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1997 MONITORING REPORT FOR THE GUNNISON, COLORADO WETLANDS MITIGATION PLAN

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Uranium Mill Tailings Remedial Action Project

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**1997 MONITORING REPORT FOR THE GUNNISON, COLORADO
WETLANDS MITIGATION PLAN**

November 1997

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LIST OF ACRONYMS

Acronym

Definition

BLM	Bureau of Land Management
DOE	U.S. Department of Energy
SPI	Standard Precipitation Index
UMTRA	Uranium Mill Tailings Remedial Action
USACE	U.S. Army Corps of Engineers

EXECUTIVE SUMMARY

Under the Uranium Mill Tailings Remedial Action (UMTRA) Project, the U.S. Department of Energy (DOE) cleaned up uranium mill tailings and other surface contamination near the town of Gunnison, Colorado. Remedial action resulted in the elimination of 4.3 acres (ac) (1.7 hectares [ha]) of wetlands. This loss is mitigated by the enhancement of six spring-fed areas on Bureau of Land Management (BLM) land (mitigation sites).

Approximately 254 ac (103.3 ha) were fenced at the six sites to exclude grazing livestock. Of the 254 ac (103.3 ha), 17.8 ac (7.2 ha) are riparian plant communities; the rest are sagebrush communities. Baseline grazed conditions of the riparian plant communities at the mitigation sites were measured prior to fencing. This report discusses results of the fourth year of a monitoring program implemented to document the response of vegetation and wildlife to the exclusion of livestock.

Three criteria for determining success of the mitigation were established: plant height, vegetation density (bare ground), and vegetation diversity (DOE, 1994). By 1996, Prospector Spring, Upper Long's Gulch, and Camp Kettle met the criteria. The DOE requested transfer of these sites to BLM for long-term oversight. The 1997 evaluation of the three remaining sites, discussed in this report, showed two sites (Houston Gulch and Lower Long's Gulch) meet the criteria. The DOE will request the transfer of these two sites to the BLM for long-term oversight.

The last remaining site, Sage Hen Spring, has met only two of the criteria (percent bare ground and plant height). The third criterion, vegetation diversity, was not met. The vegetation appears to be changing from predominantly wet species to drier upland species, although the reason for this change is uncertain. It may be due to below-normal precipitation in recent years, diversion of water from the spring to the stock tank, or manipulation of the hydrology farther up gradient. Sage Hen Spring currently accounts only for 0.3 ac (0.1 ha) of the total wetland acreage. Because unanticipated changes are occurring at this site, the DOE requests removing Sage Hen Spring from the obligation of the wetland mitigation plan. The BLM agreed that the Sage Hen site will remain fenced to exclude livestock and maintained as a wildlife mitigation site.

Although Sage Hen Spring did not meet all wetland mitigation criteria, the DOE believes the intent of the wetland mitigation for the remedial action has been met for several reasons.

- Overall, a total of 17.8 ac (7.2 ha) of riparian plant communities have been enhanced, of which 10.3 ac (4.2 ha) are jurisdictional wetlands.
- Wetlands in the mitigation sites have been expanded. From 1993 to 1996, wetlands acreage increased over 25 percent (from 8.0 to 10.3 ac [4.2 ha]).
- The enhanced mitigation sites are of a much higher quality than the areas that were eliminated, because all the mitigation sites are in remote areas rather than the wetland areas that were destroyed during cleanup activities, which were along highway drainage ditches.
- Additionally, the quality of the plant communities surrounding the jurisdictional wetlands has improved since livestock were excluded, providing enhanced wildlife habitat.

Reference

DOE (U.S. Department of Energy), 1994. *Mitigation and Monitoring Plan for Impacted Wetlands at the Gunnison UMTRA Project Site, Gunnison, Colorado*, DOE/AL/62350-85, prepared for the U.S. Department of Energy, Environmental Restoration Division, UMTRA Project Team, Albuquerque, New Mexico.

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) administers the Uranium Mill Tailings Remedial Action (UMTRA) Project to clean up uranium mill tailings and other surface contamination at 24 abandoned uranium mill sites in 10 states. One of these abandoned mill sites was near the town of Gunnison, Colorado. Surface remediation and the environmental impacts of remedial action are described in the Gunnison environmental assessment (DOE, 1992); surface remediation was completed at the Gunnison site in December 1995. Remedial action resulted in the elimination of 4.3 acres (ac) (1.7 hectares [ha]) of wetlands. However, this loss is mitigated by the enhancement of 254.2 ac (103.3 ha) of land that includes 17.8 ac (7.2 ha) of riparian plant communities. This riparian area includes 10.3 ac (4.2 ha) of wet meadow in six spring-fed areas on U.S. Bureau of Land Management (BLM) land (mitigation sites) (Figure 1.1). The mitigation and monitoring plan for impacted wetlands describes the areas disturbed by remedial action and the mitigation wetlands (DOE, 1994).

The six spring-fed mitigation sites were fenced in the fall of 1993 to exclude grazing livestock. Baseline grazed conditions within the riparian plant communities were measured prior to fencing during the summer of 1993 (DOE, 1994). A monitoring program documented the response of vegetation and wildlife to the exclusion of livestock for up to 5 years. Results for the first 2 years of monitoring appear in the 1994-1995 monitoring report (DOE, 1996). Results of the third year of the monitoring program are discussed in the 1996 monitoring report (DOE, 1997). This report discusses the fourth year of monitoring, conducted in 1997.

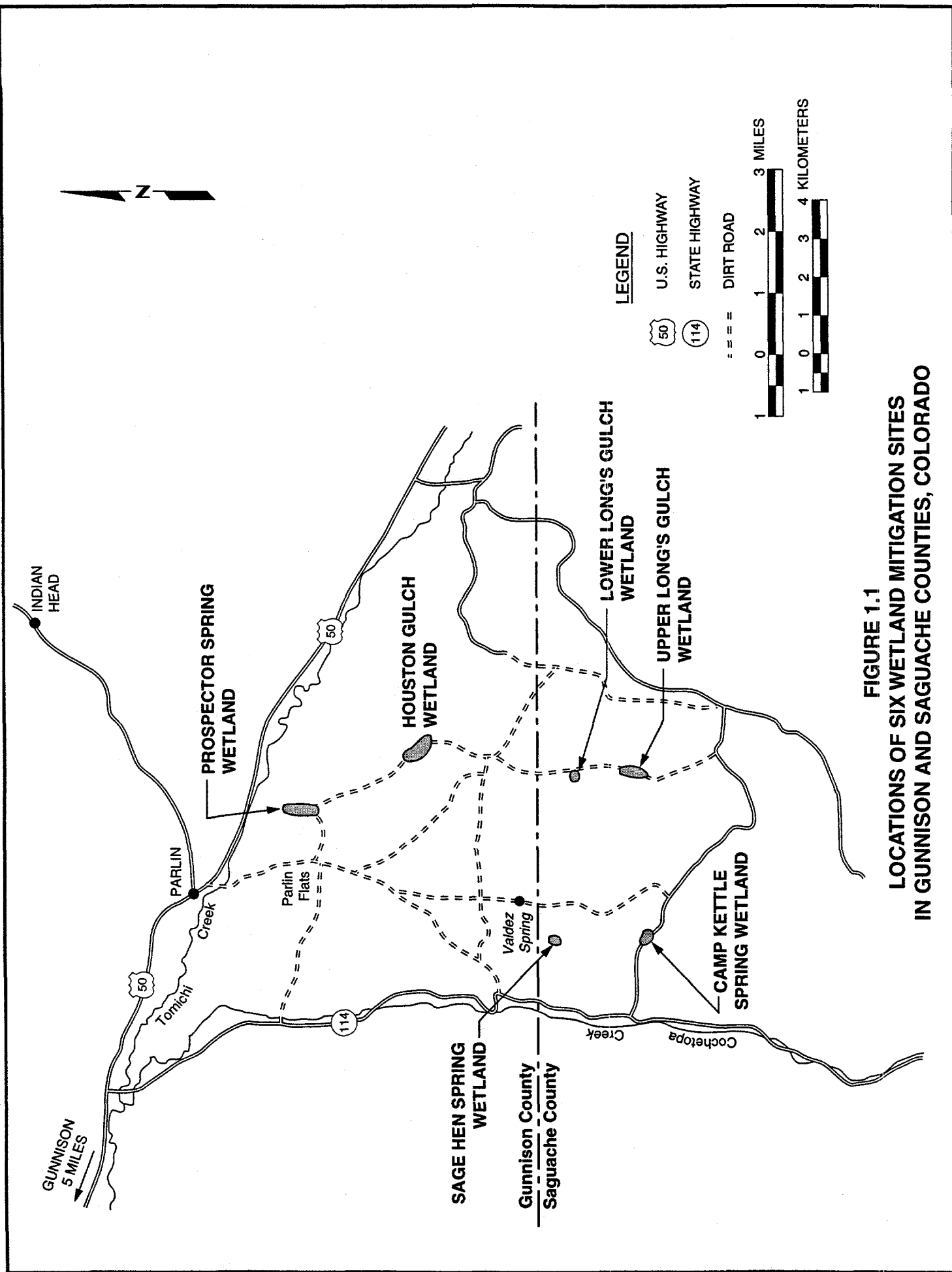


FIGURE 1.1
LOCATIONS OF SIX WETLAND MITIGATION SITES
IN GUNNISON AND SAGUACHE COUNTIES, COLORADO

2.0 METHODS

The boundaries of the U.S. Army Corps of Engineers (USACE) jurisdictional wetlands and other plant communities were determined in 1993 (DOE, 1994). At that time, the wetlands were expected to expand as a result of excluding cattle. The USACE wetlands were remapped in 1996 using the USACE wetlands delineation manual (the federal manual) to determine the wetlands boundaries (USACE, 1987). According to the federal manual, an area must meet the hydrophytic vegetation, hydric soils, and wetland hydrology criteria before it can be considered a USACE wetland. Wetlands were delineated at sites with no clear boundaries, following the federal manual (USACE, 1987).

In 1996 three of the six mitigation sites (Prospector Spring, Camp Kettle Spring, and Upper Long's Gulch) met the success criteria and are being transferred to the BLM for long-term monitoring. Quantitative vegetation sampling was conducted at the three remaining mitigation sites (Houston Gulch, Sage Hen Spring, and Lower Long's Gulch) in August 1997 (TAC, 1997). Data were collected using the Daubenmire method (Daubenmire, 1959; BLM, 1985). Appendix A contains a selected number of photographic series for the three wetland mitigation sites surveyed in 1997. This photo series is part of the methodology. Appendix B contains the transect data collected in 1997. These methods are described in detail in the Gunnison mitigation and monitoring plan (DOE, 1994).

Wildlife surveys at the mitigation sites were conducted in and consisted of traversing the sites and recording all observed wildlife. At least one early morning survey was conducted at each of the three sites. All wildlife observed during other site visits were recorded as well (TAC, 1997).

3.0 RESULTS

This section describes the performance standards, the vegetation sampling, and the wildlife surveys conducted in 1997 at the three remaining mitigation sites. These data are compared to the baseline data collected in 1993 (DOE, 1994), and the monitoring data collected in 1994, 1995 (DOE, 1996), and 1996 (DOE, 1997). The 1997 results are compared to the performance standards before potential transfer of the sites to the BLM.

3.1 PERFORMANCE STANDARDS

The DOE conducted this monitoring program to quantitatively document the enhancement in vegetation at six mitigation sites (DOE, 1994). Based on this program, increased plant height was predicted, as were decreased percent bare ground, changes in plant species composition, and increased willows at the sites containing willows. Performance criteria were established for plant height (12 inches [30 centimeters (cm)] or greater) and bare ground (15 percent bare ground or less).

A more subjective criterion of improvement is the composition of plant species. To meet this criterion, a change in the plant species composition must indicate a shift that is more representative of the lower riparian grassland community or wetland community. Specifically, the wetland status of the dominant plants would change progressively (obligate, facultative-wet, and facultative) (Reed, 1988). Appendix B defines these wetland status categories.

Using data in the national list of plant species that occur in wetlands, the average plant species composition for obligate, facultative-wet, facultative, and facultative-up was determined for the upper and lower riparian grassland and sedge wetland plant communities (Reed, 1988). These data show the sedge wetlands are dominated by obligate plant species, the lower riparian grassland type is dominated by facultative-wet and obligate species, and the upper riparian grassland type is dominated by facultative-wet species. The upper riparian grassland plant community also has the highest average percent species composition of facultative and facultative-upland species.

3.2 CLIMATE AND VEGETATION CONDITIONS

The first 2 years of this study (1993 and 1994) took place during drought conditions that represented a continuation of a 5-year drought in the Gunnison Basin (A. Hays, 1996). The Palmer Drought Index for 1988 through 1994 showed mild to extreme drought conditions occurred (CSU, 1995). Prolonged drought has been observed to result in reduced spring flow. For example, during extreme drought conditions in 1990, springs that had produced water for at least 20 years dried up (A. Hays, 1996).

During the first year of this study (1993), mild drought conditions occurred. In 1994, drought conditions were moderate to severe. The mitigation sites were noticeably drier in 1994 than in 1993, perhaps as a result of these conditions. In 1995, precipitation was above average (A. Hays, 1996). Vegetation response at the six mitigation sites was dramatic (DOE, 1996). Although there was adequate

moisture in the winter and spring of 1996, during the summer of 1996 conditions were very dry. The Palmer Drought Index has been replaced by the Standard Precipitation Index (SPI). The SPI for June, July, and August 1996 for the Gunnison area was -1.27, indicating moderate drought conditions (CSU, 1996). The BLM collects soil moisture data from an upland location near the Prospector Spring site. In early June 1996, the percent available moisture at a 0- to 3-inch (0- to 8-cm) depth was 50 to 75 percent, while at greater depths the soil was at or near field capacity. The soil dried out and by 1 August 1996 was at 0 to 25 percent available moisture to a depth of 16 inches (41 cm) (S. Hays, 1996).

In 1993 and 1994, the average percent bare ground for transects in the upper and lower riparian grassland plant communities at the mitigation sites was above the 15 percent bare ground criterion. The 1995 average was below the criterion. In 1996, the lower riparian grassland plant communities stayed well below the performance criteria while the upper riparian plant communities exceeded them. In 1997, the percent bare ground in the lower riparian grassland plant communities was less than that of 1996. The upper riparian plant community once again fell below the 15 percent criterion. This suggests that long term, the percent bare ground in the upper riparian grassland plant communities tends to fluctuate with long-term precipitation patterns. The percent bare ground in the lower riparian grassland and other wetland plant communities will be more stable over the long term due to the availability of ground water. If long-term drought conditions persist, the vegetation growth in these wetland communities could decrease. For example, 1994 was a drought year and drought conditions had occurred for the previous 6 years. Much less water was observed in the mitigation sites that year than any other and an increase in bare ground was noted in both the upper and lower riparian grassland plant communities (TAC, 1997).

3.3 MITIGATION SITES ASSESSMENT

3.3.1 Houston Gulch

At the Houston Gulch site, 10.8 ac (4.4 ha) were fenced (Figure 3.1). In 1997, 3.8 ac (1.5 ha) of this site were classified as riparian plant communities (Table 3.1). Sampling to delineate the wetland boundaries in 1996 (DOE, 1996) determined that the USACE wetlands had increased by 0.2 ac (0.1 ha) from 1993 (lower riparian wetlands expanded into the upper riparian grassland, which decreased by only 0.1 ac [<0.1 ha]). Wetlands acreage was not evaluated in 1997, but is expected to have slightly increased or remained constant. Willows have not been observed at Houston Gulch and the site did not contain a willow plant community before it was fenced.

At BLM request, cattle guards were removed from the road through the mitigation site. The west fence line of this enclosure was moved east approximately 50 feet (ft) (15 meters [m]), placing the existing road just outside the wetland enclosure (Figure 3.1). The BLM also placed a reducing valve on the inlet to the stock tank. This regulating capability will greatly reduce the amount of water that overflows this stock tank. In the past, inflow water to the tank has exceeded the tank outlet capacity.

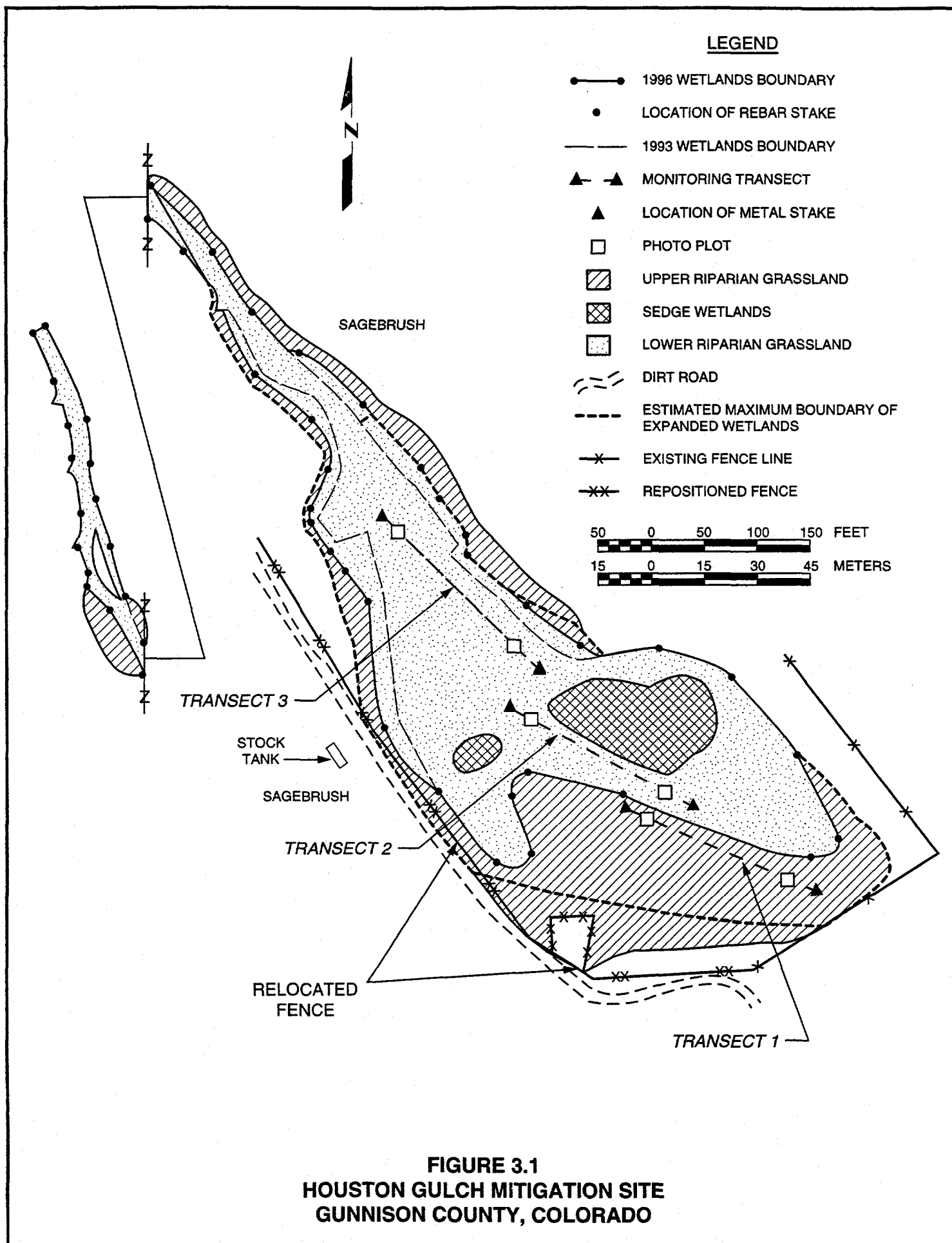


Table 3.1 Acres of wetland and upper riparian plant communities in 1996 at six wetland mitigation sites, Gunnison and Saguache Counties, Colorado

Mitigation site	Plant community type					
	Wetland				Nonwetland	
	Lower riparian grassland	Sedge	Willow	Total	Upper riparian grassland	Total
Prospector Spring	4.8 (1.9)	0.6 (0.2)	--	5.4 (2.2)+1.9	3.3 (1.3)	8.7 (3.5)
Houston Gulch	2.0 (0.8)	0.3 (0.1)	--	2.3 (0.9)+0.2	1.5 (0.6)	3.8 (1.5)
Upper Long's Gulch	0.6 (0.2)	0.2 (0.1)	0.1 <0.1	0.9 (0.4)+0.2	0.8 (0.3)	1.7 (0.7)
Lower Long's Gulch	0.1 (<0.1)	--	0.2 (0.1)	0.3 (0.1)-0.1	0.2 (0.1)	0.5 (0.2)
Sage Hen Spring	0.1 (<0.1)	0.1 (<0.1)	0.1 (<0.1)	0.3 (0.1)-0.1	0.7 (0.3)	1.0 (0.4)
Camp Kettle Spring	0.7 (0.3)	0.4 (0.2)	--	1.1 (0.5)+0.2	1.0 (0.4)	2.1 (0.9)
Total	8.3 (3.4)	1.6 (0.6)	0.4 (0.2)	10.3 (4.2)	7.5 (3.0)	17.8 (7.2)

Notes: 1. Dash indicates this plant community type did not occur at this site in 1996.
2. Hectares in parentheses.

Percent bare ground criteria were met at each of the three transects at this site. All transects were well below 15 percent in 1997 (Table 3.2).

An overstory species was considered any species greater than or equal to 12 inches (30 cm) in height during any year of mitigation monitoring. The dominant overstory species were calculated only from those species.

Transect 1 is in the upper riparian grassland plant community at the Houston Gulch site. Juba and Fowl bluegrass (Popa) are categorized as facultative wetland species and were the dominant overstory species in 1997. Juba formed 70 percent of the overstory species normalized canopy cover; Popa was 14 percent (Table 3.3).

Transect 2 is in the lower riparian grassland plant community. For 1997 common yarrow (Acla), a facultative upland plant, was the dominant overstory species at 28 percent, followed by Popa (16 percent), and Agst (15 percent), a facultative wetland species.

Transect 3 is also in the lower riparian grassland plant community. The dominant overstory species for Transect 3 was Juba (32 percent), Asoc (21 percent), a facultative species, and Dece, a facultative wetland species (14 percent).

All three transects show a slight positive trend towards more wet type habitat. The combined percent species composition of obligate and facultative-wet species has been between 50 and 57 percent during the 4-year study. Since this site has met and/or exceeded all three performance criteria, the site is recommended for transfer to the BLM for long-term management.

3.3.2 Lower Long's Gulch

Lower Long's Gulch consists of 5.2 ac (2.1 ha) (Figure 3.2). In 1993 when the site was fenced, lower riparian grasslands occurred at both the east and west ends of the site, with willows occurring in the middle of the site. From 1994 to 1997 the eastern-most and western-most willows and much of the lower riparian grasslands at both the east and west ends of the site have slowly dried up. Due to the decrease in moisture, the size of the USACE wetlands was reduced by 0.1 ac (0.1 ha). This decrease was offset by an identical increase in the upper riparian plant community. Currently, this site contains 0.5 ac (0.4 ha) of riparian plant community, of which 0.3 ac (0.1 ha) is considered USACE wetlands (0.1 ac [<0.1 ha] of lower riparian grasses and 0.2 ac [0.1 ha] of willows).

The cause of the changed hydrology in this area is not apparent. One factor may be that the long-term drought has decreased the amount of spring water available to the wetlands. Another factor may be the diversion of the spring water when the stock tank was relocated south of the site in 1994. To help bring more water into the area, a Siamese valve was installed at the spring to better control the amount of water diverted to the stock tank. Also, the highly degraded water course of this wetland could be due to past livestock use. This degradation is in the form of distinct channels and wallows that run primarily along the southern edge of the wetland. Currently, most of the water collects in the wallows and infiltrates underground, and reduces overground flow.

Table 3.2 Percent bare ground at wetland mitigation sites sampled in 1997, Gunnison
and Saguache Counties, Colorado

Site	Transect 1					Transect 2					Transect 3					Transect 4	
	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1993	1994	1995	1996	1997	1997	1997
Houston Gulch	10 ^a	37 ^a	11 ^a	17 ^a	8 ^a	23 ^b	32 ^b	8 ^b	14 ^b	2 ^b	30 ^b	40 ^b	3 ^b	2 ^b	1 ^b	--	--
Lower Long's Gulch	22 ^b	31 ^a	26 ^a	14 ^a	17 ^a	--	--	--	--	1 ^b	--	--	--	--	--	--	--
Sage Hen Spring	38 ^b	61 ^a	4 ^a	13 ^a	7 ^a	44 ^b	60 ^b	0 ^b	17 ^a	1 ^a	10 ^a	36 ^a	17 ^a	21 ^a	9 ^a	1 ^b	1 ^b

^a Considered upper riparian grassland transect for that year.^b Considered lower riparian grassland transect for that year.

Notes:

1. Bare ground also includes ground covered with rocks and wood.
2. 1993 results are from DOE, 1994; 1994 and 1995 results are from DOE, 1996; 1996 results are from DOE, 1997.
3. Dash indicates no transect established.

**Table 3.3 1997 dominant overstory species compared to like species observed
1993 to 1996, Houston Gulch, Gunnison County, Colorado**

TRANSECT 1				
1993	1994	1995	1996	1997
Juba 8% 4"	Juba 79% 6"	Juba 38% 9"	Juba 29% 8"	Juba 70% 13"
Popa 90% 1"	Popa 21% 3"	Popa 50% 10"	Popa 71% 6"	Popa 14% 14"
		Hoju 13% 9"		Hoju 5% 14"
				Agtr 7% 28"
TRANSECT 2				
1993	1994	1995	1996	1997
Popa 45% 4"	Popa 27% 5"	Popa 40% 21"	Popa 42% 13"	Popa 16% 22"
Hoju 14% 7"	Hoju 17% 9"	Hoju 32% 20"	Hoju 11% 9"	Hoju 3% 20"
Juba 9% 4"	Deca 23% 10"	Acla 12% 13"	Juba 18% 14"	Juba 8% 16"
Deca 32% 15"	Glst 3% 14"	Deca 15% 24"	Caut 13% 17"	Acla 28% 14"
		Glel 15% 26"	Deca 11% 18"	Agst 15% 27"
			Glst 5% 13"	Taof 9% 5"
				Agsp 7% 28"
TRANSECT 3				
1993	1994	1995	1996	1997
Juba 8% 7"	Juba 22% 9"	Asoc 13% 5"	Juba 33% 18"	Juba 32% 22"
Deca 83% 12"	Hoju 19% 9"	Hoju 34% 24"	Asoc 20% 7"	Asoc 21% 13"
Hoju 8% 7"	Glst 56% 13"	Glel 54% 33"	Deca 37% 23"	Deca 14% 32"
			Hoju 5% 13"	Hoju 8% 23"
				Epad 8% 15"
				Hobr 6% 26"

- Notes:
1. Plant species that in any given year had an average height of 12" or greater.
 2. The percent canopy cover for each species in each year was divided by the sum of the canopy cover for all species for each year, and multiplied by 100.
 3. Table excludes normalized canopy of 1, 2, and 3 percent.
 4. See Appendix B for definitions of plant abbreviations.

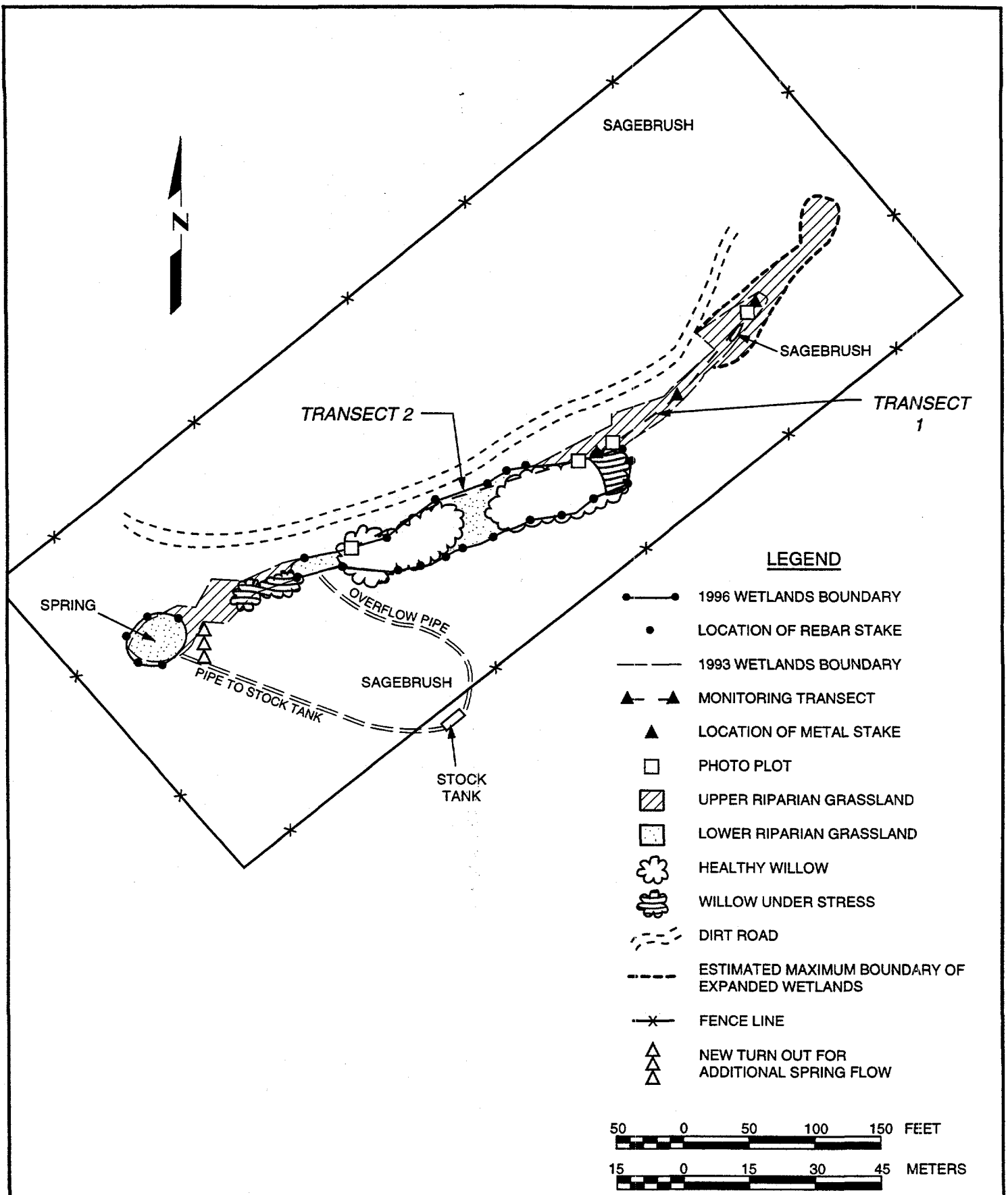


FIGURE 3.2
LOWER LONG'S GULCH MITIGATION SITE
SAGUACHE COUNTY, COLORADO

Transect 1 was established in the lower riparian grasslands at the east end of the site. In 1993, standing water was present in this area and the vegetation was dark green. As described above, this area has dried up and now is considered an upper riparian plant community. The percent bare ground for this transect was 17 percent in 1997. Although the percent bare ground criterion has not been achieved for this transect, the overall percent bare ground has decreased since the site was fenced (Table 3.2). The dominant overstory species was Popa at 65 percent. Juba and Deso also were commonly encountered along this transect (Table 3.4). All of these species average over 12 inches (30 cm) tall in this transect. Because this transect is now considered within the upper riparian plant community, vegetative response will be more a function of precipitation than groundwater.

To better evaluate trends occurring in the wetlands, a new transect (transect 2) was established in 1997. The percent bare ground for this transect measured 1 percent. Willows are the dominant species along this transect. The dominant scrub and forb overstory species are Popa at 46 percent and Agsm at 14 percent. Rimo and Hobr are subdominant.

Although some hydrology changes at the site cannot be fully explained without continued inspection, improvements have occurred at the site since it was fenced to exclude cattle. All criteria were achieved for transect 2, showing that where water is present, wetland vegetation thrives. The area around the spring was highly degraded by cattle; the vegetation is now more dense and taller. In addition, vegetation across the site also is of high quality and taller due to the elimination of grazing. With the corrective action taken to mitigate the hydrology concerns, the western portion of the wetland is expected to recover and return to a lower riparian grassland. Based on these conclusions, this site is recommended for transfer to the BLM for long-term management.

3.3.3 Sage Hen Spring

Sage Hen Spring is the smallest of the six mitigation sites. This enclosure consists of 3.8 ac (1.5 ha) (Figure 3.3). For unknown reasons, portions of the wetlands appear to be shifting to a drier type of plant community. A reduction of 0.1 ac (<0.1 ha) in USACE wetlands was observed in 1996. Over the last 4 years this area has become dryer, and during the drought of 1996 all vegetation turned brown. This reduction occurred along the drainage at the north end of the site (within transect 3). This area drier originally was mapped as a lower riparian grassland in 1993 due to the presence of standing water and wet soils; however, it has been reclassified as an upper riparian plant community. In 1997, in response to above-normal precipitation, this area as well as the site in general showed some recovery.

The vegetation in the sedge wetland community is showing signs of stress, although the conditions causing the vegetative changes are not apparent. One factor may be that the long-term drought has decreased the amount of spring water available to the wetlands. This may account for reduced plant growth within transect 3. The long-term drought also could contribute to the significant variance in percent bare ground and plant height over time. Canada thistle may be another factor. Canada thistle, which is encroaching heavily along the edge of sedge

Table 3.4 1997 dominant overstory species compared to like species observed 1993 to 1996 for Lower Long's Gulch, transects 1 and 2, Gunnison County, Colorado

TRANSECT 1				
1993	1994	1995	1996	1997
Popa 100% 2"	Popa 91% 5"	Popa 100% 15"	Popa 76% 6"	Popa 65% 12"
	Juba 9% 8"		Juba 24% 11"	Juba 18% 16"
				Deso 6% 16"
TRANSECT 2				
1993	1994	1995	1996	1997
-	-	-	-	Popa 46% 20"
-	-	-	-	Agsm 14% 24"
-	-	-	-	Rimo 11% 27"
-	-	-	-	Hobr 7% 21"
-	-	-	-	Juba 6% 15"
-	-	-	-	Agst 4% 28"

- Notes:
1. Dash Indicates no survey conduct in that year.
 2. Plant species that in any given year had an average height of 12" or greater.
 3. The percent canopy cover for each species in each year was divided by the sum of the canopy cover for all species for each year, and multiplied by 100.
 4. Table excludes normalized canopy percents of 1, 2, and 3 percent.
 5. See Appendix B for definitions of plant abbreviations.

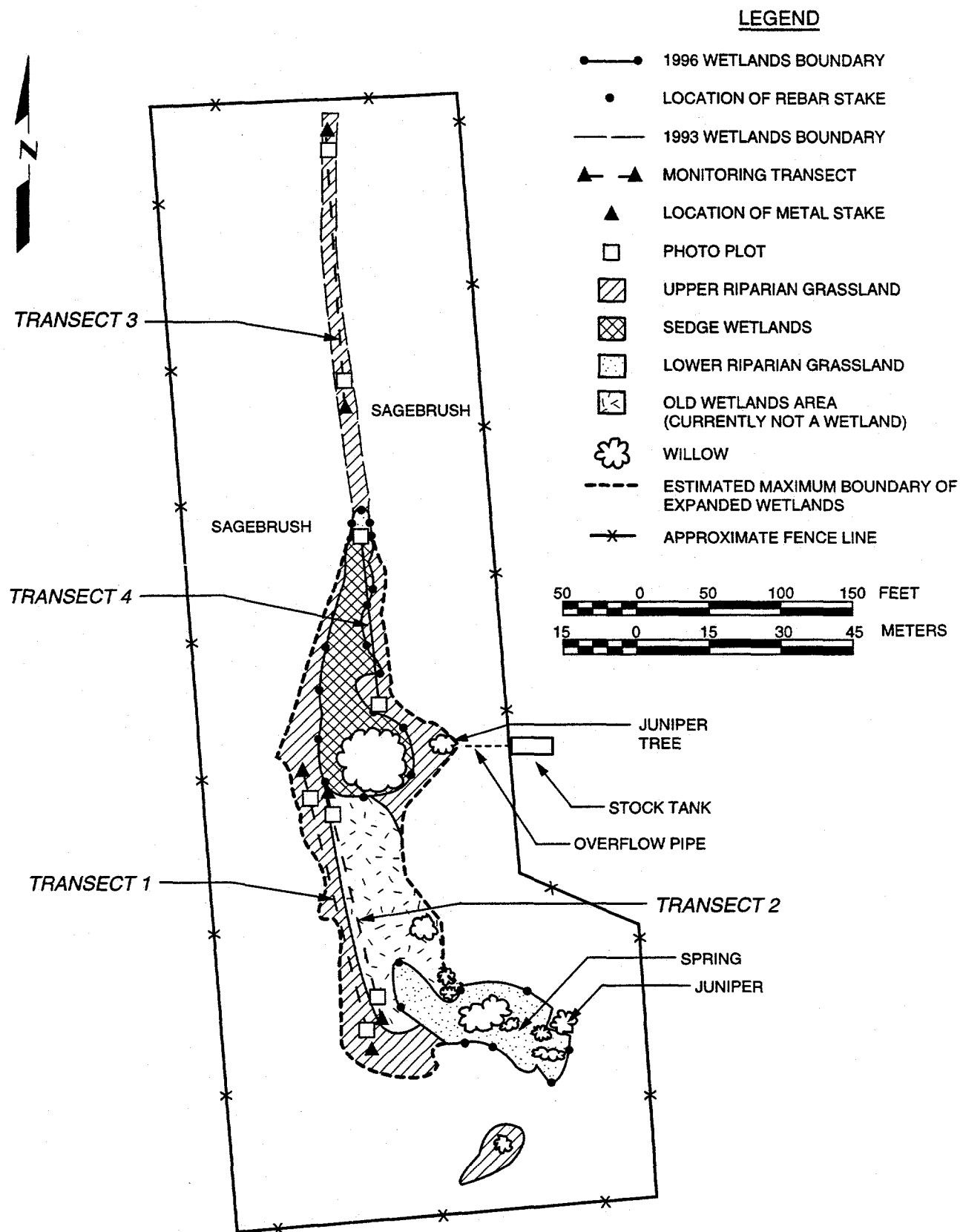


FIGURE 3.3
SAGE HEN SPRING MITIGATION SITE
SAGUACHE COUNTY, COLORADO

community, is increasing. Canada thistle is known for its ability to transpire large volumes of water.

In 1997, all transects met the bare ground and plant height criteria. However, vegetation diversity, including wetlands indicator species, is not shifting toward a more wet-type plant community. In fact, the vegetation appears to be moving toward a drier plant community (Table 3.5).

Transect 1 is in the upper riparian grassland plant community. Popa remained the dominant species in 1997. Loac, Agsm, and Ciar also were common. These species are also the dominant overstory species.

Transect 2 is in an old wetlands area and now is dominated by weedy plant species. This area may have dried up in response to diversion of the spring water to the stock tank BLM relocated in 1990. Stickseed (Laoc) has the highest percent species composition in 1997 followed by Canada thistle (Ciar). These are also the dominant overstory species.

Transect 3 is also in an upper riparian grassland plant community along a drainage downgradient of the sedge plant community. Popa and Juba are the dominant overstory species. Popa has been the dominant species during the 4-year sampling period. Juba was a subdominant species in 1997.

A new transect was established (transect 4) to measure existing wetland conditions. This transect was established because vegetation in transects 2 and 3 are not recovering as anticipated. The percent bare ground was measured at 1 percent for this new transect. The dominant overstory species are Juba and Popa, followed closely by Cahy. This transect was placed along the edge of a healthy portion of the sedge community, away from the encroachment of the Canada thistle.

Because the vegetation within this site is in a state of flux, the wetlands ability to maintain themselves and/or show future improvement is not known. This site is not recommended for wetlands mitigation. However, this site is recommended for transfer to the BLM for long-term management as a wildlife mitigation area. In addition, it is recommended that BLM continue to monitor the existing transects periodically in order to evaluate and document enhancements and/or changes on this site.

Table 3.5 1997 dominant overstory species compared to like species, 1993 to 1996 at Sage Hen Spring, transects 1, 2, 3, and 4, Saguache County, Colorado

TRANSECT 1				
1993	1994	1995	1996	1997
Popa 93% 1"	Popa 57% 3"	Popa 79% 18"	Popa 55% 8"	Popa 27% 18
Agsm 5% 7"	Agsm 33% 4"	Agsm 21% 22"	Agsm 13% 11"	Laoc 27% 17"
	Juba 10% 6"		Juba 13% 9"	Agsm 19% 15"
			Agsp 10% 17"	Ciar 10% 18"
			Sial 10% 12"	Juba 5% 14.4
TRANSECT 2				
1993	1994	1995	1996	1997
Laoc 9% 8"	Paoc 41% 7"	Hoju 84% 23"	Laoc 32% 7"	Laoc 43% 18"
Arfr 55% 7"	Ciar 11% 12"	Agsm 6% 23"	Ciar 68% 20"	Ciar 24% 24"
Popa 36% 1"	Arfr 14% 9"	Popa 11% 23"		Arfr 7% 20"
	Agsm 4% 4"			Drpa 7% 12"
	Depi 4% 15"			Agtr 5% 24"
				Hoju 4% 14"
TRANSECT 3				
1993	1994	1995	1996	1997
Popa 70% 10"	Popa 69% 8"	Popa 100% 17"	Popa 83% 8"	Popa 51% 21"
Juba 11% 3"	Juba 31% 11"		Juba 17% 10"	Juba 28% 17"
Hoju 19% 12				Hoju 5% 13"
				Rowo 5% 17%
TRANSECT 4				
1993	1994	1995	1996	1997
-	-	-	-	Juba 35% 21"
-	-	-	-	Popa 17% 17"
-	-	-	-	Cahy 11% 16"
-	-	-	-	Acla 9% 20"
-	-	-	-	Astsp 9% 14"
-	-	-	-	Deca 9% 16"
-	-	-	-	Hobr 4% 18"
-	-	-	-	Mear 4% 14"

1. Dash Indicates no survey conduct in that year.
2. Plant species that in any given year had an average height of 12 inches (") or greater.
3. The percent canopy cover for each species in each year was divided by the sum of the canopy cover for all species for each year, and multiplied by 100.
4. Table excludes normalized canopy percents of 1%, 2%, 3%.
5. See Appendix B for definitions of plant abbreviations.

4.0 CONCLUSIONS

In remediating the radioactive contamination at the former Gunnison processing site, 4.3 ac (1.7 ha) of USACE wetlands were destroyed. The destroyed wetlands were mitigated through the enhancement of six degraded wetland sites in the Gunnison basin on BLM land (DOE, 1994). Three criteria for determining success of the mitigation were established: vegetation diversity, plant height, and percent bare ground.

In 1996 three of the six sites (Prospector Spring, Upper Long's Gulch, and Camp Kettle) met the success criteria and were recommended for transfer to the BLM for long-term management. As this report shows, the 1997 evaluation of the three remaining sites found that two more sites (Houston Gulch and Lower Long's Gulch) met the success criteria and therefore are recommended for transfer to the BLM for long-term management. The third site, Sage Hen Spring, is not recommended for use as wetland mitigation. This site showed that wetlands vegetation was changing from a wet to a more dry species. Observed changes do not indicate the wetlands will be able to maintain themselves, much less show future improvement. However, this site is recommended for transfer to the BLM for long-term management as a wildlife mitigation area. In addition, it is recommended that BLM continue to periodically monitor the existing transects in order to evaluate and document enhancements and/or changes that occur on this site.

Enhancement of the five successful mitigation sites provides a total of 10 ac (4.0 ha) of USACE wetlands and 6.8 ac (2.8 ha) of upper riparian grassland plant communities. In addition, the mitigation provides approximately 235 ac (95 ha) of upland sagebrush habitat that is protected from cattle grazing. Although the mitigation has not met the USACE wetland enhancement criteria of 3 ac (1.2 ha) of enhanced wetlands per 1 acre destroyed, the DOE considers its responsibility for mitigating destroyed wetlands has been met and no further action is required. The enhanced mitigation sites provide a much higher quality wetland and wildlife area than the wetlands that were destroyed. The destroyed wetlands were located in radioactively contaminated soils next to the Gunnison municipal airport. The enhanced wetlands are located in remote areas on BLM land. These areas are remote and protected from the general population, thus providing refuge for regional wildlife. In addition, an upper riparian plant community surrounds each wetland and because the exclosures are fenced, the enhanced wetlands are more protected than the destroyed wetlands. Maintaining the exclosures and spring developments on the five sites is expected to continue expansion of the USACE wetlands and upper riparian grasslands.

In addition, the DOE sponsored the construction of three other wildlife mitigation sites (Graflin, Razor Creek, and Big Seep) by erecting fences to exclude livestock and developing existing springs to provide water to these sites. The DOE monitored these areas only for wildlife mitigation. However, mitigation activities at these sites are identical to those at the wetland mitigation sites. Therefore, the wetlands, as well as the surrounding areas, should experience a similar enhancement. The BLM will maintain these three areas for wildlife mitigation efforts. Finally, the Sage Hen Spring mitigation site probably will remain fenced, thus protecting the existing wetlands from cattle grazing as well as providing a wildlife refuge.

5.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this report.

Name	Contribution
S. Cox, J. McBee, M. Gawthrop Cooper	Data collection and report preparation
S. Cox, A. Clifford	Data collection and plant identification
L. Maez	Text processing
J. Torline	Technical editing

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APPENDIX A
PHOTOGRAPHIC SERIES AT WETLANDS MITIGATION SITES
AUGUST 1997

APPENDIX B
DAUBENMIRE FORMS AND BACKUP DATA

Table B.1 Plant species observed at the six wetlands, Gunnison and Saguache Counties, Colorado

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Achillea lanulosa</i> (Acla)	Common yarrow	FACU
<i>Agropyron smithii</i> (Agsm)	Western wheatgrass	FACU
<i>Agropyron</i> sp. (Agsp)	Wheatgrass sp.	NA
<i>Agropyron trachycaulum</i> (Agtr)	Slender wheatgrass	FACU
<i>Agrostis alba</i> (Agal)	Red top	FACW
<i>Agrostis stolonifera</i> (Agst)	Spreading bentgrass	FACW
<i>Alopecurus aequalis</i> (Algae)	Short-awn foxtail	OBL
<i>Alopecurus geniculatus</i> (Alge)	Water foxtail	OBL
<i>Antennaria parvifolia</i> (Anpa)	Pussytoes	NA
<i>Artemisia frigida</i> (Arfr)	Fringed sagebrush (fringed wormwood)	UPL
<i>Artemisia tridentata</i> (Artr)	Big sagebrush	UPL
<i>Aster occidentalis</i> (Asoc)	Rocky Mountain aster	FAC
<i>Astragalus agrestis</i> (Asag)	Field milkvetch	FAC
<i>Astragalus lentiginosus</i> (Aslen)	Specklepod milkvetch	NA
<i>Astragalus leptaleus</i> (Asle)	Park milkvetch	NA
<i>Astragalus pattersonii</i> (Aspa)	Patterson milkvetch	NA
<i>Astragalus</i> sp. (Assp)	Milkvetch	NA
<i>Brachyactis frondosa</i> (Brfr)	Gray riparian aster	NA
<i>Bromus catharticus</i> (Brca)	Rescue Grass	NA
<i>Campanula uniflora</i> (Caun)	Bellflower	FACU
<i>Campanula parryi</i> (Capa)	Bellflower	FACU
<i>Carex douglasii</i> (Cado)	Douglas' sedge	OBL
<i>Carex occidentalis</i> (Caoc)	Western sedge	OBL
<i>Carex nebraskensis</i> (Cane)	Nebraska sedge	OBL
<i>Carex utriculata</i> (Caut)	Beaked sedge	OBL
<i>Carex xerantica</i> (Caxe)	Golden sedge	OBL
<i>Carex</i> sp. (Casp)	Sedge	NA
<i>Chenopodium</i> sp.	Chenopod	NA
<i>Chrysothamnus viscidiflorus</i> (Chvi)	Green rabbitbrush	NA
<i>Cirsium arizonicum</i> (Ciar)	Canada thistle	FACU
<i>Cirsium</i> sp. (Cisp)	Thistle	NA
<i>Crepis acuminata</i> (Crac)	Hawksbeard	NA
<i>Deschampsia cespitosa</i> (Dece)	Tufted hairgrass	FACW
<i>Eleocharis palustris</i> (Elpa)	Creeping spikerush	OBL
<i>Epilobium adenocaulon</i> (Epad)	Willow-herb	OBL(?)
<i>Equisetum arvense</i> (Eqar)	Field horsetail	FAC+
<i>Glyceria elata</i> (Glel)	Tall mannagrass	OBL
<i>Glyceria</i> sp. (Glsp)	Mannagrass	OBL
<i>Glyceria striata</i> (Glst)	Fowl Mannagrass	OBL
<i>Hordeum brachyantherum</i> (Hobr)	Meadow barley	FACW
<i>Hordeum jubatum</i> (Hoju)	Foxtail barley	FAC

Table B.1 Plant species observed at the six wetlands, Gunnison and Saguache Counties, Colorado (Concluded)

Scientific name (abbreviation)	Common name	Wetland status ^a
<i>Hordeum vulgare</i> (Hovu)	Common barley	NA
<i>Iris missouriensis</i> (Irm)	Rocky Mountain iris	OBL
<i>Juncus balticus</i> (Juba)	Baltic rush	FACW
<i>Lappula occidentalis</i> (Laoc)	Stickseed	NA
<i>Lepidium perfoliatum</i> (Lepe)	Denseflower peppergrass	FACU
<i>Lepidium montanum</i> (Lemo)	Peppergrass (mountain pepperweed)	FACW
<i>Lupinus argenteus</i> (Luar)	Silvery lupine	NA
<i>Mentha arvensis</i> (Mear)	Field mint	FACW
<i>Muhlenbergia filiformis</i> (Mufi)	Pull-up muhly	FACW
<i>Nasturtium officinale</i> (Naof)	True watercress	OBL
<i>Panicum capillare</i> (Paca)	Witchgrass	FACU
<i>Panicum millifolium</i> (Pami)	Panicum	NA
<i>Phleum pratense</i> (Phpr)	Timothy	OBL
<i>Phleum</i> Sp. (Phsp)	Timothy	FACU
<i>Plagiobothrys scouleri</i> (Plsc)	Scouler popcorn flower	FACU
<i>Poa agassizensis</i> (Poag)	Bluegrass	NA
<i>Poa palustris</i> (Popa)	Fowl bluegrass	FACW
<i>Poa pratensis</i> (Popr)	Kentucky bluegrass	FACU
<i>Poa</i> sp. (Posp)	Bluegrass sp.	NA
<i>Polygonum aviculare</i> (Poav)	Prostrate knotweed	NA
<i>Potentilla anserina</i> (Poan)	Silverweed	OBL
<i>Potentilla</i> sp. (Potsp)	Cinquefoil	NA
<i>Ranunculus macounii</i> (Rama)	Buttercup	OBL
<i>Ranunculus repens</i> (Rare)	Creeping buttercup	FACW
<i>Ribes inerme</i> (Riin)	Whitestem gooseberry	FAC
<i>Rorippa islandica</i> (Rois)	Yellow cress	OBL
<i>Rosa woodsii</i> (Rowo)	Woods rose	FAC-
<i>Rumex crispus</i> (Rucr)	Curly dock	FACW
<i>Salix geyeriana</i> (Sage)	Geyer willow	OBL
<i>Sisymbrium altissimum</i> (Sial)	Tumble mustard	UPL
<i>Sisyrinchium idahoense</i> (Siid)	Blue-eyed grass	OBL
<i>Taraxacum officinale</i> (Taof)	Common dandelion	FACU
<i>Trifolium</i> sp. (Trsp)	clover	NA
<i>Trifolium repens</i> (Trre)	White clover	FACU

^aFrom National List of Plant Species That Occur in Wetlands: Intermountain (Region 8) (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.
- ? status unknown.
- species tends toward the next driest category.

Table B.2 Dominant plant species by percent species composition at Houston Gulch wetland mitigation site sampled in 1997

Transect 1				
1993	1994	1995	1996	1997
FW/Popa/66	FW/Juba/39	FW/Popa/33	FW/Popa/59	FW/Juba/23
FU/Taof/12	FW/Popa/10	FW/Juba/24	FW/Juba/25	FU/Taof/21
FU/Trre/12	FU/Taof/13	F/Asoc/13	F/Asoc/12	F/Assp/10
FW/Juba/6	F/Asoc/8	F/Hoju/9		FW/Popa/4
		FU/Taof/6		
Transect 2				
1993	1994	1995	1996	1997
FW/Agst/21	O/Glst/21	FW/Popa/31	FW/Popa/28	FW/Popa/11
FW/Popa/21	FW/Popa/18	F/Hoju/25	FU/Acla/16	FU/Acla/19
FW/Deca/15	FW/Deca/16	FW/Deca/12	FW/Juba/12	/Agst/10
FU/Taof/13	F/Hoju/11	FU/Acla/9	O/Caut/9	
FU/Trre/11	FU/Taof/9	FW/Hobr/7	FW/Deca/7	
F/Hoju/6		FU/Taof/6		
Transect 3				
1993	1994	1995	1996	1997
FW/Deca/54	O/Glst/43	O/Glel/37	FW/Deca/29	FW/Deca/8
FW/Popa/11	FW/Juba/17	FW/Hoju/24	FW/Juba/26	FW/Juba/20
	FW/Hoju/14	FW/Hobr/12	F/Asoc/16	F/Asoc/13
	?/Poav/7	F/Asoc/9	O/Poan/7	
			FU/Acla/7	
O = Obligate FW = Facultative Wet F = Facultative FU = Facultative Upland U = Upland ? = Indices not known				
Notes 1. Percent is number following species abbreviation. 2. Dash indicates no transect established.				

Table B.3 Dominant plant species by percent species composition at Lower Long's Gulch wetland mitigation site sampled in 1997

Transect 1				
1993	1994	1995	1996	1997
FW/Popa/65	FW/Popa/63	FW/Popa/50	FW/Popa/67	FW/Popa/21
O/Sage/12	O/Sage/10	FW/Juba/14	FW/Juba/21	FW/Taof/15
FU/Taof/9	O/Alge/8	FU/Taof/12	FU/Taof/6	
	FW/Juba/6	O/Sage/6		
	FU/Taof/6			
Transect 2				
1993	1994	1995	1996	1997
--	--	--	--	FW/Popa/23
				FW/Sage/14
				FU/Agsm/7
				FW/Rimo/6
O	=	Obligate		
FW	=	Facultative Wet		
F	=	Facultative		
FU	=	Facultative Upland		
U	=	Upland		
?	=	Indices not known		
Notes: 1. Percent is number following species abbreviation.				
2. Dash indicates no transect established.				

Table B.4 Dominant plant species by percent species composition at Sage Hen Spring wetland mitigation site sampled in 1997

Transect 1				
1993	1994	1995	1996	1997
FW/Popa/74 F/Asoc/16	FW/Popa/35 F/Asoc/29 FU/Agsm/20 FW/Juba/6	F/Asoc/28 FW/Popa/24 FW/Lede/20 O/Chbe/11 FU/Agsm/6	FW/Popa/40 F/Asoc/17 FU/Agsm/10 FW/Juba/10	?/Laoc/14 FW/Popa/14 FU/Agsm/10
Transect 2				
1993	1994	1995	1996	1997
FW/Poav/49 U/Arfr/15 FW/Popa/10 FU/Ciar/7	U/Arfr/31 ?/Laoc/31 O/Canev/14 FU/Ciar/8	FW/Lede/34 F/Hoju/12 FU/Cica/10 O/Chbe/10 ?/Laoc/7	FU/Ciar/39 ?/Laoc/18 O/Caut/14 U/Sial/14	FU/Ciar/16 ?/Laoc/30
Transect 3				
1993	1994	1995	1996	1997
FW/Popa/62 F/Hoju/16 FW/Juba/10	FW/Popa/52 FW/Juba/23 ?/Cane/13	FW/Popa/57 F/Hoju/28	FW/Popa/78 FW/Juba/16	FW/Popa/19 FW/Juba/10 FU/Taof/2
Transect 4				
1993	1994	1995	1996	1997
--	--	--	--	FW/Juba/15 FW/Popa/7 FU/Taof/6
O = Obligate FW = Facultative Wet F = Facultative FU = Facultative Upland U = Upland ? = Indices not known Notes: 1. Percent is number following species abbreviation. 2. Dash indicates no transect established.				

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STUDY NUMBER	DATE	EXAMINER	ALLOTMENT NAME & NUMBER						IPASTURE
HG-1	8-12-1997	STEVEN COX	Houston Gulch #1						1
			COVER CLASS 1	COVER CLASS 2	COVER CLASS 3	COVER CLASS 4	COVER CLASS 5	COVER CLASS 6	FREQ- ICANOPY SPECIES
PLANT	1-5 % (2.5)	5-25 % (15)	25-50 % (37.5)	50-75 % (62.5)	75-95 % (85)	95-100% (97.5)	UENCY	ICOVER- ICOMP.	
SPECIES	DOT COUNT #	DOT COUNT #	DOT COUNT #	DOT COUNT #	DOT COUNT #	DOT COUNT #	(%)	(%)	(%)
TAOF	4	12	17	5			95	29	21
JUBA		13	21	4			95	31	23
ASSP	12	8	11				78	14	10
POPA	8	13	1				55	6	4
AGLA	15	2					43	3	2
LAOC	1						3	1	1
AGTR	2	6					20	3	2
DEPI	1						3	1	1
POAB	1						3	1	1
GARA	1						3	1	1
MELU	7	1					20	1	1
IRMI	2						5	1	1
HOJU	12	3					38	2	1
CIAR	1						3	1	1
POAN	2	1					8	1	1
BAR	4	1					15	11	8
LITER	21	16	2				98	26	20
RUSE	1						3	1	1

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

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Plant height in inches

DATE 9/4/97

SUBJECT HG #1

SHEET NO. Cox/CLIFF

BY _____ CHKD. _____

JOB NO. Sawthorne

TRAF	JUBA	ASSP	POPA	ACLA	LAOC	AGTR	DEPI	POAB	GARA	MELU	IRMI	HOJU	CIAR	POAN	ANSE	ARTR	MJFI
2	10	4	13	5	15	23	14	4	8	2	9	14	3	2	1	4	7
3	16	8	21	1		26				3	11	15		3			
4	13	3	13	3		26				3		21					
4	12	6	18	10		28				3		11					
4	12	7	14	4		24				4		11					
4	12	3	14	4		29				3		9					
4	12	6	15	5		33				3		9					
4	12	9	20	3		38				1		15					
4	13	11	14	8								13					
4	12	11	21	2		27				2		13					
5	14	6	14	2								23					
5	12	4	13	0								17					
5	13	6	7	3								15					
11	13	6		0								12					
5	14	6	10	5								14					
5	13	7	12	7								14					
5	14	8	18														
4	13	8	14	7													
4	14	8	9	34.5													
4	14	8	9														
5	12	4	17														
4	12	7	5														
4	13	11	5														
4	12	5	13														
4	11	3	16														
4	9	7	16														
2	16	5	30														
3	15	14															
3	10	5															
2	13	5															
5	14	5															
4	14	9															
4	15	5															
4	15	5															
5	15	11															
3	14	22															
6	12																
4	12																
2	2	50.5															
2																	
146.5																	

CRITICAL
Covering

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TRAF	JUBA	ASSP	POPA	ACLA	LAOC	AGTR	DEPI	POAB	GARA	MELU	IRMI	HOJU	CIAR	POAN	ANSE	ARTR	MJFI
38	38	31	22	17	1	8	1	1	1	8	2	15	1	2	1	1	1
146.5	50.5	22	30	34.5	15	22.7	14	4	8	22	20	21.3	3	5	1	4	7
4	13	7	14	5	15	28	14	4	8	3	10	14	3	2.5	1	4	7
5-11	9-19	3-14	5-21	5-10	15	23-30	14	4	8	1-4	9-11	9-23	3	3	1	4	7

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STUDY NUMBER	DATE	EXAMINER	ALLOTMENT NAME & NUMBER	IPASTURE				
HG - 2	18-12-1997	STEVE COX	HOUSTON GULCH # 2					
		APPROVED SUPERVISOR						
COVER CLASS 1	COVER CLASS 2	COVER CLASS 3	COVER CLASS 4	COVER CLASS 5	COVER CLASS 6	FREQ-	CANOPY	SPECIES
1-5 % (2.5)	5-25 % (15)	25-50 % (37.5)	50-75 % (62.5)	75-95 % (85)	95-100% (97.5)	UENCY	COVER-	ICOMP.
DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	(%)	(%)	(%)
* AGGR	5	13	5			58	10	7
EPAD	3					8	-	
* POPA	7	13	4	2		65	12	11
AG-SP	2	5	2	1		25	5	5
ME-LV	2	4				15	2	2
POAN	7	5	2			35	4	4
* RCLA	4	14	17			88	21	19
JUBA	7	14				52	6	5
CIFO	2		1			7.5	1	
ASSP	17	3				50	2	2
* TRAF	6	9	3			45	7	6
* AGST	6	7	2	4		48	11	10
CAUT	2	1				8	-	
HOBK	13	3				40	2	2
TRRE	4	3				18	1	1
HOJU	8	4				30	2	2
IRMI	1					3	-	
LESP	2					5	-	

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

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AGE)

DATE 8-12-97
 BY _____ CHKD. _____

SUBJECT

SHEET NO. Cox / 211-1

JOB NO. Sanctus

HG-2 Plant Height in inches

AGGR	EMPD	POPA	AGSP	WELU	POPA	ACLA	JUBA	CIFO	AGSP	THOF	AGST	THOF	HOGR	TRPE	HOJU	IRMI	LESP	MUFI	ANPA	EPLO	POAV	AGTR	CAXC
8	9	12	20	4	4	4	16	6	15	13	21	20	8	17	17	8	20	1	10	15	14	8	
7	6	19	6	8	15	15	6	10	11	4	21	25	7	21	8	11	10	10	12	9	8	23	
7	6	19	6	8	15	15	6	10	11	4	21	25	7	21	8	11	10	10	12	9	8	23	
11	21	24	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	
178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	178	
571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	571	

8+16+15+13=485

$8 + 16 + 15 + 13 = 42$

CU		12	5		21	6			11	2	2	1		1				1	1	1						
	AGGR	EMPD	POPA	HOSP	WELU	POPA	ACLA	JUBA	CIFO	AGSP	THOF	AGST		HOSP	TRPE	HOFU	IRMI	LESP	MUFI	ANPA		ELPD		POPA	AGTA	CAXC
n	23	3	26	10	6	14	39	22	3	20	18	19		16	7	12	1	2	1	1		2		1	1	7
Σx	178	21	571	221	22	80	185	342	17	195	10	52		365	40	234	17	16	20	1		21		15	14	86
x̄	8.7	22	28	4	6	14	16	6	10	5	27			23	6	20	17	8	20	1		11		15	14	12

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TREND STUDY DATA
DAURENHIRE METHOD - SIX COVER CLASSES

46 Transects

PAGE 1 OF 2

Illustration Page 14

STUDY NUMBER

DATE

EXAMINER

ALLOTMENT NAME & NUMBER

PASTURE

HG-3

8-13-97

STEVEN COX

GRAND CUP FORD, HOUSTON GULCH

PLANT SPECIES	COVER CLASS 1 (COVER CLASS 1 5-25 % (2.5))		COVER CLASS 2 (COVER CLASS 2 25-50 % (37.5))		COVER CLASS 3 (COVER CLASS 3 50-75 % (62.5))		COVER CLASS 4 (COVER CLASS 4 75-95 % (85))		COVER CLASS 5 (COVER CLASS 5 95-100% (97.5))		FREQ- UENCY (Z)	ICANDPY (Z)	SPECIES (Z)
	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%			
ASOC	8	16	16	8							80	14	13
POAN	12	14									65	6	6
TUBA	4	14	16								85	21	20
HOBH	17	7									60	4	4
ACLA	6	4									25	2	2
RUMEX	2	1									8	1	1
EPAD	19	10									73	5	5
PHSP	3										8	-	-
POPA	6	1									20	2	2
AGST	3	1									10	-	-
HOJU	10	8									48	5	5
LESP	6	1									18	1	1
TAOF	15	14									73	6	6
LAOC	2	2									1	1	1
POAV	8										23	1	1
AGSM	1										3	-	-
ASSP		1									3	-	-
TRRE	2										5	-	-

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

Plant Height in inches

DATE 2/12/97

SUBJECT

HG-3

SHEET NO. Cox CLIFCORE

JOB NO. GAUTROP

BY _____ CHKD. _____

	ASPC	JULIA	HELENE	HELEN	RENNIE	ETHEL	PHILIP	POPEA	AGUST	HELEN	LESLIE	FRANK	LHUC	POPEA	ASPC	TRACY	CAROL	POPEA	CLIFCORE	MUF	DECE
11	21	25	5	8	15	16	18	30	19	8	8	13	7	15	6	14	5	18	10	37	
13	17	35	21	14	5	20	24	24	22	10	6	3	12	8	8	8	18	32			
13	18	28	8	6	9	13	20	24	23	9	3	8	6	5	23	12	20	38			
15	19	22	11	8	16	17	20	7	4	6	10	9	11	9	11	9	7	37			
11	22	29	11	22	16	21	6	5	7	5	5	5	5	7	7	7	7	29			
8	23	26	5	13	14	16	7	5	5	5	5	5	5	5	5	5	5	39			
22	25	25	6	10	13	26	5	5	5	5	5	5	5	5	5	5	5	40			
13	23	26	7	11	21	21	4	8	8	8	8	8	8	8	8	8	8	35			
14	15	19	15	17	25	25	8	8	8	8	8	8	8	8	8	8	8	42			
12	24	26	2	11	24	24	4	4	4	4	4	4	4	4	4	4	4	35			
10	23	31	7	7	22	22	4	4	4	4	4	4	4	4	4	4	4	38			
11	20	20	18	18	22	22	4	4	4	4	4	4	4	4	4	4	4	9			
12	24	27	11	11	22	22	4	4	4	4	4	4	4	4	4	4	4	21			
14	20	31	18	18	22	22	4	4	4	4	4	4	4	4	4	4	4	34			
12	21	20	15	15	19	19	4	4	4	4	4	4	4	4	4	4	4	33			
13	25	28	19	19	28	28	6	6	6	6	6	6	6	6	6	6	6	33			
13	21	28	17	17	30	30	7	7	7	7	7	7	7	7	7	7	7	30			
11	24	29	15	15	26	26	6	6	6	6	6	6	6	6	6	6	6	26			
9	22	25	17	17	30	30	3	3	3	3	3	3	3	3	3	3	3	22			
14	7	30	10	10	4	4	4	4	4	4	4	4	4	4	4	4	4	21			
4	23	24	21	21	6	6	6	6	6	6	6	6	6	6	6	6	6	32			
12	26	26	12	12	5	5	5	5	5	5	5	5	5	5	5	5	5	32			
12	22	22	13	13	5	5	5	5	5	5	5	5	5	5	5	5	5	32			
12	29	18	13	13	5	5	5	5	5	5	5	5	5	5	5	5	5	35			
14	20	27	19	19	8	8	8	8	8	8	8	8	8	8	8	8	8	39			
20	24	21	16	16	3	3	3	3	3	3	3	3	3	3	3	3	3	31			
14	25	28	22	22	6	6	6	6	6	6	6	6	6	6	6	6	6	30			
19	24	21	18	18	4	4	4	4	4	4	4	4	4	4	4	4	4	32			
16	20	32	7	7	5	5	5	5	5	5	5	5	5	5	5	5	5	32			
15	22	35	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	26			
16	32	35	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	31			
9	19	17	30	30	5	5	5	5	5	5	5	5	5	5	5	5	5	31			

31 + 36 + 42 + 30

	ASPC	JULIA	HELENE	HELEN	RENNIE	ETHEL	PHILIP	POPEA	AGUST	HELEN	LESLIE	FRANK	LHUC	POPEA	ASPC	TRACY	CAROL	POPEA	CLIFCORE	MUF	DECE
CC 14	21	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
32	34	24	10	3	29	3	7	4	19	7	29	4	9	1	2	1	36	5	1	32	
X 49	11	18	9	28	14	19	21	9	5	12	5	14	30	68	13	14	15	91	10	10	17
X 13	22	26	11	9	15	16	17	24	23	7	5	8	8	11	14	14	7	18	10	21	

DATE 2/13/77
 BY _____ CHKD. _____

SUBJECT

Plant Height in inches
 LL # 1

SHEET NO. Cor 15-15-77

JOB NO. Main

7	2	4	6	5	18	17	5	9	4	10	4	7	2	1	32	16	3	12	21	19	37	2
21	6		5	4			5		10	13	3	9	1			5			20	18		
3	2		6	3			5		9	7		4							11	9		
23	2			2					8			9							19	14		
	3			2					13			11							15	5		
	2			15					9			13							8	7		
	1.5			7															8	14		
	2			15															20	13		
	1			10															15	10		
	4			6															12	18		
	4																		13	6		
	1																		13	5		
	3																		23	10		
	2																		20	2		
	2																		16	14		
	1																		14	11		
	2																		18	2		
	1																		14	13		
	1.5																		17			
	2.5																		9			
	4																		14			
	5																		11			
	3																		10			
	2																		13			
	1																		17			
	2																		21			
	1																		15			
	4																		32			
	2+3+2+2																		32			

CC	2																		6	22	1		
	DISP	TRAF	CHAS	CHEN	PORT	PHSP	AGSO	ANSE	HOJU	HOBL	AGSM	LAOC	WSP	APTR	POW	CHNA	ACCA	CAUR	SAAG	JOBA	POPA	ANTR	RARE
n	4	38	1	3	10	1	3	1	6	3	2	6	2	1	1	2	1	1		18	27	1	1
x	64	75	4	17	42	18	15	9	53	30	7	53	3	1	32	21	3	12		28	59	31	2
	16	2	4	6	4	13	17	5	9	9	10	35	9	15	1	B-16	105	3	12	16	12	51	2

B-16

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TREND STUDY DATA
DAUBENHIRE METHOD - SIX COVER CLASSES

30 frames

PAGE 1 OF 2

Illustration
Page 1

STUDY NUMBER	DATE	EXAMINER	ALLOTMENT NAME & NUMBER	IPASTURE					
LL-2	8-10-97	Armed Cox	Lower Longs Gulch #2						
COVER CLASS 1 COVER CLASS 2 COVER CLASS 3 COVER CLASS 4 COVER CLASS 5 COVER CLASS 6 FREQ- CANOPY SPECIES									
11-5 % (2.5)	15-25 % (15)	25-30 % (37.5)	30-50 % (62.5)	50-75 % (85)	75-100% (97.5)	UENCY COVER- ICOMP.	(%)	AGE (%)	(%)
DOOT COUNT	DOOT COUNT	DOOT COUNT	DOOT COUNT	DOOT COUNT	DOOT COUNT				
TAOF	11	5	1			57	5	4	
POPA	3	7	6	10		87	32	23	
DESO	6					20	1	7	
SAGE	1	5	4	6		53	20	14	
TRRE	1					3	1	7	
PLMA		1				3	1	7	
ASSP		1				3	1	7	
AGSM	2	2	2	3		30	10	7	
CIAR	1	1				7	1	7	
JUBA	2	2				17	4	3	
ACLA	3	2	1			20	3	2	
EPAD	2	4				20	2	1	
ARPA		1				3	1	7	
POAN	4	1				17	1	7	
VEAM	1					3	1	7	
RARE	1					3	1	7	
AGST		1		1		7	3	2	

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

SUBJECT

SHEET NO. Cox / Clifford

BY _____ ~~X~~ SHKD. _____

JOB NO. Gawthrey

LL-2

B-19

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TREND STUDY DATA
DAUBENHIRE METHOD - SIX COVER CLASSES

PAGE 1

Illustr.
Page 1

40 Transsects

STUDY NUMBER	DATE	EXAMINER	ALLOTMENT NAME & NUMBER	PASTURE		
SH-SSI	8-13-97	STV ARNOLD CLIFORD	SAGE HEN #SSI			
COVER CLASS 1	COVER CLASS 2	COVER CLASS 3	COVER CLASS 4	COVER CLASS 5	COVER CLASS 6	FREQ- CANOPY SPECIES
1-5 % (2.5)	5-25 % (15)	25-50 % (37.5)	50-75 % (62.5)	75-95 % (85)	95-100% (97.5)	UENCY COVER- ICOMP.
DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	AGE (%)
ASOC	7	9				42
ALTR		1				3
DRPA	6	12	10	2		75
AGEM	3	20	5			70
EQAR	3			1		10
TAOF	5	5				20
ACLA	1					25
JUBA	1	2	2			125
CHLE	1	1				5
LAOC	2	14	9	2		68
CRPA	1					25
APER		2				5
CHNA		1				25
CIAR		5	4			23
SIHY	1					25
DRPA	1	2				75
DEPI	1					25
CAVN		1				25

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

TREND STUDY DATA
DAURENHIRE METHOD - SIX COVER CLASSES

PAGE 2 OF 2

Illustr. Page 1

STUDY NUMBER DATE EXAMINER ALLOTMENT NAME & NUMBER IPASTURE

514 - 551

8-13-77

W. J. C. C. C.

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1

PLANT SPECIES	COVER CLASS 1 (1-5 % (2.5))		COVER CLASS 2 (5-25 % (15))		COVER CLASS 3 (25-50 % (37.5))		COVER CLASS 4 (50-75 % (62.5))		COVER CLASS 5 (75-95 % (85))		COVER CLASS 6 (95-100% (97.5))		FREQ- CANOPY SPECIES
	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	DOT COUNT	%	
Litter			2	22	22	44	1						98
Blue Grass			4				3						18
HOJY													2.5

98 45 36
18 8 7
2.5 - 7

B-21
04

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

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B-22

UNITED STATES DEPARTMENT OF THE INTERIOR BUREAU OF LAND MANAGEMENT			TREND STUDY DATA DAUBENHIRE METHOD - SIX COVER CLASSES			PAGE 1 OF 1		
STUDY NUMBER	DATE	EXAMINER	ALLOTMENT NAME & NUMBER			PASTURE		
SH-2	8-13-97	APPROVED	SAGE HEN #2					
COVER CLASS 1	COVER CLASS 2	COVER CLASS 3	COVER CLASS 4	COVER CLASS 5	COVER CLASS 6	FREQ	CANOPY	SPECIES
1-5 % (2.5)	5-25 % (15)	25-50 % (37.5)	50-75 % (62.5)	75-95 % (85)	95-100 % (97.5)	UENCY	COVER	ICOMP.
DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	DOT COUNT	%	%	%
AGSM	1	3				13	2	4
SHY	1	2				10	1	4
EGAR	2					6	1	4
ARFR	7		1			23	6	5
LAOC	5	6	4	12	1	123	36	30
HOJU	1	5				10	3	2
BGR	2	6	1			26	4	3
PORA			1			3	1	2
CIAR		1	4	7		30	20	16
ARCR		1				3	1	2
CHCE	2					6	1	2
AGPR			1			3	1	2
PRPA	1	6	2			30	6	5
NUGH	1	1				6	1	2
DEPI		1				3	1	2
TAOF	2	3				13	2	4
LHOC	1	15	11	2	1	100	34	28
PRGR			1			3	1	2

CALCULATION INSTRUCTIONS ON OTHER SIDE.

NOTES (USE OTHER SIDE OR ANOTHER PAGE)

122 100

DATE _____

Plant Height (inches)

SHEET NO.

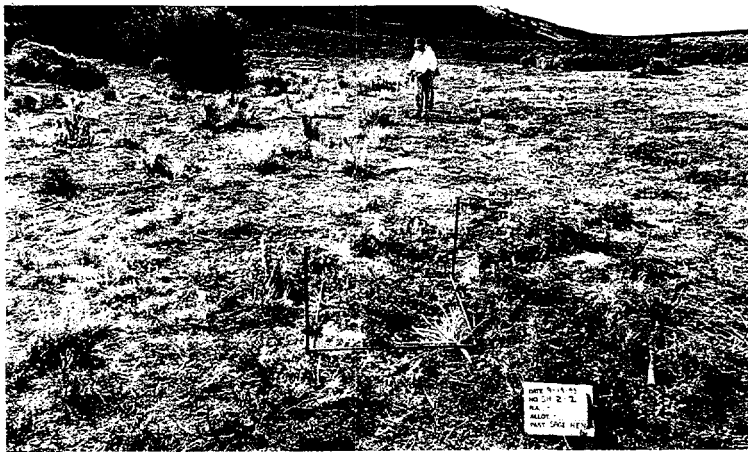
JOB NC

 $+23$

22-163634-2011191

U

9-19
15-19
20-30
18-22
9-14
6-16
17-37
16
20-31
20
11-22
442
8-16
28
5-5



1993



1994



1996



1995



1997

**SAGE HEN
PHOTO PLOT 2 - 1
(looking north down transect 2)**



1993



1996



1994



1997



1995

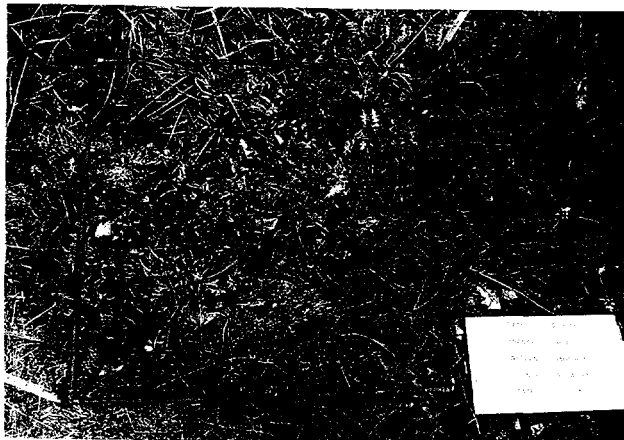
**SAGE HEN
PHOTO PLOT 3 - 1
(looking north down transect 3)**



**SAGE HEN SPRING
1997 PHOTO PLOT 4 - 1**



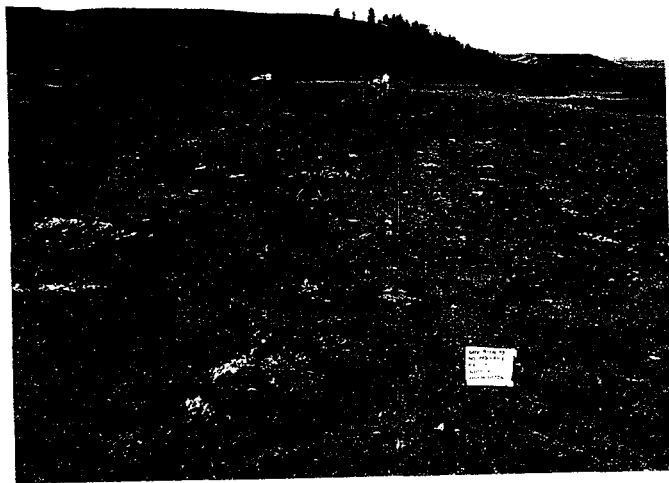
**SAGE HEN SPRING
1997 PHOTO PLOT 4 - 1
(looking north down transect 2)**



**SAGE HEN SPRING
1997 PHOTO PLOT 4 - 2**



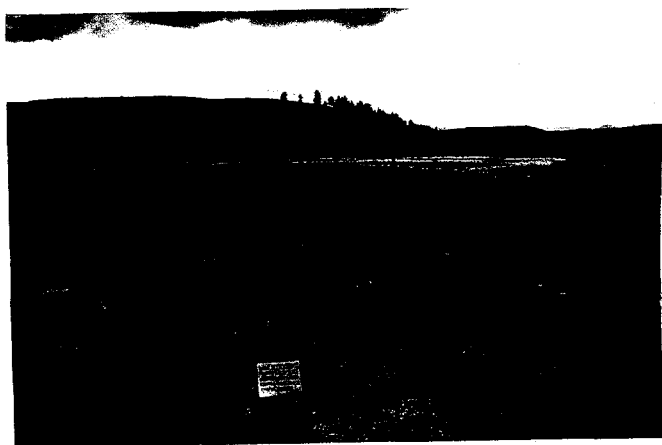
**SAGE HEN SPRING
1997 PHOTO PLOT 4 - 2
(looking south down transect 2)**



1993



1996



1994



1997



1995

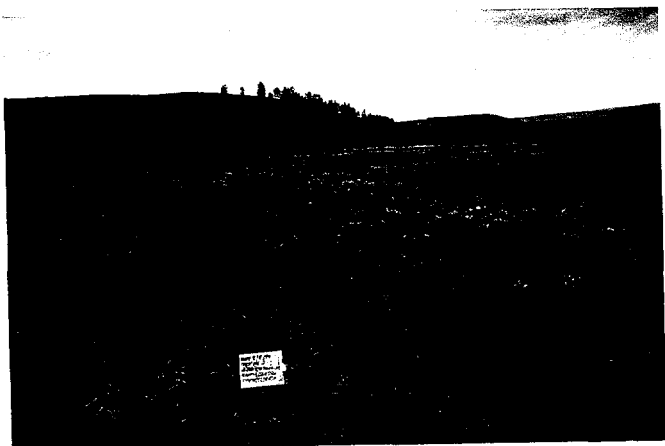
HOUSTON GULCH
PHOTO PLOT 1 - 1
(looking north down transect 1)



1993



1996



1994

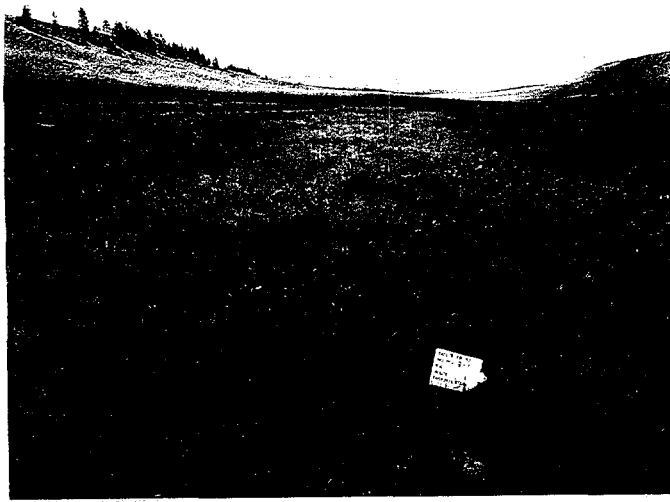


1997



1995

HOUSTON GULCH
PHOTO PLOT 2 - 1
(looking north down transect 2)



1993



1996



1994



1997



1995

HOUSTON GULCH
PHOTO PLOT 3 - 1
(looking north down transect 3)



1993



1996



1994

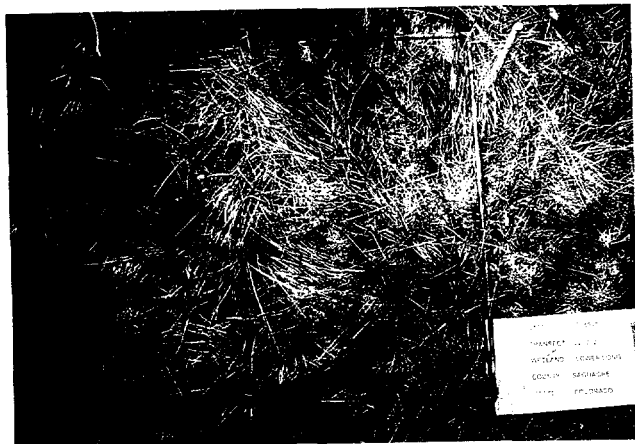


1997



1995

**LOWER LONG'S GULCH
PHOTO PLOT 1 - 1
(looking west down transect 1)**



**LOWER LONG'S GULCH
1997 PHOTO PLOT 2 - 2**



**LOWER LONG'S GULCH
1997 PHOTO PLOT 2 - 2
(looking west down transect 2)**



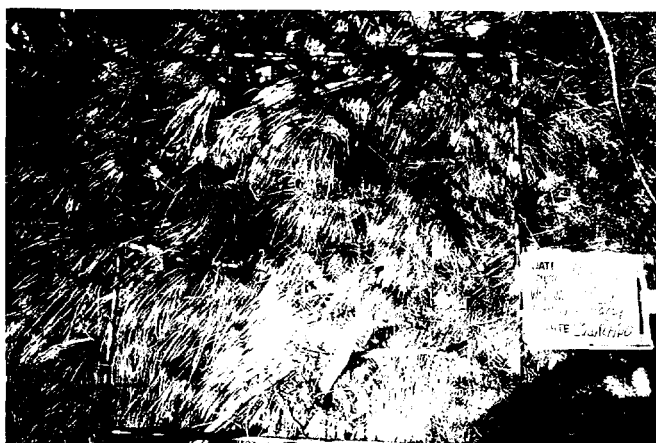
**LOWER LONG'S GULCH
1997 PHOTO PLOT 2 - 1**



**LOWER LONG'S GULCH
1997 PHOTO PLOT 2 - 1
(looking east down transect 2)**



1993



1994



1996



1995



1997

LOWER LONG'S GULCH
PHOTO PLOT 1 - 1