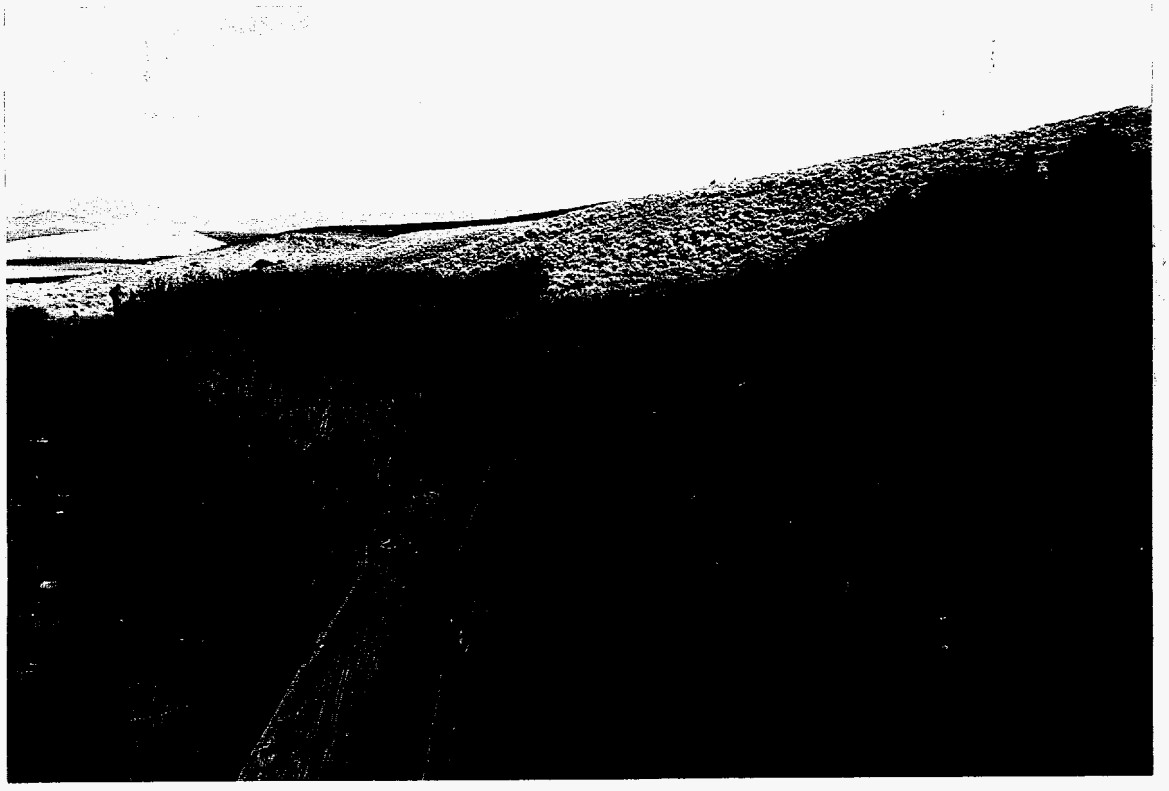
Willow Thickets Impacted by Grazing

WILLOW PLANT COMMUNITY, UPPER LONG'S GULCH, *CAREX* AND UPPER RIPARIAN GRASSLAND PLANT COMMUNITY ALSO IN EVIDENCE SEPTEMBER 1993

WILLOW PLANT COMMUNITY, SAGE HEN SPRING, SEPTEMBER 1993

Photographic Series 5

Cattle Exclosure at Valdez Spring



VALDEZ SPRING EXCLOSURE, SEPTEMBER 1993

VALDEZ SPRING EXCLOSURE, SEPTEMBER 1993