

## ***APPENDIX D8 - VEGETATION***

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## **LIST OF ADDENDA**

### **APPENDIX D8 - VEGETATION**

Addendum D8-1	Correspondence
Addendum D8-2	Photographs

## **APPENDIX D8 - VEGETATION**

### **1.0 INTRODUCTION**

Power Resources, Inc. contracted Intermountain Resources of Laramie, Wyoming to complete vegetation studies on portions of the Gas Hills Project area in 1992 through 1994. These original studies included mapping vegetation types, file and field searches for threatened or endangered plant species, field sampling for cover and shrub densities and/or preparation of a plant species list for the area. The original area studied in 1993 encompassed 5375 acres. An additional 2600 acres was added in 1994. Discussions between Power Resources and WDEQ personnel concluded that additional sampling was not required on the added 2600 acres because the vegetation types were the same as those on the original survey area. The current proposed permit area is approximately 8500 acres.

In order to provide a complete assessment of vegetation within the Permit Area and based on discussion with WDEQ-LQD staff, it was determined that additional sampling of the affected area and a corresponding reference area was necessary in 1997. As a result, earlier affected area data that was collected in 1992-93 has been deleted.

BKS Environmental Associates, Inc. of Gillette, Wyoming, was contracted in 1996 to conduct a vegetative assessment of the Gas Hills Project in the Gas Hills of Wyoming. This assessment was designed to address WDEQ comments (dated July 1996) derived from the previous permit submittal by Power Resources in 1994.

## **2.0    DESCRIPTION OF THE STUDY AREA**

The Gas Hills Project Area is located in the Gas Hills Mining District approximately 45 miles east of Riverton. The study area is located in portions of Fremont and Natrona Counties, Wyoming. This site is specifically located within Sections 21, 22, 27, 28, 29, 30, 31, 32, 33, and 34 T33N R89W, Sections 1, 2, 3, 10, 11, and 12 T32N R90W, Section 6 T32N R89W, and Section 36 T33N R90W. Precipitation ranges from 10 to 14 inches per year. Elevation varies from 6650 feet on the northern portion of the study area to 7400 feet along Beaver Divide on the south. Topography is very diverse, with rolling plains along the north and steep ridges with deep ephemeral drainages on the south. Considerable disturbances from past mining activities are also found within the area. the surface is controlled primarily by the Bureau of Land Management, but small portions of private and state land also exist within the study area.

### 3.0 METHODS

The following methodology was utilized during the 1997 vegetative assessment and was based on a site visit with Jack Smith and Alan Guile, WDEQ, in October 1996 and follow up written correspondence December 13, 1996. Refer to Addendum D8-1.

#### 3.1 Vegetative Type Determination and Mapping

The 1994 previously compiled map (1"=1000') formed the basis of the 1996 vegetation map (1"=500'). Previously designated vegetation types were verified in the field, lines adjusted accordingly, and acreage determined. Small inclusions within vegetation types were not mapped. Although narrow drainage bottoms support generally higher productivity and diversity, these areas were not delineated in mapping.

Photographs of native vegetation types, taken during 1997 fieldwork, are included in Addendum D8-2 and photo locations illustrated on the vegetation map.

#### 3.2 Species Composition

Plant identification was confirmed by the Rocky Mountain Herbarium in Laramie, WY. All scientific nomenclature followed current nomenclature in use at the Herbarium during 1997 with the exception of the genus *Agropyron*. Plant species from both sampling years were compiled. Refer to Table 28, List of Species Encountered during previous and 1997 Sampling.

Federally designated threatened and endangered species, state plants of concern, noxious weeds and primary selenium indicators were identified, if present.

#### 3.3 Study Area Sampling Design

Quantitative sampling was conducted during August, 1997. All sampling procedures were designed according to the Wyoming Department of Environmental Quality, Land Quality Division, Rules and Regulations, Guideline 2 (August 1994).

A "modified extended reference area" approach was utilized. Undisturbed land outside the proposed 500 foot monitoring ring of the ore body as outlined on the vegetation map was designated as reference for all the native vegetation types. These areas are in three distinct land units and designated on the vegetation map. Since the Rough Breaks native vegetation type was distinct in the eastern portion of the permit area compared to the western portion, two distinct areas were delineated for reference in that particular vegetation type only. The remaining portions of the permit area were considered possible affected area.

Sampling locations were randomly determined by placing a grid over the 1" - 500' vegetation map,



The x-axis was generally east-west, while the y-axis generally ran north and south. Grid interval at the scale utilized was approximately 50 feet on the ground. Sampling location coordinates were randomly generated by the HP32S hand calculator. Sample point selection was repeated until the desired number of points for each vegetation type was attained. Sample points were located in the field by pacing from known localities.

Five affected areas and five reference areas were sampled for cover and shrub density at the PRI Gas Hills project. Refer to Table 1b for sample numbers and the attached map for sample point locations.

#### 3.4 Reference Area Establishment

On October 4, 1996, WDEQ, BRS (on behalf of PRI), and BKS personnel jointly selected suitable reference areas for the 1997 work. These areas are delineated on the vegetation map. The largest area is located in Section 29 and encompasses three of the four vegetation types. The two smaller areas were selected to better represent the Rough Breaks vegetation type which varies significantly from the east and west portions of the survey area. These areas were outlined in the proposed sampling methodology forwarded to the WDEQ for their review prior to 1997 sampling. Refer to the attached correspondence in Addendum D8-1.

Some reclaimed areas will be reaffected during mining operations. However, reference areas for these areas were not established. Instead, a cover and production standard will be prepared based on consultation with the WDEQ, prior to those areas being disturbed.

#### 3.5 Reference Area Sampling Design

Sampling locations were randomly determined similar to the study area sampling and are described in the pre-sampling correspondence with the WDEQ in Addendum D8-1.

#### 3.6 Time of Sampling

Sampling occurred for all communities during July 28-August 1 and August 19-22, 1997. This later season sampling was made possible by above average moisture in July and August.

#### 3.7 Plot Size and Shape

Cover was gathered with 50 meter line intercept transects, while shrub density was gathered with 50 meter belt transects associated with the cover transect.

### 3.8 Collection and Analysis of Cover Data

Cover sampling was conducted with 50 meter line intercept transects. Within line transects, sample hits were read at 1 meter intervals along the entire length of the 50 meter transect. First hit (50) readings constituted the absolute cover values for individual species, total vegetation and total cover. The first hit information was used to compile portions of the overall plant list for the study area. In addition, litter/rock and bare ground percentages were recorded. Random numbers between 1 and 360 were generated to orient the transect. A compass was then used in the field to orient the transect to the nearest 1/8 of 360 degrees. Transects that exceeded designated vegetation boundaries were randomly reoriented to be within the sampled affected and reference area vegetation types.

A minimum of 20 transects for cover were sampled within each affected area vegetation type. If statistical adequacy was not obtained, as defined in the WDEQ Rules and Regulations, Guideline 2 (August 1994), additional transects were sampled, in increments, up to the maximum number of 50, if necessary.

A minimum of 15 transects for cover were sampled within each reference area vegetation type. The maximum sampled, if necessary, was 30.

### 3.9 Collection and Analysis of Tree and Shrub Density Data

A complete census of trees was not taken during the 1997 fieldwork within the study area. Isolated tree locations within the study area were plotted on the vegetation map, if possible. However, clumps or larger areas of trees were not delineated. The survey for possible trees took place during cover and shrub sampling. No height or diameter information was collected since no trees will be impacted.

Shrub density was collected, in conjunction with cover transects. All shrubs, full or half, were counted within 50 centimeters either side of the 50 meter cover transect (i.e. 1 meter X 50 meter belt transect). Shrub height measurements were taken only to get a general indication of overall plant vigor.

Individuals/acre were calculated using the following formula:

$$\text{individuals/acre} = \text{individuals/50m}^2 \times \frac{10,000\text{m}^2}{1 \text{ hectare}} \times \frac{1 \text{ hectare}}{2.2 \text{ acres}}$$

Refer to Table 24.

### 3.10 Cropland and Prime Farmland Productivity

No cropland or prime farmland were noted within the study area.

### 3.11 Plant Species of Special Concern

This study included field surveys and file searches for plant species which may fall into several categories of concern as required by the WDEQ-LQD. They include threatened or endangered species, noxious weeds, and selenium indicator species.

File searches were made to determine if any federally listed threatened or endangered plants may occur within the area. This included state and federal agencies, plant taxonomic keys, vegetation surveys for adjacent mines, U.S. Fish and Wildlife Services Endangered and Threatened Plant lists, and the Endangered Species Update.

During October, 1996, permit area legal coordinates were run through the Wyoming Natural Diversity Database. No federal or state protected plants were found in the existing records. However, considerable work has been conducted on the western end of the Beaver Rim. The resulting report, "Survey of Plant Species and Communities of Interest in the Beaver Rim Area of Critical Environmental Concern" by George Jones, Wyoming Natural Diversity Database, in 1989 was reviewed prior to the 1997 fieldwork. This information, in addition to a phone conversation with Walt Fertig, Wyoming Natural Diversity Database, formed a "potential list" to be included in the 1997 fieldwork. Refer to Addendum D8-1 for the October 1996 correspondence.

## 4.0 RESULTS

### 4.1 Description of Vegetation Types

Four native vegetation types occur within the study area. They are Bottomland Sagebrush (Big Sage in the attached tables), Mixed Sagebrush Grassland (Mixed Shrub Grassland in the attached tables), Rough Breaks, and Upland Grass. Rough Breaks is further divided into "east" and "west" due to distinct variations in that type.

A total of eight map units were identified on the study area. These map units are listed in Table D8-1a and the areal extent of these areas is shown on the attached map. These map units are briefly discussed in the following sections. During the 1996 mapping, Badlands acreage was combined with Rough Breaks.

#### 4.1.1 Bottomland Sagebrush (Big Sage)

The Bottomland Sagebrush (Big Sage) vegetation type occupies 991 acres within drainages and upland areas where deeper soil and moisture are present. Major species include *Artemisia tridentata*, big sagebrush, *Poa cusickii*, Cusick bluegrass, and *Agropyron dasystachum*, thickspike wheatgrass. Within this type, some willows and cottonwoods were found along the upper portion of West Canyon Creek.

#### 4.1.2 Mixed Sagebrush Grassland (Mixed Shrub Grassland)

The Mixed Shrub Grassland vegetation type is dominant in the permit area and occupies 4,089 acres of upland sloped areas with moderately deep to deep, loamy soils or shallow rocky soils. Vegetation and topography within this unit are very diverse, ranging from dense patches of sagebrush in slight draws to small patches of transitional grassland on uplands that were too small to map out separately. Major species include big sagebrush, thickspike wheatgrass, and threadleaf sedge.

#### 4.1.3 Rough Breaks

The Rough Breaks vegetation type is the second largest map unit and occupies 2,081 acres of upland, relatively steep sloped areas with generally shallow, rocky or gravelly soils. This unit is found on slopes, ridges, hilltops and side slopes of steep draws. Rock outcrops and steep bare slopes are also found within this type. Major species in Rough Breaks East include big sagebrush, threadleaf sedge and, thickspike wheatgrass. Major species in Rough Breaks West include *Agropyron spicatum*, bluebunch wheatgrass, big sagebrush, and thickspike wheatgrass. A few junipers and limber pines are also found within this type.

#### 4.1.4 Upland Grass

The Upland Grass vegetation type occupies 131 acres of upland, flat areas within the Mixed Sagebrush Grassland that contain somewhat saline soil conditions. Major species include *Carex filifolia*, threadleaf sedge, *Artemisia pedatifida*, birdfoot sagebrush, and thickspike wheatgrass.

#### 4.1.5 Reclaimed Areas

These sites are reclaimed areas distinct from other disturbed lands and mining activities. These varying aged areas comprise 844 acres of the area. Dominant plant species are primarily wheat grasses, but Indian ricegrass was also common. Some of these areas were reclaimed by mining companies responsible for the disturbances and other areas were reclaimed under the Wyoming Abandoned Mine Lands Program.

#### 4.1.6 Disturbed Land

This map unit covers 319 acres of the study area. This unit consists of existing mine pits, topsoil stockpiles, spoil piles, associated roads and facilities.

#### 4.1.7 Reservoirs

Several reservoirs were identified that encompassed 17 acres within the study area. These represent open bodies of water and range from small stock ponds to large mine impoundments.

#### 4.1.8 Wetlands

Several small wetland areas were identified that encompassed 28 acres within the study area. These areas may not be jurisdictional wetlands under the Corps of Engineers delineation criteria; no formal wetland delineation was conducted. They consist of areas that visually contained plant species more adapted to moist and/or saline conditions.

### 4.2 Sample Site Location

Study area vegetation types and sampling sites are outlined on the vegetation map.

### 4.3 Weeds, Selenium Indicators, Endangered or Threatened Species

No species cited as primary "noxious" weeds in the Agricultural Experiment Station, University of Wyoming, 1979, Bulletin 498, "Weeds of Wyoming" were encountered. Prohibited noxious weed identified on the study area include Musk thistle, Canada thistle, hoary cress (whitetop), and field

bindweed. Restricted noxious weeds include tansymustard, little blue mustard, and American licorice. These weed species were most common along drainages, roadsides, and disturbed areas.

Primary selenium indicator species identified during the 1997 survey include *Haplopappus multicaulis*, multistem goldenweed. Past documentation also include two-grooved milkvetch and woody aster. Milkvetch was common on Disturbed and Reclaimed sites. Multistem goldenweed was encountered in the Upland Grassland and Rough Breaks map units. Woody aster was observed in several types but was not common.

None of the plants identified on the study area appear on the U.S. Department of Interior's "Endangered and Threatened Species Plants", as published in the Federal Register. Legal coordinates for the study area were run through the Wyoming Natural Diversity Database in Laramie, Wyoming. Previously encountered plants of concern found in the region include *Physaria eburniflora*, Devil's Gate Twinpod, currently state ranked S2; *Cirsium aridum*, Cedar Rim Thistle, currently state ranked S2; and *Astragalus nelsonianus*, Nelson's Milkvetch, currently state ranked S2.

#### 4.4 Species Composition

Table 28 lists species of plants encountered during this baseline survey and is arranged by life form.

#### 4.5 Cover

##### 4.5.1 Bottomland Sagebrush (Big Sage)

Absolute total vegetation cover for the Big Sage affected area was 63.40%. Absolute bare soil and litter/rock percentages were 13.80 and 22.80, respectively. Absolute total cover percentage was 77.2%. *Artemisia tridentata*, Wyoming Big Sage, provided the highest relative vegetation cover, 24.90%, followed by *Poa cusickii*, Cusick Bluegrass, at 9.62%. A summary of cover values for the Big Sage affected area is presented in Table 2.

Absolute total vegetation cover for the Big Sage reference area was 55.88%. Absolute bare soil and litter/rock percentages were 16.75 and 27.38, respectively. Absolute total cover percentage was 83.25%. Wyoming Big Sage provided the highest relative vegetation cover, 48.64%, followed by *Poa sandbergii*, Sandberg bluegrass at 17.42%. A summary of cover values for the Big Sage reference area is presented in Table 7.

##### 4.5.2 Mixed Sagebrush Grassland (Mixed Shrub Grassland)

Absolute total vegetation cover for the Mixed Shrub Grassland affected area was 55.30%. Absolute bare soil and litter/rock percentages were 19.80 and 24.90, respectively. Absolute total cover was 75.00%. Wyoming Big Sage provided the highest relative vegetation cover,

30.01%, followed by *Agropyron dasystachyum*, Thickspike Wheatgrass and Cusick Bluegrass both at 10.43%. A summary of cover values for the Mixed Shrub Grassland affected area is presented in Table 3.

Absolute total vegetation cover for the Mixed Shrub Grassland reference area was 50.13%. Absolute bare soil and litter/rock percentages were 19.73 and 30.13, respectively. Absolute total cover was 80.27%. Wyoming Big Sage provided the highest relative vegetation cover, 19.73%, followed by Threadleaf Sedge at 16.91%. A summary of cover values for the Mixed Shrub Grassland reference area is presented in Table 8.

#### 4.5.3 Rough Breaks East

Absolute total vegetation cover for the Rough Breaks East affected area was 49.00%. Absolute bare soil and litter/rock percentages were 26.70 and 24.30, respectively. Absolute total cover was 73.50%. Wyoming Big Sage provided the highest relative vegetation cover at 10.55%, followed by *Carex filifolia*, Threadleaf Sedge at 9.94%. A summary of cover values for the Rough Breaks East affected area is presented in Table 4.

Absolute total vegetation cover for the Rough Breaks East reference area was 46.11%. Absolute bare soil and litter/rock percentages were 23.26 and 30.42, respectively. Absolute total cover was 76.74%. Bluebunch Wheatgrass, provided the highest relative vegetation cover at 18.76%, followed by *Artemisia nova*, Black Sagebrush at 18.08%. A summary of cover values for the Rough Breaks East reference area is presented in Table 9.

#### 4.5.4 Rough Breaks West

Absolute total vegetation cover for the Rough Breaks West affected area was 38.1%. Absolute bare soil and litter/rock percentages were 39.3 and 22.60, respectively. Absolute total cover percentage was 60.70. *Agropyron spicatum*, Bluebunch Wheatgrass, provided the highest relative vegetation cover at 15.06%, followed by Wyoming Big Sage at 11.62%. A summary of cover values for the Rough Breaks West affected area is presented in Table 5.

Absolute total vegetation cover for the Rough Breaks West reference area was 40.78%. Absolute bare soil and litter/rock percentages were 35.33 and 23.89, respectively. Absolute total cover percentage was 64.67. Bluebunch wheatgrass provided the highest relative vegetation cover at 13.74%, followed by Black Sagebrush at 13.19%. A summary of cover values for the Rough Breaks West reference area is presented in Table 10.

#### 4.5.5 Upland Grass

Absolute total vegetation cover for the Upland Grass affected area was 51.00%. Absolute bare soil and litter/rock percentages were 28.20 and 20.40, respectively. Absolute total cover percentage was 71.8. Threadleaf sedge provided the highest relative vegetation cover at 23.28%, followed by *Artemisia pedatifida*, Birdfoot Sagewort at 18.11%. A summary of cover values for the Upland Grass affected area is presented in Table 6.

Absolute total vegetation cover for the Upland Grass reference area was 44.13%. Absolute bare soil and litter/rock percentages were 32.93 and 22.93, respectively. Absolute total cover percentage was 67.60. Birdfoot sagewort provided the highest relative vegetation cover at 19.03%, followed by Sandberg Bluegrass at 18.39%. A summary of cover values for the Upland Grass reference area is presented in Table 11.

#### 4.6 Trees, Shrubs, Stock Ponds, Disturbed, and Developed Sites

##### 4.6.1 Trees

Isolated trees are indicated on the vegetation map. Groups of trees are most common in the Rough Breaks East and were not delineated.

##### 4.6.2 Shrubs

###### 4.6.2.1 Bottomland Sagebrush (Big Sage)

Total shrub density within the Big Sage affected area was 34,060 individuals/hectare, calculated to 170 individuals/50m<sup>2</sup> or 15,482/acre. Wyoming Big Sage contributed 121.7 individuals/50m<sup>2</sup> or 72% of the total. Raw shrub data and summary for the Big Sage affected area is presented in Table 12.

Total shrub density within the Big Sage reference area was 26,4378 individuals/hectare, calculated to 132 individuals/50m<sup>2</sup> or 12,017/acre. Wyoming Big Sage contributed 115.9 individuals/50m<sup>2</sup> or 88% of the total. Raw shrub data and summary for the Big Sage reference area is presented in Table 17.

###### 4.6.2.2 Mixed Sagebrush Grassland (Mixed Shrub Grassland)

Total shrub density within the Mixed Shrub Grassland affected area was 33,610 individuals/hectare, calculated to 168 individuals/50m<sup>2</sup> or



15,277/acre. Wyoming Big Sage contributed 128.5 individuals/50m<sup>2</sup> or 78% of the total. Raw shrub data and summary for the Mixed Shrub Grassland affected area is presented in Table 13.

Total shrub density within the Mixed Shrub Grassland reference area was 37,227 individuals/hectare, calculated to 186 individuals/50m<sup>2</sup> or 16,921/acre. Birdsfoot sagewort contributed 92.8 individuals/50m<sup>2</sup> or 50% of the total. Raw shrub data and summary for the Mixed Shrub Grassland reference area is presented in Table 18.

#### 4.6.2.3 Rough Breaks East

Total shrub density within the Rough Breaks East affected area was 31,730 individuals/hectare, calculated to 159 individuals/50m<sup>2</sup> or 14,423/acre. Wyoming Big Sage contributed 58.3 individuals/50m<sup>2</sup> or 37% of the total. Raw shrub data and summary for the Rough Breaks East affected area is presented in Table 14.

Total shrub density within the Rough Breaks East reference area was 27,284 individuals/hectare, calculated to 136 individuals/50m<sup>2</sup> or 12,402/acre. Black sagebrush contributed 71.2 individuals/50m<sup>2</sup> or 52% of the total. Raw shrub data and summary for the Rough Breaks East affected area is presented in Table 19.

#### 4.6.2.4 Rough Breaks West

Total shrub density within the Rough Breaks West affected area was 17,050 individuals/hectare, calculated to 85.3 individuals/50m<sup>2</sup> or 7,750/acre. Wyoming Big Sage contributed 24.4 individuals/50m<sup>2</sup> or 29% of the total. Raw shrub data and summary for the Rough Breaks West affected area is presented in Table 15.

Total shrub density within the Rough Breaks West reference area was 28,834 individuals/hectare, calculated to 144 individuals/50m<sup>2</sup> or 13,106/acre. Black sagebrush contributed 55.2 individuals/50m<sup>2</sup> or 38% of the total. Raw shrub data and summary for the Rough Breaks West reference area is presented in Table 20.

#### 4.6.2.5 Upland Grass

Total shrub density within the Upland Grass affected area was 40,640 individuals/hectare, calculated to 203 individuals/50m<sup>2</sup> or 18,473/acre.

Birdsfoot sagewort contributed 162.7 individuals/50m<sup>2</sup> or 80% of the total. Raw shrub data and summary for the Upland Grass affected area is presented in Table 16.

Total shrub density within the Upland Grass reference area 77,573.3 individuals/hectare, calculated to 387.9 individuals/50m<sup>2</sup> or 35,261/acre. Birdsfoot sagewort contributed 308.7 individuals/50m<sup>2</sup> or 80% of the total. Raw shrub data and summary for the Upland Grass reference area is presented in Table 21.

#### 4.7 Sample Adequacy

Sample adequacy was tested for each of the study area vegetation types using the following formula:

$$n_{\min} > \frac{2(sz)^2}{(dx)^2}$$

Where  $n_{\min}$  = minimum number of sampled line transects needed to adequately represent a given vegetation type.

s = sample standard deviation,

z = the z statistic (see table below)

d = amount of reduction desired (see table below)

x = sample mean for cover

\*Note\* Standard deviation presented in all the tables uses "n-1".

#### z Statistic and d Table

	z	d
Cover, grassland/shrubland	1.28	0.1

Sample adequacy for Total Vegetation Cover and Total Cover was attained on all of the affected and reference areas. A summary is presented in Table 22.

#### 4.8 t-Test Comparisons

T-tests were calculated for each of the study area vegetation types using the following formula:

$$t = \frac{(X_1 - X_2)}{Sp(1/n_1 + 1/n_2)^{1/2}}$$

**\*Note\*** Calculated by RIMA, version 2.

Derived t-Test values indicate that total vegetation cover is the most similar between the affected and reference areas in the Rough Breaks East vegetation type. Total cover was derived to be the most similar in the Mixed Shrub Grassland and Big Sage vegetation types. Refer to Table 23.

## 5.0 DISCUSSION

Transition between the four vegetation types is dynamic and boundaries are often obscure. Every effort was made to refine existing mapping; however, it should be noted the map boundaries are often gross estimations of actual boundaries. Small inclusions within vegetation types were not mapped. Although narrow drainage bottoms support generally higher productivity and diversity, these areas were not delineated in mapping.

Locations of the major vegetation types were often linked to existing geologic features and resulting soil formation. Ridgetops often contained rocky soil material and were associated with the Rough Breaks vegetation type. Flatter topography with moderately deep soils were more characteristic of the Mixed Shrub Grassland. The clayey and saline soils resulted in more expanses of the Upland Grass vegetation type. Big Sage is often associated with deeper soils and is present in the draws within the study area.

Higher cover sampling variability was generally found in the Rough Breaks portion of the study area. This may be due, in part, to the topographic extremes noted in the Rough Breaks. Some points may have fallen within the "rocky or bare phase" which would result in very small cover levels. Extreme required sample numbers were not generally noted within the Mixed Shrub Grassland and Big Sage vegetation types.

Overall shrub density was generally higher in the Upland Grass vegetation type, both reference and affected areas. Halfshrubs (primarily *Artemisia pedatifida*) were much higher in number within the Upland Grass reference vegetation type. Full shrubs were much higher in number in the Big Sage affected area.

Refer to Table 28 for a composite list of plant species encountered during 1992 and 1997 sampling.

## 6.0 CONCLUSIONS

This appendix provides a summary of the 1997 fieldwork for the Power Resources, Inc. Gas Hills Project Area, in addition to incorporating any applicable information gathered prior to 1997. Cover and shrub density sampling was accomplished on affected and associated reference areas in 1997.

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# TABLES

**TABLE D8-1a**

**VEGETATION MAP UNIT ACREAGES FOR THE  
POWER RESOURCES GAS HILLS PROJECT (Revised December 1997)**

Vegetation Map Unit	Total Permit		Disturbed	
	Acreage	Percentage of Area	Acreage	Percentage of Area
Mixed Sagebrush-Grassland (Mixed Shrub Grassland)	4089	47.2	552	51.0
Rough Breaks West	569	7.0	29	2.7
Rough Breaks East	1512	18.7	216	20.0
Bottomland Sagebrush (Big Sage)	991	10.8	93	8.6
Upland Grassland	131	1.5	42	3.9
Reclaimed Areas	844	10.3	98	9.0
Disturbed Land	319	3.9	41	3.8
Reservoirs	17	0.2	0	0.0
Wetlands	28	0.4	11*	1.0
TOTAL	8500	100	1082	100

- \* A wetland area crosses Mine Unit No. 4 and is within the area of potential disturbance. Actual disturbance of the wetland area will be avoided whenever possible or mitigated as described in The Operations Plan.

**TABLE 1B. - SUMMARY OF 1997 SAMPLED PARAMETERS**

Area	Cover	Production	Shrub Density	Acreage
<b>Affected</b>				
Bottomland Sagebrush (Big Sage)	20	0	20	991.0
Mixed Sagebrush Grassland (Mixed Shrub Grassland)	20	0	20	4,089.0
Rough Breaks East	20	0	20	1,512.0
Rough Breaks West	20	0	20	569.0
Upland Grass	20	0	20	131.0
<b>Reference (includes all 3 areas)</b>				
Bottomland Sagebrush (Big Sage)	16	0	16	177.3
Mixed Sagebrush Grassland (Mixed Shrub Grassland)	15	0	15	316.8
Rough Breaks East 1 75.1		19	0	1      9
Rough Breaks West 2	18	0	18	55.1
Upland Grass	15	0	15	1   7   .   8

1 Actual delineated acreage is 75.1; however, only 64.9 of the 75.1 acres were sampled as Rough Breaks East.

2 Actual delineated acreage is 77.5; however only 55.1 of the 77.5 acres were sampled as Rough Breaks West.

NOTE: Big Sage = Bottomland Sage

Mixed Sagebrush Grassland = Mixed Shrub Grassland

Power Resources, Inc. Gas Hills Project WDEQ-LQD Permit to Mine Application  
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Table 2.

## Cover Summary for Big Sage Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	4.80	7.57	0 - 12	75.00	6.98	14.55	3
<i>Agropyron smithii</i>	4.10	6.47	0 - 18	70.00	6.51	12.98	4
<i>Agropyron spicatum</i>	2.20	3.47	0 - 8	40.00	3.72	7.19	7
<i>Agropyron trachycaulum</i>	0.40	0.63	0 - 2	20.00	1.86	2.49	18
<i>Carex filifolia</i>	1.40	2.21	0 - 8	45.00	4.19	6.39	10
<i>Elymus</i> sp.	0.20	0.32	0 - 2	10.00	0.93	1.25	25
<i>Festuca idahoensis</i>	0.40	0.63	0 - 4	15.00	1.40	2.03	21
<i>Noeleria macrantha</i>	1.50	2.37	0 - 6	45.00	4.19	6.55	8
<i>Oryzopsis hymenoides</i>	1.20	1.89	0 - 8	30.00	2.79	4.68	13
<i>Poa ampla</i>	0.60	0.95	0 - 8	10.00	0.93	1.88	9
<i>Poa compressa</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Poa cusickii</i>	6.10	9.62	0 - 20	95.00	8.84	18.46	2
<i>Poa sandbergii</i>	2.40	3.78	0 - 10	55.00	5.12	8.90	6
<i>Stipa comata</i>	1.10	1.73	0 - 12	25.00	2.33	4.06	15
<i>Stipa viridula</i>	1.90	3.00	0 - 16	35.00	3.26	6.25	11
Sub-total	28.40	44.78					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Bouteloua gracilis</i>	0.20	0.32	0 - 4	5.00	0.47	0.78	26
<i>Bouteloua hirsuta</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
Sub-total	0.30	0.47					
<b>INTRODUCED PERENNIAL GRASSES</b>							
<i>Poa pratensis</i>	0.50	0.79	0 - 6	10.00	0.93	1.72	22
Sub-total	0.50	0.79					
<b>PERENNIAL FORBS</b>							
<i>Aster</i> sp.	0.40	0.63	0 - 4	20.00	1.86	2.49	18
<i>Astragalus</i> sp.	0.02	0.02	0 - 2	100.00	9.30	9.33	5
<i>Cirsium</i> sp.	0.30	0.47	0 - 4	10.00	0.93	1.40	23

Table 2.(cont'd).

## Cover Summary for Big Sage Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Comandra umbellata</i>	0.80	1.26	0 - 6	25.00	2.33	3.59	16
<i>Dalea purpurea</i>	0.20	0.32	0 - 4	5.00	0.47	0.78	26
<i>Lupinus argenteus</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Lupinus sp.</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Paronychia sessiliflora</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Phlox hoodii</i>	1.00	1.58	0 - 4	30.00	2.79	4.37	14
<i>Phlox multiflora</i>	0.30	0.47	0 - 4	10.00	0.93	1.40	23
<i>Ratibida columnaris</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Taraxacum officinale</i>	0.50	0.79	0 - 6	15.00	1.40	2.18	19
Sub-total	3.91	6.17					
ANNUAL AND BIENNIAL FORBS							
<i>Alyssum desertorum</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Orthocarpus luteus</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
Sub-total	0.20	0.32					
SEMI-SHRUBS OR HALF-SHRUBS							
<i>Artemisia pedatifida</i>	0.60	0.95	0 - 4	20.00	1.86	2.81	17
<i>Gutierrezia sarothrae</i>	0.20	0.32	0 - 2	10.00	0.93	1.25	25
<i>Sphaeromeria capitata</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
Sub-total	0.90	1.42					
SHRUBS							
<i>Artemisia nova</i>	0.10	0.16	0 - 2	5.00	0.47	0.62	27
<i>Artemisia tridentata</i>	24.90	39.27	12 - 38	100.00	9.30	48.57	1
<i>Chrysothamnus nauseosus</i>	0.70	1.10	0 - 12	10.00	0.93	2.03	20
<i>Chrysothamnus viscidiflorus</i>	1.40	2.21	0 - 6	35.00	3.26	5.46	12
<i>Rosa woodsii</i>	0.20	0.32	0 - 4	5.00	0.47	0.78	26
<i>Symphoricarpos albus</i>	1.20	1.89	0 - 6	30.00	2.79	4.68	13
<i>Tetradymia canescens</i>	0.50	0.79	0 - 10	5.00	0.47	1.25	24
Sub-total	29.00	45.73					

Table 2.(cont'd).

## Cover Summary for Big Sage Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>CACTI AND SUCCULENTS</b>							
Opuntia polyacantha	0.20	0.32	0 - 2	10.00	0.93	1.25	25
Sub-total	0.20	0.32					
<b>SUM OF SPECIES COVER</b>	63.41						
Lichens	0.10		0 - 2	5.00			
<b>TOTAL VEGETATION</b>	63.40 +/-	8.78					
<b>LITTER/ROCK</b>	13.80 +/-	7.78					
<b>BARE SOIL</b>	22.80 +/-	10.43					
<b>TOTAL COVER</b>	77.20 +/-	10.43					
<b>Number of Species/sample</b>	9.90						

Table 3.

## Cover Summary for Mixed Shrub Grassland Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	5.70	10.43	0 - 14	90.00	9.94	20.37	2
<i>Agropyron smithii</i>	1.50	2.74	0 - 4	55.00	6.08	8.82	7
<i>Agropyron spicatum</i>	2.10	3.84	0 - 12	35.00	3.87	7.71	9
<i>Carex filifolia</i>	5.50	10.06	0 - 18	70.00	7.73	17.80	4
<i>Carex stenophylla</i>	0.85	1.56	0 - 6	25.00	2.76	4.32	11
<i>Festuca idahoensis</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
<i>Koeleria macrantha</i>	2.10	3.84	0 - 10	40.00	4.42	8.26	8
<i>Oryzopsis hymenoides</i>	0.30	0.55	0 - 4	10.00	1.10	1.65	15
<i>Poa cusickii</i>	5.70	10.43	0 - 18	90.00	9.94	20.37	2
<i>Poa sandbergii</i>	5.00	9.15	0 - 16	80.00	8.84	17.99	3
<i>Sitanion hystrix</i>	0.20	0.37	0 - 2	10.00	1.10	1.47	16
<i>Stipa comata</i>	3.00	5.49	0 - 16	65.00	7.18	12.67	5
<i>Stipa viridula</i>	0.20	0.37	0 - 4	5.00	0.55	0.92	17
Sub-total	32.25	59.01					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Bouteloua gracilis</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Sub-total	0.10	0.18					
<b>INTRODUCED PERENNIAL GRASSES</b>							
<i>Agropyron cristatum</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Sub-total	0.10	0.18					
<b>PERENNIAL FORBS</b>							
<i>Aster sp.</i>	0.30	0.55	0 - 2	15.00	1.66	2.21	14
<i>Astragalus drummondii</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
<i>Astragalus sp.</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
<i>Astragalus spatulatus</i>	0.30	0.55	0 - 4	10.00	1.10	1.65	15
<i>Oxytropis nana</i>	0.10	0.18	0 - 2	5.00	0.55	0.74	18
<i>Paronychia sessiliflora</i>	0.30	0.55	0 - 2	30.00	3.31	3.86	12

Table 3.(cont'd).

## Cover Summary for Mixed Shrub Grassland Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
Penstemon sp.	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Phlox hoodii	2.10	3.84	0 - 6	60.00	6.63	10.47	6
Phlox multiflora	0.30	0.55	0 - 4	10.00	1.10	1.65	15
Vicia americana	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Sub-total	3.80	6.95					
SEMI-SHRUBS OR HALF-SHRUBS							
Artemisia frigida	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Artemisia pedatifida	1.00	1.83	0 - 10	25.00	2.76	4.59	10
Gutierrezia sarothrae	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Sub-total	1.20	2.20					
SHRUBS							
Artemisia nova	0.50	0.91	0 - 4	20.00	2.21	3.12	13
Artemisia tridentata	16.40	30.01	6 - 34	100.00	11.05	41.06	1
Chrysothamnus viscidiflorus	0.10	0.18	0 - 2	5.00	0.55	0.74	18
Symphoricarpos albus	0.20	0.37	0 - 4	5.00	0.55	0.92	17
Sub-total	17.20	31.47					
SUM OF SPECIES COVER	54.65						
Mosses	0.10		0 - 2	5.00			
Lichens	0.60		0 - 2	30.00			
TOTAL VEGETATION	55.30 +/-	7.43					
LITTER/ROCK	19.80 +/-	11.16					
BARE SOIL	24.90 +/-	8.27					
TOTAL COVER	75.00 +/-	8.30					
Number of Species/sample	9.05						

Table 4.

## Cover Summary for Rough Breaks East Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	4.10	8.32	0 - 12	60.00	5.66	13.98	4
<i>Agropyron smithii</i>	1.20	2.43	0 - 4	30.00	2.83	5.26	11
<i>Agropyron spicatum</i>	7.00	14.20	0 - 16	95.00	8.96	23.16	1
<i>Agropyron trachycaulum</i>	0.20	0.41	0 - 4	5.00	0.47	0.88	24
<i>Carex filifolia</i>	4.90	9.94	0 - 14	65.00	6.13	16.07	3
<i>Festuca idahoensis</i>	0.70	1.42	0 - 10	10.00	0.94	2.36	18
<i>Koeleria macrantha</i>	2.10	4.26	0 - 8	60.00	5.66	9.92	7
<i>Oryzopsis hymenoides</i>	4.20	8.52	0 - 62	30.00	2.83	11.35	6
<i>Poa cusickii</i>	2.00	4.06	0 - 6	60.00	5.66	9.72	8
<i>Poa sandbergii</i>	1.30	2.64	0 - 6	40.00	3.77	6.41	9
<i>Sitanion hystrix</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Stipa comata</i>	0.80	1.62	0 - 6	25.00	2.36	3.98	14
<i>Stipa viridula</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
Sub-total	28.70	58.22					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Bouteloua gracilis</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
Sub-total	0.10	0.20					
<b>INTRODUCED PERENNIAL GRASSES</b>							
<i>Agropyron cristatum</i>	0.20	0.41	0 - 4	5.00	0.47	0.88	24
Sub-total	0.20	0.41					
<b>PERENNIAL FORBS</b>							
<i>Antennaria</i> sp.	0.30	0.61	0 - 6	5.00	0.47	1.08	23
<i>Apocynum cannabinum</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Arenaria hookeri</i>	0.30	0.61	0 - 4	10.00	0.94	1.55	21
<i>Aster ascendens</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Astragalus</i> sp.	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Astragalus spatulatus</i>	1.00	2.03	0 - 4	40.00	3.77	5.80	10

Table 4.(cont'd).

## Cover Summary for Rough Breaks East Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Cirsium</i> sp.	0.60	1.22	0 - 6	20.00	1.89	3.10	16
<i>Comandra umbellata</i>	0.30	0.61	0 - 2	15.00	1.42	2.02	20
<i>Crepis acuminata</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Dalea purpurea</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Erigeron caespitosus</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Haplopappus multicaulis</i>	0.80	1.62	0 - 6	20.00	1.89	3.51	15
<i>Hyaenoxys acaulis</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Lupinus argenteus</i>	0.20	0.41	0 - 2	10.00	0.94	1.35	22
<i>Machaeranthera grindelioides</i>	0.30	0.61	0 - 2	15.00	1.42	2.02	20
<i>Oxytropis nana</i>	0.30	0.61	0 - 4	10.00	0.94	1.55	21
<i>Oxytropis</i> sp.	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Paronychia sessiliflora</i>	0.70	1.42	0 - 4	30.00	2.83	4.25	13
<i>Phlox hoodii</i>	0.70	1.42	0 - 4	30.00	2.83	4.25	13
<i>Phlox muscoides</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Psoralea argophylla</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Psoralea tenuiflora</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Vicia americana</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
Sub-total	6.70	13.59					
<b>SEMI-SHRUBS OR HALF-SHRUBS</b>							
<i>Artemisia frigida</i>	0.20	0.41	0 - 2	10.00	0.94	1.35	22
<i>Artemisia pedatifida</i>	1.20	2.43	0 - 8	30.00	2.83	5.26	11
<i>Ceratoides lanata</i>	0.30	0.61	0 - 4	10.00	0.94	1.55	21
<i>Eriogonum brevicaulis</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Eriogonum ovalifolium</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Gutierrezia sarothrae</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Leptodactylon pungens</i>	0.40	0.81	0 - 2	20.00	1.89	2.70	17
<i>Sphaeromeria capitata</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
Sub-total	2.50	5.07					
<b>SHRUBS</b>							
<i>Artemisia nova</i>	3.50	7.10	0 - 16	55.00	5.19	12.29	5

Table 4.(cont'd).

## Cover Summary for Rough Breaks East Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Artemisia tridentata</i>	5.20	10.55	0 - 18	75.00	7.08	17.62	2
<i>Chrysothamnus nauseosus</i>	0.10	0.20	0 - 2	5.00	0.47	0.67	25
<i>Chrysothamnus viscidiflorus</i>	0.80	1.62	0 - 4	30.00	2.83	4.45	12
<i>Purshia tridentata</i>	0.30	0.61	0 - 6	5.00	0.47	1.08	23
<i>Symphoricarpos albus</i>	0.80	1.62	0 - 6	20.00	1.89	3.51	15
<i>Tetradymia canescens</i>	0.40	0.81	0 - 4	15.00	1.42	2.23	19
Sub-total	11.10	22.52					
SUM OF SPECIES COVER	49.30						
Mosses	0.10		0 - 2	5.00			
Lichens	0.10		0 - 2	5.00			
TOTAL VEGETATION	49.00 +/-	6.73					
LITTER/ROCK	24.30 +/-	13.24					
BARE SOIL	26.70 +/-	11.90					
TOTAL COVER	73.50 +/-	11.95					
Number of Species/sample	10.60						



Table 5.

## Cover Summary for Rough Breaks West Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	3.40	8.98	0 - 12	85.00	7.98	16.96	4
<i>Agropyron smithii</i>	0.30	0.79	0 - 2	15.00	1.41	2.20	17
<i>Agropyron spicatum</i>	5.70	15.06	0 - 18	85.00	7.98	23.04	1
<i>Carex filifolia</i>	2.50	6.61	0 - 8	55.00	5.16	11.77	5
<i>Carex stenophylla</i>	0.20	0.53	0 - 4	5.00	0.47	1.00	23
<i>Festuca idahoensis</i>	0.30	0.79	0 - 6	5.00	0.47	1.26	22
<i>Koeleria macrantha</i>	1.30	3.43	0 - 4	45.00	4.23	7.66	8
<i>Oryzopsis hymenoides</i>	0.30	0.79	0 - 2	15.00	1.41	2.20	17
<i>Poa cusickii</i>	1.30	3.43	0 - 8	40.00	3.76	7.19	9
<i>Poa sandbergii</i>	1.20	3.17	0 - 6	50.00	4.69	7.87	7
<i>Stipa comata</i>	1.60	4.23	0 - 8	40.00	3.76	7.98	6
<i>Stipa viridula</i>	0.20	0.53	0 - 2	10.00	0.94	1.47	21
Sub-total	18.30	48.35					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Aristida</i> sp.	0.20	0.53	0 - 4	5.00	0.47	1.00	23
<i>Bouteloua gracilis</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Bouteloua hirsuta</i>	0.30	0.79	0 - 2	15.00	1.41	2.20	17
Sub-total	0.60	1.59					
<b>PERENNIAL FORBS</b>							
<i>Arenaria congesta</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Arenaria hookeri</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Astereaceae</i> species	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Astragalus drummondii</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Astragalus</i> sp.	0.40	1.06	0 - 4	15.00	1.41	2.47	16
<i>Astragalus spatulatus</i>	0.60	1.59	0 - 4	25.00	2.35	3.93	11
<i>Cirsium</i> sp.	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Comandra umbellata</i>	0.30	0.79	0 - 2	15.00	1.41	2.20	17
<i>Dalea purpurea</i>	0.30	0.79	0 - 2	15.00	1.41	2.20	17

Table 5.(cont'd).

## Cover Summary for Rough Breaks West Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
Erigeron sp.	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Eriogonum sp.	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Grindelia squarrosa	0.20	0.53	0 - 2	10.00	0.94	1.47	21
Gypsophila sp.	0.20	0.53	0 - 2	10.00	0.94	1.47	21
Haplopappus multicaulis	0.60	1.59	0 - 4	25.00	2.35	3.93	11
Hymenoxys acaulis	0.20	0.53	0 - 4	5.00	0.47	1.00	23
Machaeranthera grindelioides	0.30	0.79	0 - 2	15.00	1.41	2.20	17
Paronychia sessiliflora	1.20	3.17	0 - 6	5.00	0.47	3.64	13
Phlox hoodii	0.70	1.85	0 - 2	30.00	2.82	4.67	10
Phlox multiflora	0.30	0.79	0 - 2	15.00	1.41	2.20	17
Phlox muscoides	0.70	1.85	0 - 4	30.00	2.82	4.67	10
Phlox sp.	0.20	0.53	0 - 2	10.00	0.94	1.47	21
Sedum sp.	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Taraxacum officinale	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Thermopsis rhombifolia	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Sub-total	7.20	19.02					
ANNUAL AND BIENNIAL FORBS							
Orthocarpus luteus	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Sub-total	0.10	0.26					
SEMI-SHRUBS OR HALF-SHRUBS							
Artemisia frigida	0.20	0.53	0 - 2	10.00	0.94	1.47	21
Artemisia pedatifida	0.50	1.32	0 - 2	25.00	2.35	3.67	12
Ceratoides lanata	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Eriogonum brevicaulis	0.25	0.66	0 - 2	15.00	1.41	2.07	18
Gutierrezia sarothrae	0.50	1.32	0 - 4	20.00	1.88	3.20	14
Leptodactylon pungens	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Sub-total	1.65	4.36					
SHRUBS							
Artemisia nova	3.70	9.78	0 - 8	85.00	7.98	17.76	3

Table 5.(cont'd).

## Cover Summary for Rough Breaks West Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Artemisia tridentata</i>	4.40	11.62	0 - 16	80.00	7.51	19.14	2
<i>Chrysothamnus nauseosus</i>	0.30	0.79	0 - 4	10.00	0.94	1.73	20
<i>Chrysothamnus viscidiflorus</i>	0.20	0.53	0 - 2	10.00	0.94	1.47	21
<i>Purshia tridentata</i>	0.60	1.59	0 - 6	15.00	1.41	2.99	15
<i>Rosa woodsii</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Salix</i> species	0.10	0.26	0 - 2	5.00	0.47	0.73	24
<i>Symphoricarpos albus</i>	0.40	1.06	0 - 4	10.00	0.94	2.00	19
<i>Tetradymia canescens</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Sub-total	9.90	26.16					
CACTI AND SUCCULENTS							
<i>Opuntia polyacantha</i>	0.10	0.26	0 - 2	5.00	0.47	0.73	24
Sub-total	0.10	0.26					
SUM OF SPECIES COVER	37.85						
Mosses	0.20		0 - 2	10.00			
TOTAL VEGETATION	38.10 +/-	7.15					
LITTER/ROCK	22.60 +/-	8.88					
BARE SOIL	39.30 +/-	12.02					
TOTAL COVER	60.70 +/-	12.02					
Number of Species/sample	10.65						

Table 6.

## Cover Summary for Upland Grass Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	7.90	15.72	0 - 20	95.00	11.11	26.83	3
<i>Agropyron smithii</i>	1.00	1.99	0 - 4	35.00	4.09	6.08	11
<i>Agropyron spicatum</i>	1.20	2.39	0 - 6	35.00	4.09	6.48	10
<i>Carex filifolia</i>	11.70	23.28	0 - 26	90.00	10.53	33.81	1
<i>Koeleria macrantha</i>	0.30	0.60	0 - 2	15.00	1.75	2.35	15
<i>Oryzopsis hymenoides</i>	2.10	4.18	0 - 8	70.00	8.19	12.37	6
<i>Poa cusickii</i>	2.00	3.98	0 - 8	45.00	5.26	9.24	8
<i>Poa sandbergii</i>	5.10	10.15	0 - 14	85.00	9.94	20.09	4
<i>Sitanion hystrix</i>	0.70	1.39	0 - 6	20.00	2.34	3.73	13
<i>Stipa comata</i>	1.50	2.99	0 - 12	35.00	4.09	7.08	9
<i>Stipa viridula</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18
Sub-total	33.60	66.87					
<b>PERENNIAL FORBS</b>							
<i>Aster sp.</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18
<i>Astragalus spatulatus</i>	0.40	0.80	0 - 4	15.00	1.75	2.55	14
<i>Hymenoxys acaulis</i>	0.80	1.59	0 - 4	20.00	2.34	3.93	12
<i>Oxytropis nana</i>	0.25	0.50	0 - 4	10.00	1.17	1.67	16
<i>Paronychia sessiliflora</i>	0.30	0.60	0 - 2	15.00	1.75	2.35	15
<i>Phlox hoodii</i>	1.60	3.18	0 - 8	65.00	7.60	10.79	7
Sub-total	3.45	6.87					
<b>SEMI-SHRUBS OR HALF-SHRUBS</b>							
<i>Artemisia pedatifida</i>	9.10	18.11	2 - 18	100.00	11.70	29.81	2
<i>Ceratoides lanata</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18
<i>Gutierrezia sarothrae</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18
Sub-total	9.30	18.51					
<b>SHRUBS</b>							
<i>Artemisia cana</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18

Table 6.(cont'd).

## Cover Summary for Upland Grass Affected Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Artemisia tridentata</i>	3.50	6.97	0 - 20	65.00	7.60	14.57	5
<i>Chrysothamnus nauseosus</i>	0.10	0.20	0 - 2	5.00	0.58	0.78	18
Sub-total	3.70	7.36					
CACTI AND SUCCULENTS							
<i>Opuntia polyacantha</i>	0.20	0.40	0 - 2	10.00	1.17	1.57	17
Sub-total	0.20	0.40					
SUM OF SPECIES COVER	50.25						
Lichens	1.00		0 - 4	35.00			
TOTAL VEGETATION	51.00 +/-	10.59					
LITTER/ROCK	20.40 +/-	8.70					
BARE SOIL	28.20 +/-	9.56					
TOTAL COVER	71.80 +/-	9.56					
Number of Species/sample	8.55						

Table 7.

## Cover Summary for Big Sage Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	4.00	7.24	0 - 14	87.50	12.50	19.74	3
<i>Agropyron smithii</i>	4.13	7.47	0 - 12	81.25	11.61	19.07	4
<i>Agropyron trachycaulum</i>	0.13	0.23	0 - 2	6.25	0.89	1.12	16
<i>Koeleria macrantha</i>	0.38	0.68	0 - 2	18.75	2.68	3.36	10
<i>Dryopsis hymenoides</i>	0.38	0.68	0 - 6	6.25	0.89	1.57	14
<i>Poa cusickii</i>	2.13	3.85	0 - 14	50.00	7.14	10.99	5
<i>Poa sandbergii</i>	9.63	17.42	2 - 20	100.00	14.29	31.71	2
<i>Sitanion hystrix</i>	0.38	0.68	0 - 2	18.75	2.68	3.36	10
<i>Stipa comata</i>	1.25	2.26	0 - 6	31.25	4.46	6.73	6
<i>Stipa viridula</i>	0.50	0.90	0 - 4	12.50	1.79	2.69	12
Sub-total	22.88	41.40					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Aristida purpurea</i>	0.50	0.90	0 - 4	18.75	2.68	3.58	9
<i>Bouteloua gracilis</i>	0.38	0.68	0 - 6	6.25	0.89	1.57	14
Sub-total	0.88	1.58					
<b>INTRODUCED PERENNIAL GRASSES</b>							
<i>Agropyron cristatum</i>	0.13	0.23	0 - 2	6.25	0.89	1.12	16
Sub-total	0.13	0.23					
<b>PERENNIAL FORBS</b>							
<i>Antennaria</i> sp.	0.13	0.23	0 - 2	6.25	0.89	1.12	16
<i>Arenaria hookeri</i>	0.13	0.23	0 - 2	6.25	0.89	1.12	16
<i>Aster</i> sp.	0.13	0.23	0 - 2	6.25	0.89	1.12	16
<i>Astragalus spatulatus</i>	0.13	0.23	0 - 2	6.25	0.89	1.12	16
<i>Cerastium arvense</i>	0.25	0.45	0 - 4	6.25	0.89	1.35	15
<i>Erigeron</i> sp.	0.25	0.45	0 - 2	12.50	1.79	2.24	13
<i>Phlox hoodii</i>	0.63	1.13	0 - 2	31.25	4.46	5.60	7
<i>Taraxacum officinale</i>	0.63	1.13	0 - 8	12.50	1.79	2.92	11
Sub-total	2.25	4.07					

Table 7.(cont'd).

## Cover Summary for Big Sage Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
ANNUAL AND BIENNIAL FORBS							
Orthocarpus luteus	0.38	0.68	0 - 6	6.25	0.89	1.57	14
Sub-total	0.38	0.68					
SEMI-SHRUBS OR HALF-SHRUBS							
Ceratoides lanata	0.13	0.23	0 - 2	6.25	0.89	1.12	16
Sub-total	0.13	0.23					
SHRUBS							
Artemisia nova	0.25	0.45	0 - 4	6.25	0.89	1.35	15
Artemisia tridentata	26.88	48.64	16 - 42	100.00	14.29	62.93	1
Chrysothamnus viscidiflorus	1.00	1.81	0 - 6	25.00	3.57	5.38	8
Symphoricarpos albus	0.13	0.23	0 - 2	6.25	0.89	1.12	16
Sub-total	28.25	51.13					
CACTI AND SUCCULENTS							
Opuntia polyacantha	0.38	0.68	0 - 2	18.75	2.68	3.36	10
Sub-total	0.38	0.68					
SUM OF SPECIES COVER							
	55.25						
Mosses	0.25		0 - 2	12.50			
Lichens	0.25		0 - 2	12.50			
TOTAL VEGETATION							
	55.88 +/-	11.13					
LITTER/ROCK							
	27.38 +/-	7.03					
BARE SOIL							
	16.75 +/-	10.73					
TOTAL COVER							
	83.25 +/-	10.73					
Number of Species/sample							
	7.00						

Table 8.

## Cover Summary for Mixed Shrub Grassland Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	2.27	4.96	0 - 10	46.67	5.65	10.60	5
<i>Agropyron smithii</i>	2.27	4.96	0 - 8	33.33	4.03	8.99	11
<i>Agropyron spicatum</i>	0.67	1.46	0 - 6	20.00	2.42	3.88	14
<i>Carex filifolia</i>	7.73	16.91	0 - 16	93.33	11.29	28.20	2
<i>Carex stenophylla</i>	2.00	4.37	0 - 10	46.67	5.65	10.02	7
<i>Koeleria macrantha</i>	1.87	4.08	0 - 10	46.67	5.65	9.73	10
<i>Dryopsis hymenoides</i>	1.07	2.33	0 - 6	33.33	4.03	6.36	13
<i>Poa cusickii</i>	1.73	3.79	0 - 8	40.00	4.84	8.63	12
<i>Poa sandbergii</i>	6.53	14.29	0 - 12	86.67	10.48	24.77	3
<i>Stipa comata</i>	2.80	6.12	0 - 10	66.67	8.06	14.19	4
<i>Stipa viridula</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
Sub-total	29.07	63.56					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Aristida purpurea</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
Sub-total	0.13	0.29					
<b>PERENNIAL FORBS</b>							
<i>Arenaria hookeri</i>	0.53	1.17	0 - 6	13.33	1.61	2.78	15
<i>Astragalus drummondii</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
<i>Astragalus spatulatus</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
<i>Comandra umbellata</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
<i>Paronychia sessiliflora</i>	0.67	1.46	0 - 4	20.00	2.42	3.88	14
<i>Phlox hoodii</i>	1.33	2.92	0 - 4	53.33	6.45	9.37	9
Sub-total	2.93	6.41					
<b>SEMI-SHRUBS OR HALF-SHRUBS</b>							
<i>Artemisia frigida</i>	0.13	0.29	0 - 2	6.67	0.81	1.10	16
<i>Artemisia pedatifida</i>	2.13	4.66	0 - 8	46.67	5.65	10.31	6
Sub-total	2.27	4.96					



Table 8.(cont'd).

## Cover Summary for Mixed Shrub Grassland Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>SHRUBS</b>							
Artemisia nova	2.27	4.96	0 - 12	40.00	4.84	9.79	8
Artemisia tridentata	9.07	19.83	2 - 18	100.00	12.10	31.92	1
Sub-total	11.33	24.78					
<b>SUM OF SPECIES COVER</b>	<b>45.73</b>						
Mosses	0.40		0 - 2	20.00			
Lichens	3.47		0 - 8	80.00			
<b>TOTAL VEGETATION</b>	<b>50.13 +/-</b>	<b>5.88</b>					
<b>LITTER/ROCK</b>	<b>30.13 +/-</b>	<b>6.70</b>					
<b>BARE SOIL</b>	<b>19.73 +/-</b>	<b>8.24</b>					
<b>TOTAL COVER</b>	<b>80.27 +/-</b>	<b>8.24</b>					
<b>Number of Species/sample</b>	<b>8.27</b>						

Table 9.

## Cover Summary for Rough Breaks East Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	1.37	2.97	0 - 14	21.05	2.15	5.13	11
<i>Agropyron smithii</i>	0.32	0.69	0 - 4	10.53	1.08	1.76	19
<i>Agropyron spicatum</i>	8.63	18.76	2 - 18	100.00	10.22	28.98	1
<i>Carex filifolia</i>	2.95	6.41	0 - 16	52.63	5.38	11.78	5
<i>Festuca idahoensis</i>	0.21	0.46	0 - 2	10.53	1.08	1.53	21
<i>Koeleria macrantha</i>	1.79	3.89	0 - 10	47.37	4.84	8.73	6
<i>Muhlenbergia</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Oryzopsis hymenoides</i>	0.21	0.46	0 - 2	10.53	1.08	1.53	21
<i>Poa cusickii</i>	4.00	8.70	0 - 16	78.95	8.06	16.76	4
<i>Poa sandbergii</i>	0.63	1.37	0 - 4	26.32	2.69	4.06	15
Sub-total	20.21	43.94					
<b>PERENNIAL FORBS</b>							
<i>Achillea millefolium</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Amsinkia</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Arenaria hookeri</i>	0.42	0.92	0 - 4	10.53	1.08	1.99	18
<i>Aster</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Astragalus bisulcatus</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Astragalus drummondii</i>	0.21	0.46	0 - 2	10.53	1.08	1.53	21
<i>Astragalus lentiginosus</i>	0.74	1.60	0 - 4	26.32	2.69	4.29	14
<i>Astragalus</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Astragalus spatulatus</i>	0.32	0.69	0 - 4	10.53	1.08	1.76	19
<i>Cirsium</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Comandra umbellata</i>	0.84	1.83	0 - 4	31.58	3.23	5.06	12
<i>Crepis acuminata</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Dalea candida</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Haplopappus multicaulis</i>	0.84	1.83	0 - 4	36.84	3.76	5.59	10
<i>Hymenoxys acaulis</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Linum</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Machaeranthera grindelioides</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8

Table 9.(cont'd).

## Cover Summary for Rough Breaks East Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Oxytropis nana</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Paronychia sessiliflora</i>	0.32	0.69	0 - 2	15.79	1.61	2.30	17
<i>Phlox hoodii</i>	0.84	1.83	0 - 6	26.32	2.69	4.52	13
<i>Phlox multiflora</i>	1.47	3.20	0 - 10	31.58	3.23	6.43	9
<i>Sedum</i> sp.	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Solidago</i> sp.	0.32	0.69	0 - 6	5.26	0.54	1.22	22
<i>Vicia americana</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
Sub-total	7.79	16.93					
ANNUAL AND BIENNIAL FORBS							
<i>Orthocarpus luteus</i>	0.21	0.46	0 - 2	10.53	1.08	1.53	21
Sub-total	0.21	0.46					
SEMI-SHRUBS OR HALF-SHRUBS							
<i>Artemisia frigida</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Eriogonum brevicaulis</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Eriogonum ovalifolium</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Gutierrezia sarothrae</i>	0.32	0.69	0 - 2	15.79	1.61	2.30	17
<i>Leptodactylon pungens</i>	0.21	0.46	0 - 2	10.53	1.08	1.53	21
Sub-total	0.84	1.83					
SHRUBS							
<i>Artemisia nova</i>	8.32	18.08	0 - 24	94.74	9.68	27.76	2
<i>Artemisia tridentata</i>	4.84	10.53	2 - 16	89.47	9.14	19.67	3
<i>Chrysothamnus viscidiflorus</i>	1.16	2.52	0 - 6	42.11	4.30	6.82	7
<i>Purshia tridentata</i>	0.53	1.14	0 - 10	5.26	0.54	1.68	20
<i>Ribes cereum</i>	1.05	2.29	0 - 10	15.79	1.61	3.90	16
Rosaceae species	0.11	0.23	0 - 2	5.26	0.54	0.77	8
<i>Symphoricarpos albus</i>	0.84	1.83	0 - 4	26.32	2.69	4.52	13
Sub-total	16.84	36.61					
CACTI AND SUCCULENTS							
<i>Opuntia polyacantha</i>	0.11	0.23	0 - 2	5.26	0.54	0.77	8
Sub-total	0.11	0.23					

Table 9.(cont'd).

## Cover Summary for Rough Breaks East Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
SUM OF SPECIES COVER	46.00						
Lichens	0.11		0 - 2	5.26			
TOTAL VEGETATION	46.11 +/-	10.32					
LITTER/ROCK	30.42 +/-	10.64					
BARE SOIL	23.26 +/-	13.99					
TOTAL COVER	76.74 +/-	13.99					
Number of Species/sample	9.79						

Table 10.

## Cover Summary for Rough Breaks West Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	1.89	4.67	0 - 8	44.44	4.21	8.88	6
<i>Agropyron smithii</i>	0.33	0.82	0 - 4	11.11	1.05	1.88	22
<i>Agropyron spicatum</i>	5.56	13.74	0 - 16	88.89	8.42	22.16	1
<i>Agropyron trachycaulum</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Carex filifolia</i>	1.33	3.30	0 - 4	44.44	4.21	7.51	7
<i>Carex stenophylla</i>	0.22	0.55	0 - 2	11.11	1.05	1.60	23
<i>Festuca idahoensis</i>	0.56	1.37	0 - 6	16.67	1.58	2.95	18
<i>Koeleria macrantha</i>	1.78	4.40	0 - 6	50.00	4.74	9.13	5
<i>Oryzopsis hymenoides</i>	0.89	2.20	0 - 6	27.78	2.63	4.83	12
<i>Poa cusickii</i>	1.11	2.75	0 - 6	44.44	4.21	6.96	8
<i>Poa sandbergii</i>	0.67	1.65	0 - 4	22.22	2.11	3.75	15
<i>Sitanion hystrix</i>	0.22	0.55	0 - 4	5.56	0.53	1.08	24
<i>Stipa comata</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Sub-total	14.78	36.54					
<b>WARM SEASON PERENNIAL GRASSES</b>							
<i>Bouteloua hirsuta</i>	0.44	1.10	0 - 6	11.11	1.05	2.15	21
Sub-total	0.44	1.10					
<b>PERENNIAL FORBS</b>							
<i>Antennaria microphylla</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Arenaria congesta</i>	0.22	0.55	0 - 2	11.11	1.05	1.60	23
<i>Arenaria hookeri</i>	0.22	0.55	0 - 2	11.11	1.05	1.60	23
<i>Aster sp.</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Astragalus drummondii</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Astragalus spatulatus</i>	0.33	0.82	0 - 2	16.67	1.58	2.40	20
<i>Cirsium sp.</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Crepis acuminata</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Dalea purpurea</i>	0.89	2.20	0 - 8	16.67	1.58	3.78	14
<i>Erigeron sp.</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25

Table 10.(cont'd).

## Cover Summary for Rough Breaks West Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
Eriogonum sp.	0.22	0.55	0 - 2	5.56	0.53	1.08	24
Gypsophila sp.	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Haplopappus multicaulis	0.44	1.10	0 - 4	16.67	1.58	2.68	19
Hymenoxys acaulis	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Linum lewisii	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Lupinus argenteus	0.44	1.10	0 - 4	16.67	1.58	2.68	19
Machaeranthera grindelioides	0.89	2.20	0 - 6	27.78	2.63	4.83	12
Paronychia sessiliflora	0.22	0.55	0 - 2	11.11	1.05	1.60	23
Phlox hoodii	0.33	0.82	0 - 4	11.11	1.05	1.88	22
Phlox multiflora	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Phlox muscoides	1.00	2.47	0 - 8	22.22	2.11	4.58	13
Thermopsis rhombifolia	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Townsendia spathulata	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Sub-total	6.56	16.21					
ANNUAL AND BIENNIAL FORBS							
Orthocarpus luteus	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Sub-total	0.11	0.27					
SEMI-SHRUBS OR HALF-SHRUBS							
Artemisia frigida	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Artemisia pedatifida	0.67	1.65	0 - 8	16.67	1.58	3.23	16
Ceratoides lanata	0.11	0.27	0 - 2	5.56	0.53	0.80	25
Eriogonum brevicaulis	0.44	1.10	0 - 2	22.22	2.11	3.20	17
Leptodactylon pungens	0.33	0.82	0 - 4	11.11	1.05	1.88	22
Sub-total	1.67	4.12					
SHRUBS							
Artemisia arbuscula	0.78	1.92	0 - 4	33.33	3.16	5.08	10
Artemisia nova	5.33	13.19	0 - 14	83.33	7.89	21.08	2
Artemisia tridentata	4.00	9.89	0 - 20	66.67	6.32	16.21	3
Chrysothamnus nauseosus	0.22	0.55	0 - 2	11.11	1.05	1.60	23

Table 10.(cont'd). Cover Summary for Rough Breaks West Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<i>Chrysothamnus viscidiflorus</i>	0.22	0.55	0 - 2	11.11	1.05	1.60	23
<i>Purshia tridentata</i>	1.11	2.75	0 - 8	22.22	2.11	4.85	11
<i>Symphoricarpos albus</i>	3.33	8.24	0 - 8	61.11	5.79	14.03	4
<i>Symphoricarpos oreophilus</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Tetradymia canescens</i>	1.00	2.47	0 - 4	44.44	4.21	6.68	9
Sub-total	16.11	39.84					
TREE SPECIES							
<i>Juniperus communis</i>	0.22	0.55	0 - 4	5.56	0.53	1.08	24
<i>Pinus flexilis</i>	0.11	0.27	0 - 2	5.56	0.53	0.80	25
<i>Robinia sp.</i>	0.44	1.10	0 - 4	16.67	1.58	2.68	19
Sub-total	0.78	1.92					
SUM OF SPECIES COVER	40.44						
Lichens	0.11		0 - 2	5.56			
TOTAL VEGETATION	40.78 +/-	9.58					
LITTER/ROCK	23.89 +/-	11.91					
BARE SOIL	35.33 +/-	10.95					
TOTAL COVER	64.67 +/-	10.95					
Number of Species/sample	10.56						

Table 11.

## Cover Summary for Upland Grass Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
<b>COOL SEASON PERENNIAL GRASSES</b>							
<i>Agropyron dasystachyum</i>	2.40	5.81	0 - 12	53.33	6.84	12.64	6
<i>Agropyron smithii</i>	3.87	9.35	0 - 12	86.67	11.11	20.47	4
<i>Agropyron spicatum</i>	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Carex filifolia</i>	6.80	16.45	0 - 14	93.33	11.97	28.42	3
<i>Carex stenophylla</i>	0.40	0.97	0 - 4	13.33	1.71	2.68	12
<i>Koeleria macrantha</i>	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Oryzopsis hymenoides</i>	1.20	2.90	0 - 4	53.33	6.84	9.74	9
<i>Poa cusickii</i>	0.67	1.61	0 - 6	20.00	2.56	4.18	11
<i>Poa sandbergii</i>	7.60	18.39	2 - 16	100.00	12.82	31.21	2
<i>Stipa comata</i>	4.00	9.68	0 - 12	66.67	8.55	18.22	5
Sub-total	27.20	65.81					
<b>PERENNIAL FORBS</b>							
<i>Arenaria hookeri</i>	0.67	1.61	0 - 4	20.00	2.56	4.18	11
<i>Astragalus drummondii</i>	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Astragalus lentiginosus</i>	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Astragalus spatulatus</i>	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Lomatium</i> sp.	0.13	0.32	0 - 2	6.67	0.85	1.18	13
<i>Phlox hoodii</i>	1.73	4.19	0 - 8	53.33	6.84	11.03	7
Sub-total	2.93	7.10					
<b>SEMI-SHRUBS OR HALF-SHRUBS</b>							
<i>Artemisia pedatifida</i>	7.87	19.03	2 - 20	100.00	12.82	31.85	1
<i>Ceratoides lanata</i>	1.20	2.90	0 - 4	40.00	5.13	8.03	10
Sub-total	9.07	21.94					
<b>SHRUBS</b>							
<i>Artemisia tridentata</i>	2.13	5.16	0 - 8	40.00	5.13	10.29	8
Sub-total	2.13	5.16					



Table 11.(cont'd). Cover Summary for Upland Grass Reference Area.

Species	Mean Cover (%)	Relative Cover (%)	Range of Cover Values (%)	Percent Frequency (%)	Relative Frequency (%)	Importance Value	Rank
SUM OF SPECIES COVER	41.33						
Mosses	0.13		0 - 2	6.67			
Lichens	2.53		0 - 8	46.67			
TOTAL VEGETATION	44.13 +/-	7.15					
LITTER/ROCK	22.93 +/-	7.74					
BARE SOIL	32.93 +/-	12.33					
TOTAL COVER	67.60 +/-	12.54					
Number of Species/sample	7.80						

Table 12. Big Sage Affected Shrub Density Data Summary.

Project Name : PRI GAS HILLS BASLINE  
Vegetation Type : Big Sage  
Area Name : Affected  
Vegetation Parameter : Shrub Density  
Number of Plots : 20

CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDA
	11	12	13	14	15	16	17	18	19	20		DEVIATIO
TOTAL DENSITY	103.00 136.00	266.00 106.00	266.00 179.00	136.00 195.00	152.00 177.00	130.00 390.00	187.00 88.00	211.00 125.00	165.00 193.00	95.00 107.00	170.30	71.15
HALF/SEMI-SHRUBS												
Artemisia pedatifida	0.00 0.00	111.00 0.00	0.00 35.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	19.00 36.00	0.00 0.00	10.15	25.64
Ceratoides lanata	0.00 0.00	23.00 0.00	0.00 0.00	2.00 0.00	0.00 2.00	0.00 0.00	1.00 0.00	4.00 0.00	7.00 0.00	0.00 0.00	1.95	5.13
Gutierrezia sarothrae	0.00 0.00	0.00 0.00	7.00 0.00	0.00 0.00	0.00 5.00	4.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00 0.00	0.85	1.96
Leptodactylon pungens	0.00 0.00	0.00 0.00	0.00 0.00	3.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00 0.00	0.00 0.00	0.20	0.63
FULL SHRUBS												
Atriplex canescens	0.00 0.00	0.00 0.00	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.05	0.22
Artemisia nova	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.05	0.22
Artemisia tridentata	83.00 57.00	132.00 106.00	119.00 122.00	128.00 196.00	88.00 72.00	126.00 301.00	186.00 88.00	139.00 70.00	120.00 151.00	75.00 75.00	121.65	55.09
Chrysothamnus nauseosus	20.00 0.00	0.00 0.00	7.00 2.00	3.00 0.00	18.00 4.00	0.00 3.00	0.00 0.00	0.00 0.00	0.00 1.00	0.00 2.00	3.00	5.64
Chrysothamnus viscidiflorus	0.00 19.00	0.00 0.00	47.00 18.00	0.00 0.00	39.00 53.00	0.00 80.00	0.00 0.00	61.00 49.00	16.00 0.00	16.00 8.00	20.30	24.58
Rhus trilobata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.05	0.22
Rosa woodsii	0.00 41.00	0.00 0.00	5.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 7.00	2.65	8.98
Symphoricarpos albus	0.00 19.00	0.00 0.00	67.00 0.00	0.00 0.00	5.00 39.00	0.00 6.00	0.00 0.00	5.00 6.00	2.00 5.00	4.00 14.00	8.60	16.21
Tetradymia canescens	0.00 0.00	0.00 0.00	14.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00 0.00	0.00 1.00	0.80	3.04
											0.00	0.00

HECTARE: 34060

Table 13. Mixed Shrub Grassland Affected Shrub Density Data Summary.

Project Name	PRI GAS HILLS												
Vegetation Type	: Mixed Shrub Grassland												
Area Name	: Affected												
Vegetation Parameter	: Shrub Density												
Number of Plots	20												
CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD	
	11	12	13	14	15	16	17	18	19	20		DEVIATION	
TOTAL DENSITY	61.00 285.00	32.00 138.00	435.00 108.00	135.00 280.00	109.00 122.00	213.00 192.00	189.00 249.00	161.00 87.00	210.00 143.00	109.00 103.00	168.05	90.82	
HALP/SEMI-SHRUBS													
Artemisia frigida	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 21.00	0.00 0.00	20.00 2.00	0.00 0.00	2.15	6.13	
Artemisia pedatifida	0.00 0.00	0.00 0.00	0.00 0.00	27.00 75.00	0.00 0.00	0.00 64.00	66.00 7.00	0.00 3.00	64.00 0.00	13.00 8.00	16.35	26.31	
Ceratoides lanata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 29.00	0.00 0.00	0.00 0.00	9.00 0.00	0.00 0.00	4.00 0.00	0.00 0.00	2.10	6.52	
Gutierrezia sarothrae	0.00 0.00	0.00 0.00	11.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 5.00	0.00 0.00	0.00 1.00	0.85	2.57	
Leptodactylon pungens	1.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	16.00 0.00	0.00 0.00	0.85	3.48	
FULL SHRUBS													
Artemisia nova	0.00 0.00	0.00 4.00	2.00 0.00	0.00 0.00	0.00 0.00	5.00 2.00	0.00 41.00	29.00 16.00	0.00 0.00	1.00 0.00	5.00	10.79	
Artemisia tridentata	60.00 273.00	32.00 134.00	288.00 108.00	108.00 175.00	109.00 104.00	144.00 126.00	114.00 180.00	128.00 60.00	104.00 141.00	95.00 87.00	128.50	61.54	
Chrysothamnus nauseosus	0.00 0.00	0.00 0.00	35.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.75	7.63	
Chrysothamnus viscidiflorus	0.00 12.00	0.00 0.00	81.00 0.00	0.00 1.00	0.00 11.00	0.00 0.00	0.00 0.00	4.00 3.00	2.00 0.00	0.00 7.00	6.05	17.57	
Rosa woodsii	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.10	0.44	
Symphoricarpos albus	0.00 0.00	0.00 0.00	16.00 0.00	0.00 0.00	0.00 7.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.15	3.73	
HECTAR 33610.0													

Table 14. Rough Breaks East Affected Shrub Density Data Summary.

Project Name	PRI GAS HILLS											
Vegetation Type	Rough Breaks											
Area Name	: Affected											
Vegetation Parameter	: Shrub Density											
Number of Plots	20											
CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
	11	12	13	14	15	16	17	18	19	20		
TOTAL DENSITY	82.00 130.00	165.00 303.00	105.00 128.00	238.00 152.00	165.00 117.00	228.00 112.00	9.00 243.00	31.00 96.00	250.00 191.00	192.00 236.00	158.65	75.07
HALF/SRMI-SHRUBS												
Artemisia frigida	2.00 0.00	0.00 0.00	5.00 3.00	3.00 0.00	21.00 3.00	0.00 1.00	2.00 10.00	1.00 36.00	0.00 0.00	0.00 0.00	4.35	8.72
Artemisia pedatifida	0.00 4.00	0.00 111.00	0.00 0.00	18.00 7.00	0.00 26.00	0.00 0.00	0.00 43.00	1.00 0.00	77.00 26.00	0.00 17.00	16.50	28.88
Ceratoides lanata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 4.00	0.00 1.00	3.00 0.00	0.00 0.00	0.40	1.07
Eriogonum brevicaulis	0.00 0.00	0.00 0.00	0.00 6.00	0.00 0.00	3.00 2.00	2.00 0.00	0.00 6.00	0.00 0.00	0.00 0.00	8.00 0.00	1.35	2.41
Gutierrezia sarothrae	0.00 0.00	0.00 0.00	0.00 9.00	8.00 1.00	0.00 28.00	0.00 3.00	0.00 4.00	0.00 0.00	0.00 0.00	0.00 7.00	3.00	6.42
Leptodactylon pungens	9.00 1.00	15.00 4.00	2.00 4.00	0.00 13.00	4.00 0.00	19.00 2.00	2.00 9.00	1.00 6.00	5.00 0.00	21.00 0.00	5.85	6.31
FULL SHRUBS												
Artemisia nova	28.00 1.00	16.00 46.00	58.00 22.00	80.00 50.00	126.00 7.00	52.00 100.00	0.00 28.00	0.00 25.00	42.00 8.00	91.00 52.00	41.60	34.75
Artemisia tridentata	23.00 90.00	96.00 105.00	40.00 32.00	104.00 77.00	11.00 24.00	40.00 0.00	2.00 99.00	17.00 28.00	98.00 120.00	4.00 149.00	58.25	44.77
Chrysothamnus nauseosus	4.00 21.00	0.00 8.00	0.00 9.00	0.00 3.00	0.00 19.00	1.00 2.00	1.00 10.00	11.00 0.00	0.00 7.00	0.00 0.00	4.80	6.27
Chrysothamnus viscidiflorus	10.00 13.00	21.00 26.00	0.00 14.00	19.00 1.00	0.00 1.00	36.00 3.00	2.00 27.00	0.00 0.00	8.00 15.00	26.00 10.00	11.60	10.86
Purshia tridentata	0.00 0.00	4.00 0.00	0.00 6.00	0.00 0.00	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	4.00 0.00	12.00 0.00	1.35	2.97
Rhus trilobata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.10	0.44
Rosa woodsii	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.05	0.22
Symphoricarpos albus	0.00 0.00	9.00 3.00	0.00 14.00	6.00 0.00	0.00 6.00	70.00 0.00	0.00 0.00	0.00 0.00	5.00 15.00	7.00 0.00	6.75	15.24
Tetradymia canescens	0.00 0.00	13.00 0.00	0.00 9.00	0.00 0.00	0.00 0.00	5.00 1.00	0.00 3.00	0.00 0.00	8.00 0.00	23.00 1.00	3.15	5.83
HECTAR 31730.0												

Table 15. Rough Breaks West Affected Shrub Density Data Summary.

CATEGORY/SPECIES	PRI GAS HILLS Shrub Breaks Affected : Shrub Density Number of Plots										MEAN STANDARD DEVIATION
	1	2	3	4	5	6	7	8	9	10	
TOTAL DENSITY	47.00 58.00	77.00 86.00	84.00 77.00	115.00 122.00	72.00 101.00	83.00 60.00	109.00 115.00	114.00 64.00	80.00 95.00	37.00 122.00	85.25 : 25.00 :
BALP/SEH-SHRUBS											
Artemisia frigida	: 0.00 2.00	: 16.00 0.00	: 0.00 0.00	: 0.00 0.00	: 4.00 0.00	: 0.00 0.00	: 8.00 2.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 1.80 : 3.80 :
Artemisia longifolia	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 3.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.15 : 0.65 :
Artemisia pedatifida	: 0.00 0.00	: 0.00 8.00	: 3.00 32.00	: 0.00 0.00	: 0.00 2.00	: 0.00 2.00	: 34.00 18.00	: 0.00 0.00	: 0.00 1.00	: 0.00 10.00	: 5.50 : 10.20 :
Cercoides lanata	: 6.00 0.00	: 0.00 3.00	: 0.00 0.00	: 12.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 4.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 1.25 : 2.95 :
Bryonox breviscula	: 6.00 4.00	: 3.00 0.00	: 2.00 0.00	: 0.00 5.00	: 0.00 4.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 5.00 0.00	: 1.00 5.00	: 1.75 : 2.19 :
Gutierrezia serotina	: 4.00 13.00	: 11.00 4.00	: 4.00 32.00	: 9.00 9.00	: 12.00 0.00	: 9.00 30.00	: 9.00 30.00	: 0.00 7.00	: 0.00 8.00	: 2.00 22.00	: 9.30 : 8.89 :
Lepidodactylon pugens	: 0.00 2.00	: 0.00 0.00	: 4.00 0.00	: 5.00 0.00	: 1.00 0.00	: 0.00 6.00	: 0.00 0.00	: 0.00 0.00	: 2.00 0.00	: 0.00 21.00	: 2.05 : 4.71 :
FULL SHRUBS											
Asheuchner sp.	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 3.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.15 : 0.65 :
Artemisia tridentata	: 6.00 33.00	: 29.00 66.00	: 45.00 14.00	: 38.00 2.00	: 35.00 5.00	: 21.00 23.00	: 21.00 25.00	: 26.00 9.00	: 22.00 9.00	: 6.00 48.00	: 24.35 : 16.40 :
Artemisia nova	: 17.00 1.00	: 5.00 5.00	: 18.00 19.00	: 4.00 75.00	: 6.00 16.00	: 32.00 15.00	: 27.00 31.00	: 21.00 36.00	: 49.00 30.00	: 16.00 13.00	: 21.80 : 17.11 :
Atriplex confertifolia	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 25.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 1.25 : 5.45 :
Chrysothamnus nauseosus	: 2.00 3.00	: 9.00 0.00	: 4.00 7.00	: 3.00 1.00	: 0.00 25.00	: 0.00 2.00	: 1.00 5.00	: 1.00 3.00	: 2.00 32.00	: 4.00 2.00	: 5.30 : 8.12 :
Chrysothamnus viscidiflorus	: 1.00 0.00	: 4.00 3.00	: 4.00 1.00	: 8.00 14.00	: 1.00 0.00	: 0.00 0.00	: 9.00 0.00	: 4.00 0.00	: 0.00 11.00	: 3.00 1.00	: 3.20 : 4.04 :
Purshia tridentata	: 1.00 0.00	: 0.00 0.00	: 0.00 0.00	: 6.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 4.00 6.00	: 0.00 0.00	: 0.00 0.00	: 0.95 : 1.95 :
Rosa sp.	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 4.00	: 0.00 0.00	: 0.20 : 0.87 :
Rosa woodsii	: 0.00 0.00	: 0.00 0.00	: 0.00 32.00	: 0.00 0.00	: 3.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 1.75 : 6.97 :
Symphoricarpos albus	: 0.00 0.00	: 0.00 0.00	: 0.00 15.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 54.00 3.00	: 0.00 0.00	: 0.00 0.00	: 3.60 : 12.02 :
Tetradymia canescens	: 1.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.00 7.00	: 0.00 0.00	: 0.00 0.00	: 0.00 0.00	: 1.00 0.00	: 0.00 0.00	: 0.00 0.00	: 0.45 : 1.53 :

BECTAR 17050.0

Table 16. Upland Grass Affected Shrub Density Data Summary.

Project Name : PRI GAS HILLS  
Vegetation Type : Uplandgrass  
Area Name : Affected  
Vegetation Parameter : Shrub Density  
Number of Plots : 20

CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDA
	11	12	13	14	15	16	17	18	19	20		DEVIATIO
TOTAL DENSITY	251.00 240.00	165.00 153.00	135.00 206.00	163.00 209.00	164.00 229.00	190.00 353.00	165.00 139.00	227.00 253.00	222.00 219.00	187.00 194.00	203.20	49.15
HALF/SRM-SHRUBS												
Artemisia frigida	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.10	0.44
Artemisia pedatifida	232.00 220.00	152.00 140.00	45.00 184.00	158.00 193.00	164.00 213.00	146.00 276.00	61.00 132.00	227.00 178.00	126.00 215.00	57.00 130.00	162.70	59.97
Ceratoides lanata	10.00 3.00	1.00 6.00	3.00 0.00	0.00 0.00	0.00 0.00	0.00 70.00	0.00 0.00	0.00 49.00	0.00 0.00	0.00 1.00	7.15	17.94
Gutierrezia sarothrae	0.00 0.00	0.00 0.00	0.00 0.00	0.00 2.00	0.00 0.00	0.00 0.00	5.00 0.00	0.00 0.00	0.00 0.00	5.00 0.00	0.60	1.53
FULL SHRUBS												
Artemisia cana	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 1.00	0.00 0.00	0.05	0.22
Artemisia tridentata	9.00 17.00	12.00 6.00	87.00 22.00	5.00 6.00	0.00 16.00	44.00 7.00	90.00 7.00	0.00 26.00	95.00 3.00	107.00 63.00	31.15	35.33
Chrysothamnus nauseosus	0.00 0.00	0.00 1.00	0.00 0.00	0.00 3.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	7.00 0.00	0.55	1.63
Chrysothamnus viscidiflorus	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	7.00 0.00	0.00 0.00	0.00 0.00	11.00 0.00	0.90	2.77

HECTAR 40640.0

Table 17. Big Sage Reference Shrub Density Data Summary.

Project Name	PRI GAS HILLS											
Vegetation Type	: Big Sage											
Area Name	: Reference											
Vegetation Parameter	: Shrub Density											
Number of Plots	16											
CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
	11	12	13	14	15	16						
TOTAL DENSITY	154.00 172.00	107.00 145.00	197.00 89.00	127.00 101.00	90.00 112.00	144.00 141.00	149.00	102.00	145.00	139.00	132.19	29.33
HALF/SEMI-SHRUBS												
Artemisia pedatifida	0.00 1.00	0.00 0.00	0.00 0.00	0.00 9.00	0.00 0.00	34.00 1.00	6.00	7.00	0.00	0.00	3.63	8.34
Ceratoides lanata	9.00 1.00	0.00 0.00	0.00 0.00	8.00 0.00	0.00 0.00	2.00 0.00	21.00	0.00	1.00	0.00	2.63	5.49
Gutierrezia sarothrae	0.00 0.00	1.00 0.00	0.00 0.00	0.00 0.00	7.00 0.00	0.00 0.00	0.00	0.00	0.00	5.00	0.81	2.01
FULL SHRUBS												
Artemisia nova	17.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	1.00	0.00	0.00	1.13	4.11
Artemisia tridentata	128.00 122.00	106.00 145.00	197.00 89.00	119.00 92.00	83.00 112.00	108.00 125.00	93.00	94.00	144.00	95.00	115.94	27.97
Chrysothamnus viscidiflorus	0.00 48.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 8.00	29.00	0.00	0.00	24.00	6.81	13.79
Symphoricarpos albus	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 6.00	0.00	0.00	0.00	14.00	1.25	3.60
HECTAR 26437.5												

Table 18. Mixed Shrub Grassland Reference Shrub Density Data Summary.

Project Name	PRI GAS HILLS											
Vegetation Type	: Mixed Shrub Grassland											
Area Name	: Reference											
Vegetation Parameter	: Shrub Density											
Number of Plots	: 15											

CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDA
	11	12	13	14	15							DEVIATIO
TOTAL DENSITY	161.00 194.00	150.00 265.00	308.00 152.00	123.00 146.00	245.00 156.00	76.00	320.00	130.00	198.00	168.00	186.13	67.27
HALF/SEMI-SHRUBS												
Artemisia frigida	0.00 0.00	4.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.00
Artemisia pedatifida	107.00 40.00	0.00 187.00	261.00 87.00	3.00 24.00	167.00 52.00	17.00	221.00	76.00	38.00	112.00	92.80	79.42
Ceratoides lanata	0.00 0.00	0.00 7.00	0.00 0.00	0.00 1.00	0.00 1.00	0.00	59.00	2.00	0.00	2.00	4.80	14.59
Gutierrezia sarothrae	0.00 0.00	1.00 0.00	0.00 3.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	2.00	0.40	0.88
Leptodactylon pungens	0.00 0.00	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.50
FULL SHRUBS												
Artemisia nova	37.00 142.00	16.00 0.00	0.00 4.00	61.00 1.00	1.00 23.00	2.00	0.00	23.00	20.00	0.00	22.00	36.27
Artemisia tridentata	17.00 12.00	129.00 71.00	47.00 58.00	57.00 120.00	77.00 80.00	57.00	40.00	29.00	140.00	49.00	65.53	37.36
Chrysothamnus nauseosus	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	2.00	0.13	0.50
Chrysothamnus viscidiflorus	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	1.00	0.07	0.25
HECTAR 37225.7												



Table 19. Rough Breaks East Reference Shrub Density Data Summary.

Project Name	PRI GAS HILLS												
Vegetation Type	: Rough Breaks												
Area Name	: Reference												
Vegetation Parameter	: Shrub Density												
Number of Plots	19												
CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDA	
	11	12	13	14	15	16	17	18	19			DEVIATIO	
TOTAL DENSITY	183.00 57.00	113.00 91.00	250.00 222.00	152.00 107.00	178.00 74.00	125.00 131.00	134.00 107.00	133.00 129.00	117.00 115.00	174.00	136.42	120.23	
HALF/SEMI-SHRUBS													
Artemisia frigida	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00	0.11	0.45	
Artemisia pedatifida	0.00 0.00	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 48.00	0.00 1.00	1.00 0.00	0.00 0.00	0.00	2.68	10.69	
Ceratoides lanata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 9.00	0.00 3.00	0.00 0.00	0.00 0.00	0.00	0.63	2.08	
Eriogonum brevicaul	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 6.00	0.00 0.00	0.00 0.00	0.00	0.32	1.34	
Gutierrezia sarothrae	2.00 0.00	0.00 32.00	7.00 0.00	0.00 0.00	0.00 15.00	11.00 18.00	0.00 1.00	0.00 11.00	0.00 6.00	2.00	5.53	8.36	
Leptodactylon pungens	0.00 0.00	0.00 2.00	0.00 0.00	0.00 7.00	1.00 0.00	1.00 0.00	2.00 0.00	0.00 0.00	1.00 1.00	0.00	0.79	1.61	
FULL SHRUBS													
Artemisia nova	72.00 14.00	60.00 34.00	147.00 185.00	99.00 45.00	94.00 52.00	73.00 18.00	77.00 40.00	86.00 57.00	67.00 55.00	78.00	71.21	40.01	
Artemisia tridentata	72.00 25.00	52.00 21.00	21.00 19.00	32.00 19.00	37.00 3.00	31.00 23.00	47.00 37.00	36.00 56.00	30.00 10.00	53.00	32.84	16.76	
Chrysothamnus nauseosus	0.00 1.00	0.00 1.00	0.00 0.00	2.00 1.00	3.00 0.00	0.00 1.00	1.00 2.00	4.00 0.00	8.00 1.00	0.00	1.32	1.92	
Chrysothamnus viscidiflorus	35.00 1.00	1.00 0.00	58.00 13.00	11.00 14.00	37.00 0.00	0.00 12.00	7.00 9.00	4.00 5.00	8.00 0.00	16.00	12.16	15.00	
Rhus trilobata	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00	0.05	0.22	
Ribes aureum	0.00 1.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.05	0.22	
Ribes sp.	0.00 12.00	0.00 0.00	1.00 0.00	2.00 10.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	3.00	1.47	3.38	
Ribes cereum	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 32.00	0.00	1.68	7.15	
Symphoricarpos albus	2.00 3.00	0.00 0.00	16.00 5.00	6.00 11.00	6.00 4.00	9.00 2.00	0.00 5.00	0.00 0.00	2.00 4.00	22.00	5.11	5.72	
Tetradymia canescens	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 3.00	0.00 0.00	0.00 6.00	0.00	0.47	1.46	
HECTAR 27284.21													

Table 20. Rough Breaks West Reference Shrub Density Data Summary.

Project Name	PRI GAS HILLS											
Vegetation Type	: Rough Breaks											
Area Name	: Reference											
Vegetation Parameter	: Shrub Density											
Number of Plots	18											
CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
	11	12	13	14	15	16	17	18				
TOTAL DENSITY	206.00 275.00	237.00 120.00	192.00 55.00	73.00 233.00	160.00 174.00	60.00 69.00	134.00 58.00	111.00 204.00	93.00	141.00	144.17	67.51
HALF/SEMI-SHRUBS												
Artemisia frigida	31.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 4.00	0.00 0.00	15.00 0.00	0.00	0.00	2.78	7.69
Artemisia pedatifida	43.00 15.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 65.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	6.83	17.41
Ceratoides lanata	0.00 0.00	0.00 4.00	0.00 0.00	0.00 0.00	0.00 0.00	2.00 0.00	0.00 0.00	0.00 0.00	1.00	0.00	0.40	1.20
Eriogonum brevicaulis	0.00 0.00	8.00 3.00	9.00 4.00	1.00 0.00	3.00 0.00	1.00 2.00	0.00 0.00	0.00 0.00	1.00	2.00	2.80	3.19
Gutierrezia sarothrae	0.00 4.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 4.00	11.00 4.00	3.00 4.00	0.00	0.00	0.40	1.20
Leptodactylon pungens	4.00 4.00	0.00 9.00	0.00 0.00	0.00 37.00	8.00 0.00	0.00 0.00	0.00 0.00	3.00 1.00	4.00	7.00	4.28	8.47
FULL SHRUBS												
Artemisia nova	25.00 120.00	111.00 40.00	2.00 33.00	66.00 117.00	37.00 35.00	0.00 14.00	97.00 45.00	53.00 80.00	52.00	66.00	55.17	36.36
Artemisia tridentata	33.00 67.00	22.00 7.00	72.00 7.00	2.00 11.00	27.00 32.00	12.00 30.00	18.00 6.00	27.00 110.00	7.00	18.00	28.22	27.38
Chrysothamnus nauseosus	0.00 1.00	3.00 6.00	2.00 0.00	3.00 3.00	3.00 1.00	3.00 0.00	0.00 0.00	0.00 0.00	4.00	5.00	1.89	1.88
Chrysothamnus viscidiflorus	4.00 7.00	22.00 11.00	31.00 4.00	0.00 11.00	14.00 23.00	5.00 0.00	3.00 0.00	0.00 5.00	2.00	5.00	8.17	8.76
Purshia tridentata	0.00 0.00	3.00 0.00	5.00 5.00	0.00 0.00	16.00 0.00	16.00 4.00	0.00 0.00	0.00 0.00	6.00	0.00	3.06	5.03
Ribes americanum	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	9.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00	0.00	0.90	2.70
Symphoricarpos albus	0.00 48.00	68.00 17.00	71.00 2.00	0.00 51.00	33.00 3.00	5.00 6.00	4.00 3.00	10.00 4.00	12.00	22.00	19.94	23.13
Symphoricarpos oreophilus	0.00 0.00	0.00 0.00	0.00 0.00	1.00 0.00	0.00 0.00	3.00 0.00	1.00 0.00	0.00 0.00	4.00	14.00	0.10	0.30
Tetradymia canescens	0.00 9.00	0.00 23.00	0.00 0.00	0.00 3.00	10.00 15.00	13.00 5.00	0.00 0.00	0.00 0.00	0.00	2.00	6.00	7.64
HECTAR 28833.33												

Table 21. Upland Grass Reference Shrub Density Data Summary.

Project Name : PRI GAS HILLS  
Vegetation Type : Uplandgrass  
Area Name : Reference  
Vegetation Parameter : Shrub Density  
Number of Plots : 15

CATEGORY/SPECIES	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
	11	12	13	14	15							
TOTAL DENSITY	432.00 366.00	353.00 328.00	379.00 306.00	358.00 245.00	336.00 384.00	440.00	408.00	557.00	477.00	449.00	387.87	73.68
HALF/SEMI-SHRUBS												
Artemisia pedatifida	305.00 339.00	253.00 301.00	264.00 266.00	251.00 238.00	233.00 359.00	342.00	344.00	419.00	383.00	333.00	308.67	54.85
Ceratoides lanata	125.00 7.00	97.00 0.00	107.00 4.00	97.00 0.00	90.00 3.00	90.00	44.00	135.00	94.00	116.00	67.27	49.50
Leptodactylon pungens	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 1.00	0.00	0.00	0.00	0.00	0.00	0.07	0.25
FULL SHRUBS												
Artemisia nova	0.00 0.00	0.00 0.00	0.00 4.00	0.00 0.00	0.00 0.00	0.00	0.00	0.00	0.00	0.00	0.27	1.00
Artemisia tridentata	2.00 20.00	3.00 27.00	8.00 32.00	10.00 7.00	13.00 21.00	8.00	20.00	3.00	0.00	0.00	11.60	9.81

HECTAR 77573.3

Table 22. Sample Adequacy of Derived Data.

SAMPLED AREA	MEAN	STANDARD DEVIATION	SAMPLE ADEQUACY	Z VALUE	ACTUAL SAMPLE	CONFIDENCE LEVEL ACHIEVED
AFFECTED						
Big Sage						
VEGETATION CO	63.40	8.78	6.28	N/A	20.00	N/A
TOTAL COVER	77.20	10.43	5.98	N/A	20.00	N/A
Mixed Shrub Grassland						
VEGETATION CO	55.30	7.44	5.92	N/A	20.00	N/A
TOTAL COVER	75.00	8.30	4.01	N/A	20.00	N/A
Rough Breaks East						
VEGETATION CO	49.00	6.73	6.18	N/A	20.00	N/A
TOTAL COVER	73.50	11.95	8.65	N/A	20.00	N/A
Rough Breaks West						
VEGETATION CO	38.10	7.15	11.55	N/A	20.00	N/A
TOTAL COVER	60.70	12.02	12.85	N/A	20.00	N/A
Upland Grass						
VEGETATION CO	51.00	10.59	14.14	N/A	20.00	N/A
TOTAL COVER	71.80	9.56	5.80	N/A	20.00	N/A
REFERENCE						
Big Sage						
VEGETATION CO	55.38	11.17	13.32	N/A	16.00	N/A
TOTAL COVER	82.00	10.04	4.91	N/A	16.00	N/A
Mixed Shrub Grassland						
VEGETATION CO	46.27	6.18	5.85	N/A	15.00	N/A
TOTAL COVER	80.27	8.24	3.45	N/A	15.00	N/A
Rough Breaks East						
VEGETATION CO	46.11	10.32	16.40	N/A	19.00	N/A
TOTAL COVER	76.74	13.99	10.89	N/A	19.00	N/A
Rough Breaks West						
VEGETATION CO	40.78	9.58	18.00	N/A	18.00	N/A
TOTAL COVER	64.67	10.95	9.40	N/A	18.00	N/A
Upland Grass						
VEGETATION CO	41.47	5.78	6.37	N/A	15.00	N/A
TOTAL COVER	67.60	12.54	11.28	N/A	15.00	N/A

NOTE: File: ADEQUACY.WE3

Table 23. Derived t-Test Values.

SAMPLED AREA	MEAN	STANDARD DEVIATION	VALUE OF t	DEGREES OF FREEDOM	t TABLE VALUE
VEGETATION COVER					
BIG SAGE					
AFFECTED	63.40	8.78	2.42	34.00	1.697
REFERENCE	55.38	11.17			
MIXED SHRUB GRASSLAND					
AFFECTED	55.30	7.44	3.82	33.00	1.697
REFERENCE	46.27	6.18			
ROUGH BREAKS EAST					
AFFECTED	49.00	6.73	1.04	37.00	1.697
REFERENCE	46.11	10.32			
ROUGH BREAKS WEST					
AFFECTED	38.10	7.15	-0.98	35.00	1.697
REFERENCE	40.78	9.58			
UPLAND GRASS					
AFFECTED	51.00	10.59	3.15	33.00	1.697
REFERENCE	41.47	5.78			
TOTAL COVER					
BIG SAGE					
AFFECTED	77.20	10.43	-1.40	34.00	1.697
REFERENCE	82.00	10.04			
MIXED SHRUB GRASSLAND					
AFFECTED	75.00	8.30	-1.86	33.00	1.697
REFERENCE	80.27	8.24			
ROUGH BREAKS EAST					
AFFECTED	73.50	11.95	-0.78	37.00	1.697
REFERENCE	76.74	13.99			
ROUGH BREAKS WEST					
AFFECTED	60.70	12.02	-1.06	35.00	1.697
REFERENCE	64.67	10.95			
UPLAND GRASS					
AFFECTED	71.80	9.56	1.13	33.00	1.697
REFERENCE	67.60	12.54			

\*NOTE: Derived t-Test values were calculated by RIMA, version 2 for a two-tailed test.

Table 24. 1997 Shrub Density Summary.

Area	Shrub Density		
	(# / sq.m)	(#/acre)	(#/hectare)
Affected			
Big Sage	170.30	15,481.8	34,060.0
Mixed Shrub Grassland	168.05	15,277.3	33,610.0
Rough Breaks East	158.65	14,422.7	31,730.0
Rough Breaks West	85.25	7,750.0	17,050.0
Upland Grass	203.20	18,472.7	40,640.0
Reference			
Big Sage	132.19	12,017.0	26,437.5
Mixed Shrub Grassland	186.13	16,921.2	37,226.7
Rough Breaks East	136.42	12,401.9	27,284.2
Rough Breaks West	144.17	13,106.4	28,833.3
Upland Grass	387.87	35,260.6	77,573.3

Table 25. Comparison of 1997 Major Vegetative Parameters.

Area	Sample Parameter	
	Total Veg (% Absolute)	Total Cover (% Absolute)
<b>Affected</b>		
Big Sage	63.40	77.20
Mixed Shrub Grassland	55.30	75.00
Rough Breaks East	49.00	73.50
Rough Breaks West	38.10	60.70
Upland Grass	51.00	71.80
<b>Reference</b>		
Big Sage	55.88	83.25
Mixed Shrub Grassland	50.13	80.27
Rough Breaks East	46.11	76.74
Rough Breaks West	40.78	64.67
Upland Grass	44.13	67.60

Table 26. Comparison of Absolute Cover Data between Areas.

Area	Total Veg Cover	Litter/ Rock	Bare Ground	Total Cover
<b>Affected</b>				
Big Sage	63.40	22.80	13.80	77.20
Mixed Shrub Grassland	55.30	24.90	19.80	75.00
Rough Breaks East	49.00	24.30	26.70	73.50
Rough Breaks West	38.10	22.60	39.30	60.70
Upland Grass	51.00	20.40	28.20	71.80
<b>Reference</b>				
Big Sage	55.88	27.38	16.75	83.25
Mixed Shrub Grassland	50.13	30.13	19.73	80.27
Rough Breaks East	46.11	30.42	23.26	76.74
Rough Breaks West	40.78	23.89	35.33	64.67
Upland Grass	44.13	22.93	32.93	67.60



**Table 27. Comparison of Relative Vegetation Cover Data, by Lifeform, between Areas.**

<b>Area</b>	<b>Annual Grasses</b>	<b>Perennial+ Grasses</b>	<b>Annual* Forbs</b>	<b>Perennial Forbs</b>	<b>Shrubs**</b>	<b>Cacti &amp; Succulents</b>
<b>Affected</b>						
Big Sage	0.00	29.20	0.20	3.91	29.90	0.20
Mixed Shrub Grassland	0.00	32.45	0.00	3.80	18.40	0.00
Rough Breaks East	0.00	29.66	0.00	6.00	13.60	0.00
Rough Breaks West	0.00	18.90	0.10	7.20	11.55	0.10
Upland Grass	0.00	33.60	0.00	3.45	13.00	0.20
<b>Reference</b>						
Big Sage	0.00	23.89	0.38	2.25	28.38	0.38
Mixed Shrub Grassland	0.00	29.20	0.00	2.93	13.60	0.00
Rough Breaks East	0.00	20.21	0.21	6.40	17.48	0.11
Rough Breaks West	0.00	15.22	0.11	7.79	17.78	0.00
Upland Grass	0.00	27.2	0.00	2.93	11.20	0.00

+Includes cool season, warm season, and introduced grasses

\*Includes annual and biennial forbs.

\*\*Includes semi or half, and full shrubs.

Table 28. List of Species Encountered during 1992 and 1997 Sampling

COOL SEASON PERENNIAL GRASSES

Aciacu	<i>Scirpus acutus</i>	Tule Bulrush
Agrdas	<i>Agropyron dasystachyum</i>	Thickspike Wheatgrass
Agrsmi	<i>Agropyron smithii</i>	Western Wheatgrass
Agrspi	<i>Agropyron spicatum</i>	Bluebunch Wheatgrass
Agtra	<i>Agropyron trachycantum</i>	Slender Wheatgrass
Cal spp	<i>Calamagrostis spp.</i>	Reedgrass
Carfil	<i>Carex filifolia</i>	Threadleaf Sedge
Carneb	<i>Carex nebraskensis</i>	Nebraska Sedge
Carspp	<i>Carex spp.</i>	Sedge
Carste	<i>Carex stenophylla</i>	Sedge
Descae	<i>Deschampsia caespitosa</i>	Tufted hairgrass
Disspi	<i>Distichlis spicata</i>	Seashore saltgrass
Elepal	<i>Eleocharis palustris</i>	Creeping Spikerush
Elycin	<i>Elymus cinereus</i>	Basin Wildrye
Elyjun	<i>Elymus junceus</i>	Russian Wildrye
Elymsp	<i>Elymus sp.</i>	Wildrye
Equarv	<i>Equisetum arvense</i>	Field Horsetail
Fesida	<i>Festuca idahoensis</i>	Bluebunch Fescue
Horbra	<i>Hordeum brachyantherum</i>	Meadow Barley
Horjub	<i>Hordeum jubatum</i>	Foxtail Barley
Junbal	<i>Juncus balticus</i>	Baltic Rush
Junspp	<i>Juncus spp.</i>	Rush
Juntor	<i>Juncus torreyi</i>	Torrey Rush
Koemac	<i>Koeleria macrantha</i>	Prairie Junegrass
Muhlsp	<i>Muhlenbergia sp.</i>	Muhly
Oryhym	<i>Oryzopsis hymenoides</i>	Indian Ricegrass
Phlpra	<i>Phleum pratense</i>	Common Timothy
Poaamp	<i>Poa ampla</i>	Big Bluegrass
Poacan	<i>Poa canbyi</i>	Canby Bluegrass
Poacom	<i>Poa compressa</i>	Canada Bluegrass
Poacus	<i>Poa cusickii</i>	Cusick Bluegrass
Poajun	<i>Poa juncifolia</i>	Big Bluegrass
Poapra	<i>Poa pratensis</i>	Kentucky Bluegrass
Poasan	<i>Poa sandbergii</i>	Sandberg Bluegrass
Pucnut	<i>Puccinellia nuttalliana</i>	Nuttalls Alkaligrass
Scipun	<i>Scirpus pungens</i>	Bulrush
Sithys	<i>Sitanion hystrix</i>	Bottlebrush Squirreltail
Spagra	<i>Spartina gracilis</i>	Alkali Cordgrass
Sticom	<i>Stipa comata</i>	Needleandthread
Stivir	<i>Stipa viridula</i>	Green Needlegrass

Typlat

*Typha latifolia*

Common Cattail

## WARM SEASON PERENNIAL GRASSES

Aripur

*Aristida purpurea*

Red Three Awn

Arissp

*Aristida* sp.

Three Awn

Bougra

*Bouteloua gracilis*

Blue Grama

Bouhir

*Bouteloua hirsuta*

Hairy Grama

Spoair

*Sporobolus airoides*

Alkali Sacaton

## INTRODUCED PERENNIAL GRASSES

Agrcri

*Agropyron cristatum*

Crested Wheatgrass

Broine

*Bromus inermis*

Smooth Brome

## ANNUAL GRASSES

Brojap

*Bromus japonicus*

Japanese Chess Brome

Brotec

*Bromus tectorum*

Cheatgrass Brome

## PERENNIAL FORBS

Achmil

*Achillea millefolium*

Yarrow

Alttx

*Allium textile*

Prairie Onion

Amsisp

*Amsinckia* sp.

Fiddleneck

Antdim

*Antennaria dimorpha*

Low Pussy Toes

Antesp

*Antennaria* sp.

Pussy Toes

Antmic

*Antennaria microphyllum*

Pink Pussy Toes

Antpar

*Antennaria parvifolia*

Smallleaf Pussy Toes

Apocan

*Apocynum cannabinum*

Hemp Dogbane

Arahol

*Arabis holboellii*

Holboell Rockcress

Arecon

*Arenaria congesta*

Ballhead Sandwort

Arehoo

*Arenaria hookeri*

Hooker Sandwort

Ascspe

*Asclepias speciosa*

Showy Milkvetch

Astsp.

*Asteraceae* species

Unknown Aster Family

Astersp.

*Aster* sp.

Aster

Astasc

*Aster ascendens*

Creeping Aster

Astarg

*Astragalus argophyllus*

Silverleafed Milkvetch

Astbis

*Astragalus bisulcatus*

Two-grooved Milkvetch

Astcic

*Astragalus cicer*

Cicer Milkvetch

Astdru

*Astragalus drummondii*

Drummond Milkvetch

PERENNIAL FORBS (cont.)

Astlen	<i>Astragalus lentiginosus</i>	Freckled Milkvetch
Astmis	<i>Astragalus miser</i>	Weedy Milkvetch
Astpur	<i>Astragalus purshii</i>	Pursh Milkvetch
Astrsp	<i>Astragalus</i> sp.	Milkvetch
Astspa	<i>Astragalus spatulatus</i>	Spoonleaf Milkvetch
Balinc	<i>Balsamorhiza incana</i>	Hoary Balsamroot
Calnut	<i>Calochortus nuttallii</i>	Sego Mariposa Lily
Carnut	<i>Carduus nutans</i>	Musk Thistle
Carpub	<i>Cardaria pubescens</i>	Hairy Whitetop
Caschr	<i>Castilleja chromosa</i>	Desert Indian Paintbrush
Casses	<i>Castilleja sessiliflora</i>	Largeflowered Indian Paintbrush
Casspp	<i>Castilleja</i> spp.	Indian Paintbrush
Cerarv	<i>Cerastium arvense</i>	Field Chickweed
Chadou	<i>Chaenactis douglasii</i>	Douglas Dustymaiden
Circan	<i>Cirsium canescens</i>	Platte Thistle
Cirsp.	<i>Cirsium</i> sp.	Thistle
Cirund	<i>Cirsium undulatum</i>	Wavyleaf Thistle
Cirvul	<i>Cirsium vulgare</i>	Bull Thistle
Cleser	<i>Cleome serrulata</i>	Rocky Mountain Bee Plant
Comumb	<i>Comandra umbellata</i>	Bastard Toad-flax
Conarv	<i>Convolvulus arvensis</i>	Field Bindweed
Creacu	<i>Crepis acuminata</i>	Tapertip Hawksbeard
Cremod	<i>Crepis modocensis</i>	Yellow Hawksbeard
Crysp.	<i>Cryptantha</i> spp.	Cryptantha
Crybra	<i>Cryptantha bradburiana</i>	Minerscandle Cryptantha
Crycel	<i>Cryptantha celosiodes</i>	Northern Cryptantha
Cryfla	<i>Cryptantha flavoculata</i>	Roughseed Cryptantha
Dalcan	<i>Dalea candida</i>	White Prairie-clover
Dalpur	<i>Dalea purpurea</i>	Purple Prairieclover
Delnut	<i>Delphinium nuttalianum</i>	Nuttall Larkspur
Dodpul	<i>Dodecatheon pulchellum</i>	Dark-Throat Shooting Star
Erigeron sp.	<i>Erigeron</i> sp.	Daisy Fleabane
Ericae	<i>Erigeron caespitosus</i>	Tufted Fleabane
Erioch	<i>Erigeron ochroleucus</i>	Fleabane
Eripum	<i>Erigeron pumilus</i>	Low Fleabane
Eriospp	<i>Eriogonum</i> sp.	Wild Buckwheat
Ericae	<i>Eriogonum caespitosum</i>	Mat Wild Buckwheat
Erifla	<i>Eriogonum flavum</i>	Yellow Wild Buckwheat
Eriova	<i>Eriogonum ovalifolium</i>	Oval-leaf Wild Buckwheat
Eriumb	<i>Eriogonum umbellatum</i>	Sulfur Wild Buckwheat
Eryasp	<i>Erysimum asperum</i>	Plains Wallflower
Gaucoc	<i>Gaura coccinea</i>	Scarlet Gaura
Geutri	<i>Geum triflorum</i>	Prairie Smoke

PERENNIAL FORBS (cont.)

Glylep	<i>Glycyrrhiza lepidota</i>	American Licorice
Grisqu	<i>Grindelia squarrosa</i>	Curlcup Gumweed
Gypssp	<i>Gypsophila</i> sp.	Baby's Breath
Hapaca	<i>Haplopappus acaulis</i>	Stemless Goldenweed
Hapmul	<i>Haplopappus multicaulis</i>	Multistem Goldenweed
Hetvil	<i>Heterotheca villosa</i>	Hairy Goldenaster
Hydcap	<i>Hydrophyllum capitatum</i>	Ballhead Waterleaf
Hymfil	<i>Hymenopappus filifolius</i>	Fineleaf Hymenopappus
Hymaca	<i>Hymenoxys acaulis</i>	Stemless Hymenoxys
Hyonig	<i>Hymocyanus niger</i>	Black Henbane
Lesalp	<i>Lesquerella alpina</i>	Alpine Bladderpod
Lesare	<i>Lesquerella arenosa</i>	Sand Bladderpod
Lewred	<i>Lewisia rediviva</i>	Bitterroot Lewisia
Linlew	<i>Linum lewisii</i>	Common Blue Flax
Linusp	<i>Linum</i> sp.	Flax
Litinc	<i>Lithospermum incisum</i>	Narrowleaf Gromwell
Lomnut	<i>Lomatium nuttallii</i>	Nuttall Lomatium
Lomtri	<i>Lomatium triternatum</i>	Nineleaf Lomatium
Lomasp	<i>Lomatium</i> sp.	Biscuitroot
Luparg	<i>Lupinus argenteus</i>	Silvery Lupine
Lupisp	<i>Lupinus</i> sp.	Lupine
Lupwye	<i>Lupinus wyethii</i>	Wyeth Lupine
Lyggra	<i>Lygodesmia grandiflora</i>	Largeflowered Skeleton Weed
Maccan	<i>Machaeranthera canescens</i>	Hoary Aster
Macgri	<i>Machaeranthera grindelioides</i>	Shinners
Medsat	<i>Medicago sativa</i>	Alfalfa
Meloff	<i>Melilotus officinalis</i>	Yellow Sweet Clover
Merobl	<i>Mertensia oblongifolia</i>	Oblongleaf Bluebells
Oencae	<i>Oenothera caespitosa</i>	Tufted Evening Primrose
Oenpal	<i>Oenothera pallida</i>	Pale Evening Primrose
Onovic	<i>Onobrychis viciaefolia</i>	Common Sainfoin
Orofas	<i>Orobancha fasciculata</i>	Purple Broomrape
Oxycam	<i>Oxytropis campestris</i>	Plains Locoweed
Oxynan	<i>Oxytropis nana</i>	Dwarf Locoweed
Oxyser	<i>Oxytropis sericea</i>	Silky Loco
Oxytsp	<i>Oxytropis</i> sp.	Locoweed
Parses	<i>Paronychia sessiliflora</i>	Stemless Nailwort
Peneri	<i>Penstemon eriantherus</i>	Fussytongue Penstemon
Penhum	<i>Penstemon humilis</i>	Low Penstemon
Penlar	<i>Penstemon laricifolius</i>	Larchleaf Penstemon
Penpay	<i>Penstemon paysoniorum</i>	Payson Penstemon
Pen sp	<i>Penstemon</i> sp.	Penstemon
Phlhoo	<i>Phlox hoodii</i>	Hoods Phlox

PERENNIAL FORBS (cont.)

Phllon	<i>Phlox longifolia</i>	Longleaf Phlox
Phlmul	<i>Phlox multiflora</i>	Flowery Phlox
Phlmus	<i>Phlox muscoides</i>	Flowery Phlox
Phl sp.	<i>Phlox sp.</i>	Phlox
Phydid	<i>Physaria didymocarpa</i>	Twinpod
Plaint	<i>Platyschekuhria integrifolia</i>	Platyschekuhria
Potcon	<i>Potentilla concinna</i>	Elegant Cinquefoil
Potovi	<i>Potentilla ovina</i>	Cinque Foil
Potpen	<i>Potentilla pensylvanica</i>	Pennsylvania Cinquefoil
Psoarg	<i>Psoralea argophylla</i>	Silver-leaf Scurfspea
Psoten	<i>Psoralea tenuiflora</i>	Slimflower Scurfspea
Rancym	<i>Ranunculus cymbalaria</i>	Shore Buttercup
Rumcri	<i>Rumex crispus</i>	Curley Dock
Rumsal	<i>Rumex salicifolius</i>	Willowleaf Dock
Sencan	<i>Senecio canus</i>	Wooly Groundsel
Senint	<i>Senecio integerrimus</i>	Lambstongue Groundsel
Sphcoc	<i>Sphaeralcea coccinea</i>	Scarlet Globemallow
Ratcol	<i>Ratibida columnaris</i>	Prairie Coneflower
Rosasp	<i>Rosaceae sp.</i>	Unknown Rose family
Sedusp	<i>Sedum sp.</i>	Stonecrop
Solisp	<i>Solidago sp.</i>	Goldenrod
Taroff	<i>Taraxacum officinale</i>	Common Dandelion
Therho	<i>Thermopsis rhombifolia</i>	Prairie Thermopsis
Towhoo	<i>Townsendia hookeri</i>	Hooker Daisy
Towinc	<i>Townsendia incana</i>	Hoary Daisy
Towspa	<i>Townsendia spathulata</i>	Easter Daisy
Tradub	<i>Tragopogon dubius</i>	Yellow Salsify
Trigym	<i>Trifolium gymnocarpon</i>	Hollyleaf Clover
Vicame	<i>Vicia americana</i>	American Vetch
Vioval	<i>Viola vallicola</i>	Valley Yellow Violet
Xylgla	<i>Xylorhiza glabriuscula</i>	Woody Aster
Zigven	<i>Zigadenus venenosus</i>	Meadow Death Camas

ANNUAL AND BIENNIAL FORBS

Alyaly	<i>Alyssum alyssoides</i>	Pale Alyssum
Amabli	<i>Amaranthus blitoides</i>	Prostrate Pigweed
Atrsuc	<i>Atriplex suckleyi</i>	Scurfless Saltbush
Chespp	<i>Chenopodium spp.</i>	Goosefoot
Choten	<i>Chorispora tenella</i>	Little Blue Mustard
Corram	<i>Cordylanthus ramosus</i>	Bushy Bird Beak
Despin	<i>Descurainia pinnata</i>	Pinnate Tansymustard
Halglo	<i>Halogeton glomeratus</i>	Halogeton

## ANNUAL AND BIENNIAL FORBS (cont.)

Kocsco	<i>Kochia scoparia</i>	Fireweed
Lapred	<i>Lappula redowskii</i>	Bluebur Stickseed
Lepden	<i>Lepidium densiflorum</i>	Prairie Pepperweed
Lepper	<i>Lepidium perfoliatum</i>	Clasping Pepperweed
Ortlut	<i>Orthocarpus luteus</i>	Yellow Owl Clover
Plapat	<i>Plantago patagonica</i>	Woolly Plantain
Polavi	<i>Polygonum aviculare</i>	Prostrate Knotweed
Salkal	<i>Salsola kali</i>	Russian Thistle
Sedlan	<i>Sedum lanceolatum</i>	Lanceleaf Stonecrop
Sisalt	<i>Sisymbrium altissimum</i>	Tumbling Hedgemustard
Stesal	<i>Stenogonum salsuginosum</i>	Stenogonum
Thlarv	<i>Thlaspi arvense</i>	Field Pennycress

## SEMI-SHRUBS OR HALF-SHRUBS

Artfri	<i>Artemisia frigida</i>	Fringed Sagewort
Artped	<i>Artemisia pedatifida</i>	Birdfoot Sagewort
Artspi	<i>Artemisia spinescens</i>	Bud Sagewort
Atrgar	<i>Atriplex gardneri</i>	Gardner Saltbush
Cerlan	<i>Ceratoides lanata</i>	Winterfat
Eribe	<i>Eriogonum brevicaulis</i>	Shortstem Wild Buckwheat
Erimic	<i>Eriogonum microthecum</i>	Slenderbush Wild Buckwheat
Gutsar	<i>Gutierrezia sarothrae</i>	Broom Snakeweed
Leppun	<i>Leptodactylon pungens</i>	Prickly Gilia
Sanmin	<i>Sanguisorba minor</i>	Small Burnet
Sphcap	<i>Sphaeromeria capitata</i>	False Sagebrush
Yucgla	<i>Yucca glauca</i>	Yucca

## SHRUBS

Amealn	<i>Amelanchier alnifolia</i>	Saskatoon Serviceberry
Artarb	<i>Artemisia arbuscula</i>	Low Sagebrush
Artcan	<i>Artemisia cana</i>	Silver Sagebrush
Artnov	<i>Artemisia nova</i>	Black Sagebrush
Arttri	<i>Artemisia tridentata</i>	Wyoming Big Sagebrush
Atrcan	<i>Atriplex canescens</i>	Fourwing Saltbush
Atrcon	<i>Atriplex confertifolia</i>	Shadscale Saltbush
Chrnau	<i>Chrysothamnus nauseosus</i>	Rubber Rabbitbrush
Chrvis	<i>Chrysothamnus viscidiflorus</i>	Green Rabbitbrush
Purtri	<i>Purshia tridentata</i>	Antelope Bitterbrush
Rhutri	<i>Rhus trilobata</i>	Skunkbush Sumac
Ribcer	<i>Ribes cereum</i>	Wax Currant
Robisp	<i>Robinia sp.</i>	Locust

## SHRUBS (cont.)

Roswoo	<i>Rosa woodsii</i>	Wild Rose
Salexi	<i>Salix exigua</i>	Coyote Willow
Salisp	<i>Salix</i> sp.	Willow
Sarver	<i>Sarcobatus vermiculatus</i>	Black Greasewood
Symalb	<i>Symphoricarpos albus</i>	Common Snowberry
Symocc	<i>Symphoricarpos occidentalis</i>	Western Snowberry
Symore	<i>Symphoricarpos oreophilus</i>	Roundleaf Snowberry
Tamchi	<i>Tamarix chinensis</i>	Tamarisk
Tetcan	<i>Tetradymia canescens</i>	Grey Horsebrush

## CACTI AND SUCCULENTS

Opupol	<i>Opuntia polyacantha</i>	Prickly Pear
Pedsim	<i>Pediocactus simsonii</i>	Barrel Cactus

## MOSS AND LICHENS

Moss  
Lichens

## TREES

Juncom	<i>Juniperus communis</i>	Prostrate Juniper
Junsco	<i>Juniperus scopulorum</i>	Rocky Mountain Juniper
Pinfle	<i>Pinus flexilis</i>	Limber Pine
Popang	<i>Populus angustifolia</i>	Narrowleaf Cottonwood
Poptre	<i>Populus tremuloides</i>	Aspen



# **ADDENDUM D8-1 CORRESPONDENCE**



**BKS ENVIRONMENTAL  
ASSOCIATES, INC.**

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**FILE COPY**

March 31, 1997

Mr. Jack Smith  
WDEQ-LQD  
250 Lincoln  
Lander, WY 82520

Dear Jack:

Per the December 13, 1996 BKS correspondence and your subsequent reply December 27, attached is the revised proposed vegetation methodology for the fieldwork associated with the vegetation responses for the PRI Gas Hills Project. This current revision incorporates changes based on your December 27 memo. The following are the two main outstanding issues for sampling in 1997:

- 1) Whether production is still not necessary, as discussed last fall;  
and,
- 2) Whether the western area should be sampled separately from the eastern area, i.e., REFA only or AFFA/REFA.

I would appreciate any "short turn-around" comments you may have by approximately April 15 since we are formulating spring/summer 1997 fieldwork plans. Thank you for your input. If you have any questions, please feel free to contact me in Laramie at (307)721-5179.

Sincerely,

Brenda K. Schladweiler  
BKS ENVIRONMENTAL ASSOCIATES, INC.

cc. Paul Hildebrand, PRI  
Doug Beahm, BRS

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
March 31, 1997**

**General**

Preliminary baseline vegetation mapping and initial cover sampling of the Power Resources, Inc. (PRI) Gas Hills Project was conducted between 1992 and 1994. Based on WDEQ completeness review comments dated July, 1996, the following proposed vegetation sampling methodology is designed to enhance or replace the current permit vegetation information. The previously collected data will not be resubmitted since no corresponding reference area data was provided. BKS Environmental Associates, Inc. will conduct the 1997 sampling.

**Mapping**

All vegetation community types, including disturbed and reclaimed areas, were originally delineated on a topographic base map at a scale of 1"=1000'. This original mapping was used as a basis for remapping the area on a 1"=500' photo base map during the Fall, 1996. Disturbed and reclaimed areas were more easily visible on the photographic base map. Defined areas were field checked during remapping in Fall, 1996. Small areas will be refined during cover sampling in 1997, if necessary.

A tabular summary of the acreage of each vegetation mapping unit to be disturbed by mining is outlined in the attached Table D8-1, as part of the current permit submittal.

**Species List**

A species list for the 1997 study area, based on the 1992-1994 and 1997 assessments, will be compiled. All nomenclature will follow that currently in use at the Rocky Mountain Herbarium in Laramie, Wyoming. Any encountered federally designated threatened and endangered species, state plants of concern, noxious weeds, and primary selenium indicators will be identified. A computer search of the Wyoming Natural Heritage database will be conducted prior to fieldwork to determine possible habitat for rare species previously located near the Beaver Rim. Since rare plants have been found in the Beaver Rim area of Wyoming, potential habitat within the study area will be surveyed during the 1997 fieldwork to determine existence of any rare plant individuals.

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
March 31, 1997 (cont.)**

**Reference Area (s)**

During the 1992-1994 vegetation assessments, no reference or control areas were established. During the 1997 assessment, reference areas were selected based on the WDEQ site visit on October 4, 1996, and operational constraints, i.e., at least 500 feet outside the mine units. Therefore, the proposed reference areas (REFA's) for Mine Units 1, 2, 4 and 5 are outlined for the following vegetation types:

- 1) MIXED SHRUB GRASSLAND AND ROUGH BREAKS  
Variable Shaped Area within N 1/2 Section 6 T32N R89W
- 2) MIXED SHRUB GRASSLAND, BOTTOMLAND SAGEBRUSH,  
UPLAND GRASSLAND  
Section 29 T33N R89W north and west of a 500 foot buffer around Mine Unit 2  
(area outside current permit boundary is included in Permit 438)

The extent and location of these REFA's may differ slightly from what was discussed in the field October 4, 1996 due to a reduction in overall permit acreage by PRI. Summarization of each reference area will be separated by vegetation type, e.g., in REFA 1, RB points will be summarized separately from MSG. In REFA 2, BS and UG points will be summarized separately. However, MSG points will be summarized in REFA 1 and REFA 2 collectively as one.

Mine Unit 3 is located in highly different topography and existing condition from the remaining mine units in the eastern portion of the permit area. Inclusion of this area in the random affected area and REFA sampling for the eastern portions may bias the sampling effort and/or result in unusually high sample adequacy numbers. As a result, a possible separate REFA for all vegetation types in the E 1/2 SW 1/4 Section 2, E 1/2 E 1/2 Section 11 T33N R90W (up to the flat top of the Beaver Rim), and S 1/2 NW 1/4 Section 12 T33N R90W (up to the flat top of the Beaver Rim) for the western portion of the permit area, i.e., Mine Unit 3, may be selected. If a separate REFA is used for Mine Unit 3, sampling and summarization would be separate from the 1997 sampling in the eastern portion. It appears that Mine Unit 3, according to the current mining schedule, will not go into an exploration phase until 1999.

Some reclaimed areas will be reaffected during mining operations. However, reference areas for these areas will not be established. Instead, a cover and production standard will be proposed, based on consultation with the WDEQ, when those areas are scheduled to be affected based on the operational plan. The vegetation map, however, will indicate when a specific reclaimed area was reseeded and under which program or applicable permit. The originally submitted data on the UPZ and Buss-Cap/Bengal reclaimed areas will not be resubmitted.

**1997 Vegetation Sampling Methodology**  
**Power Resources, Inc., Gas Hills Project**  
**March 31, 1997 (cont.)**

**Qualitative Description**

All disturbed areas within the 1997 study area and reference area (s) will be qualitatively described. Due to the difference in growth medium and potential for reclamation success, reclaimed areas in the eastern portion of the study area will be described separately from the reclaimed areas in the western portion. Previously delineated Badlands has been combined with Rough Breaks on the vegetation map and for sampling purposes.

Possible "wetland" vegetation types will be delineated on the vegetation map, wherever located. Small, unmappable pockets at the current map scale within ephemeral drainages will be described in the text only. However, these areas will not be included in any vegetation sampling since the permit document will state that these areas will be avoided in the operational plan.

**Quantitative Description**

Four vegetation types will be sampled within the 1997 study area. Bottomland Sagebrush, Mixed Sagebrush-Grassland, Rough Breaks, and Upland Grassland. Both the reference area(s) and study or affected area will be sampled in 1997, and the representative nature of the reference area vegetation type to the affected area type will be determined. Minimum and maximum sample numbers for this project will follow WDEQ Guideline 2.

**Cover**

A minimum of 20 transects for cover will be sampled within each vegetation type within the affected area. A minimum of 15 transects for cover will be sampled within each vegetation type within the reference area. If statistical adequacy is not obtained, as defined in WDEQ Guideline 2 with the minimum number, additional samples will be collected in increments up to the maximum number of 50, if necessary. All field sampling for cover will occur after June 15, 1997, depending upon overall weather conditions.

Sample locations for cover will be chosen by randomly selecting points within a grid of the 1997 affected area or reference area, respectively. Grid intervals will not exceed 100 feet on the ground. Random sample location coordinates will be plotted on a map and located in the field by pacing from known localities. Random numbers between 1 and 360 will be generated to orient the transect. A compass will then be used in the field to orient the transect to the nearest 1/8 of 360 degrees.

**1997 Vegetation Sampling Methodology**  
**Power Resources, Inc., Gas Hills Project**  
**March 31, 1997 (cont.)**

**Cover (cont.)**

Sample hits will be read at 1 meter intervals along the entire length of the 50 meter transect. These first hit (50) readings will constitute the absolute cover values for total vegetation and total cover. In addition, litter, rock and bare ground percentages will be recorded. Transects that exceed designated vegetation boundaries will be randomly reoriented to be within the sampled type.

**Production**

No production sampling will be necessary for the 1997 baseline vegetation assessment.

**Shrub Density**

Even though shrub density sampling is not required for non-coal sites, this data will be taken at the time of cover sampling to ensure adequate use of field time. Summarization of that data, however, may not be included in the report submittal for the permit. It is assumed that this area is not part of any wildlife critical winter range; thus, shrub density information is not necessary.

Shrub density data will be collected in conjunction with randomly selected cover transects, wherever possible. All shrubs, full or half, will be counted within 50 centimeters either side of the 50 meter cover transect (1 meter x 50 meter belt transect). Sample adequacy will not be calculated on shrub density transects; the number of belt transects will equal the number of cover transects for a given vegetation type. No shrub height measurements will be collected.

**Tree Density**

Due to the general sparsity or lack of tree individuals within the study area, a complete census will be taken, where appropriate. The exception of this may include the willow individuals within West Canyon Creek or juniper on the side slopes within Rough Breaks; willows will likely be described as a clumped group rather than individuals. Tree height will be determined by use of a clinometer, where appropriate. Tree diameter at breast height will be determined by a diameter tape, where appropriate. All tree locations (individuals or groups) within the study area will be plotted on the vegetation map.

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
March 31, 1997 (cont.)**

**This vegetation sampling methodology correctly documents previous discussion as stated above and is hereby approved.**

---

Jack Smith  
WDEQ, Land Quality Division



THE STATE

OF WYOMING

JIM GERINGER  
GOVERNOR

## Department of Environmental Quality

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ABANDONED MINES  
(307) 332-5085AIR QUALITY  
(307) 332-6755LAND QUALITY  
(307) 332-3047SOLID & HAZARDOUS WASTE  
(307) 332-6924WATER QUALITY  
(307) 332-3144

April 11, 1997

Ms. Brenda K. Schladweiler  
BKS Environmental Associates, Inc.  
P.O. Box 6021  
Laramie, WY 82070-6021

**RE: Power Resources, Inc. Vegetation Sampling Methodology (TFN 3 5/93)**

Dear Brenda,

I have read your March 31, 1997 letter concerning proposed vegetation sampling methodology. I will address your two questions first, then present one comment.. I am sorry that I can not give you one or two word answers to those questions, but only the data you collect can provide you those answers - and those data may force you to make several "mid-stream" changes during your vegetation sampling program.

The first question deals with the collection of vegetation production data from affected and extended reference area lands. Production data are not necessary in the baseline data collection phase if PRI is committed to using a reference area (either defined or extended) to determine final revegetation success. Baseline vegetation data are collected to characterize the vegetation communities to be affected by mining so that an acceptable reclamation plan can be formulated. Reference Area data are collected to demonstrate that the areas chosen to evaluate reclamation success accurately represent those lands to be affected by mining. This characterization and demonstration can be made through vegetation cover data alone if those data are properly collected from accurately mapped vegetation units. The data themselves will give you the final say on how accurate the mapping is.

I must stress: PRI needs to realize that the omission of production data from the baseline study locks them into using a Reference Area (defined or extended) to evaluate reclamation success. Baseline production data are necessary if Control Areas are to be used. The differences in Control and Reference Areas are described in Guideline 2.

Your second question deals with whether the western area should be sampled separately from the



eastern area. I can not give you an answer to that question. If climatic and edaphic conditions differ enough between the eastern and western areas to cause significant differences the vegetation, then the two areas need to be identified and sampled separately. Again, only the data can make that determination. I suggest the following: randomly locate the minimum number of sample points in each affected vegetation type (hopefully these will be equally distributed between east and west); collect cover data from those locations; analyze those data to determine means, standard deviations, and n-min sample sizes; then, separate eastern data from western data and analyze each for means, standard deviations, and n-min sample sizes. Comparing these three data sets, you should be able to make a decision if the eastern and western areas are similar enough to be combined or not.

If the eastern and western areas are similar enough to be combined, continue with your sampling to reach the required sample size. Then collect data from the extended Reference Areas chosen for each affected vegetation type. A comparison of the baseline vegetation cover with the extended reference area vegetation cover data will determine if the chosen extended reference areas represent their respective vegetation communities.

If the eastern and western areas are separated because of significant differences in the data, then separate eastern and western extended reference areas should be established for each vegetation type that reflects this difference.

I have one comment concerning the wording of extended reference areas in your sampling methodology. Extended reference areas are a special type of reference area with respect to their boundaries - but are still reference areas. A separate reference area (either defined or extended) should be established for each vegetation community experiencing more than 10 acres of disturbance. This permit application appears to require the establishment of four extended reference areas: mixed shrub grassland, rough breaks, bottomland sagebrush, and upland grassland. A possible fifth extended reference area may be required for the wetland community if more than 10 acres of this community are to be disturbed in Mine Unit No. 4. Additional extended reference areas to reflect possible differences between the eastern and western areas of the proposed permit are addressed above. Previously disturbed and reclaimed lands can be addressed at a later date as we have discussed.

Your sampling methodology describes the establishment of two extended reference areas, one containing two vegetation types and the other containing three vegetation types. In actuality, these are not extended reference areas but "blocks" of land containing two or more parcels of extended reference areas. I realize that this is a matter of semantics, but I feel we need to get the wording in the permit as correct and precise as possible to avoid confusion many years down the road when the reclamation is being sampled for bond release.

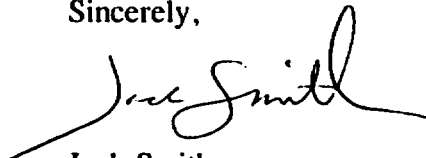
At this time I can not tell you if the areas you have blocked out for the establishment of the extended reference areas are acceptable. Each extended reference area needs to accurately

represent their respective affected community. Even though our site visit suggested the lands in these blocks would do that, **only the actual cover data you collect will tell you if this is the case.** For example: if your sampling tells you that the data collected for the Upland Grassland extended reference area in Section 29 do not represent the Upland Grassland affected area, then you need to make the decision to either scrap that area and collect data from another area or increase the extent of that proposed extended reference area. These "mid-stream" professional judgments need to be made in the field in order to avoid me having to make them in the office and forcing PRI to reinitiate a new vegetation study.

Hopefully I have given you enough information to initiate your upcoming vegetation survey. If you have any questions concerning any of the items in this letter, please feel free to give me a call at (307) 332-3047.

JS:js

Sincerely,

A handwritten signature in black ink, appearing to read "Jack Smith", with a long horizontal flourish extending to the left.

Jack Smith  
Sr. Environmental Specialist

xc: Rick Chancellor  
Paul Hildenbrand - PRI, 800 Werner Court, Suite 230, Casper, WY 82601  
Mark Moxley

THE STATE



OF WYOMING

JIM GERINGER  
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## Department of Environmental Quality

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December 27, 1996

Ms. Brenda K. Schladweiler  
BKS Environmental Associates, Inc.  
P.O. Box 6021  
Laramie, WY 82070-6021

**RE: Power Resources, Vegetation Sampling Methodology (TFN 3 5/93)**

Dear Brenda,

I have read your December 13, 1996 letter concerning proposed vegetation sampling methodology. The associated map referenced in the letter has not been received. I do have some major comments and questions concerning the text portion.

1. This first comment is rather significant and deals with the proposed affected lands.

You state on Page 1 that a "tabular summary of the acreage of each vegetation mapping unit to be disturbed by mining will be provided, if that acreage can be determined. These disturbance acreages, however, may be part of the operational plan as it is developed." **Affected area data are the driving force behind a reclamation plan.** The delineation of the affected area is absolutely critical to the formulation of an acceptable reclamation plan. Because of this, I hesitate to make even a cursory review of any reclamation plan (as was the case when the original application was submitted) when affected area data are absent.

The Power Resources application needs to have the geologic, hydrologic, and mine plan information (along with the right to mine) that allows the company to identify where their well fields will be located and the general configuration of their groundwater monitoring rings. We must assume that all lands within those rings have the potential to be disturbed. That area, along with access roads and facilities constitute the affected area. The department does not expect an absolutely precise line denoting this boundary, but permit data should be sufficient to give an accurate boundary. If the geologic, hydrologic, and specific mining methodology data are not available at this time to delineate an accurate affected area boundary, I don't see how the application can proceed beyond a completeness review with respect to not only vegetation and soils, but also those other portions of the permit.

If there are areas within the proposed permit area that Power Resources currently does not know if they mine because of the lack of data or the right to mine, those lands should not be included in a proposed mine and reclamation plan. Once those data are obtained and the decision made to mine such an area, the applicant can submit a mine and reclamation plan revision to the permit. Such a revision would include additional baseline data and a discussion on the adequacy of the existing extended reference area system to characterized and evaluate the new disturbance.

2. I'm not sure I understand what constitutes your "modified extended reference area." From your letter I get the feeling that one extended reference area encompassing three vegetation types will be established. Such an interpretation does not represent an acceptable methodology. Combining data from three vegetation types into one data set would add a huge amount of variability and make any type of correlation of the reference area to affected and reclaimed lands meaningless.

Three interspaced extended reference areas encompassing three vegetation types within one contiguous area is acceptable. Three sets of extended reference area data, one for each vegetation type, would need to be provided in the application.

I feel the three reference areas are necessary even if only one or two seed mixtures are proposed. Different topographic, moisture regime, and erosional forces all factor into the development of specific post-disturbance vegetation communities, even when only one initial seed mixture is used. A single, diverse seed mixture will have some components that establish well in bottomland areas with other components forming the bulk of established vegetation on drier, upland areas. Ten, fifteen, or twenty years down the road, revegetated swales may be best compared with the bottomland sagebrush extended reference area. The flat upland areas will be compared to either the mixed sagebrush-grassland or upland grassland extended reference areas depending upon environmental conditions such as microtopography, snow collection areas, wind scour areas, aspect, etc. that have shaped vegetation community development.

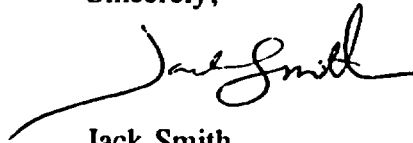
3. You state that some sample points for mixed sagebrush-grassland may be included in the rough breaks extended reference area. Areas mapped as mixed sagebrush-grassland should not be available as a transect location during the random selection of rough breaks sample points. The amount of minor inclusions of mixed sagebrush lands within an area mapped as rough breaks depends upon the degree of mapping accuracy. Offhand, I would suggest that if a randomly chosen rough breaks sampling location turns out in the field to be mixed sagebrush for a majority of the length of the sample transect, a mixed sagebrush inclusion should be mapped and the transect direction changed at point of community intersection. If a randomly chosen sample location is located near the edge of two vegetation types and the randomly chosen transect direction results in the transect exiting the community, the direction of the transect should randomly change at the point of intersection to remain within the desired community. Hopefully, the attached drawing will help explain this comment.

4. Discussions in the "Cover" portion of the plan state that sample hit readings will constitute absolute cover values for total vegetation and total cover. Plant species for each vegetation hit also needs to be recorded.

If you have any questions concerning the items in this letter, please feel free to give me a call at (307) 332-3047.

JS:js

Sincerely,

A handwritten signature in black ink, appearing to read "Jack Smith", with a long horizontal flourish extending to the left.

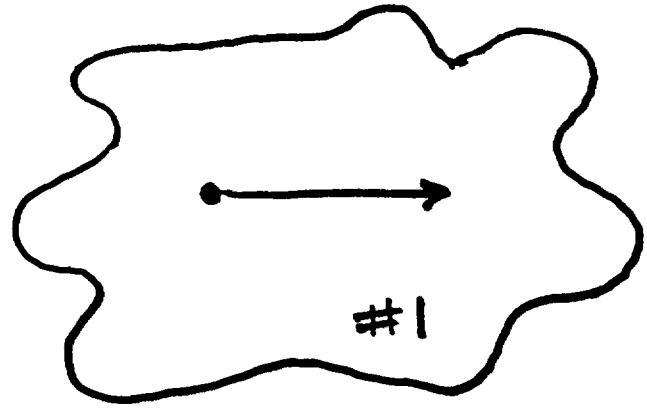
Jack Smith  
Sr. Environmental Specialist

attachment

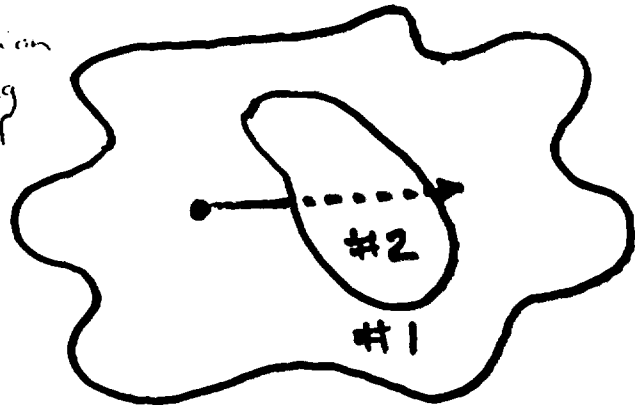
xc: Rick Chancellor  
Mark Moxley

# PK1 ATTACHMENT

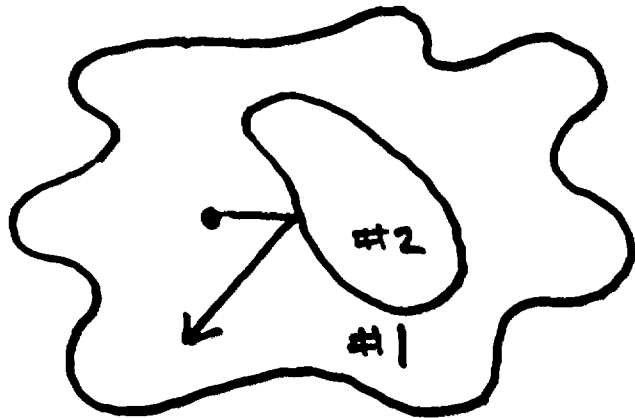
1. ORIGINAL MAPPING UNIT #1  
Random sample location  
within area, random direction  
of transect  $90^\circ$ .



2. FIELD VERIFICATION. Indication  
of an inclusion of Mapping  
Unit #2 (significant % of  
transect). Inclusion  
mapped as Unit #2.



3. Continuation of Transect  
Random direction of  
 $225^\circ$  continues the  
transect within Mapping  
Unit No. 1.





**BKS ENVIRONMENTAL  
ASSOCIATES, INC.**

**FILE COPY**

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**P.O. Box 6021  
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Fax (307) 721-5179**

December 13, 1996

Mr. Jack Smith  
WDEQ-LQD  
250 Lincoln  
Lander, WY 82520

Dear Jack:

Per our previous conversations and the site visit on October 4, 1996, with WDEQ, BKS Environmental Associates, and BRS, Inc. personnel, attached is the proposed vegetation methodology for the fieldwork associated with the vegetation responses for the PRI Gas Hills Project. I would appreciate any comments you may have by January 31 since we are formulating spring/summer 1997 fieldwork plans.

The associated map outlining the proposed extended reference areas will be sent under separate cover. These maps will indicate the current proposed Permit Area and the wellfield.

Thank you for your input. If you have any questions, please feel free to contact me in Laramie at (307)721-5179.

Sincerely,

Brenda K. Schladweiler  
BKS ENVIRONMENTAL ASSOCIATES, INC.

cc. Paul Hildebrand, PRI  
Doug Beahm, BRS

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
December 13, 1996**

**General**

Preliminary baseline vegetation mapping and initial cover sampling of the Power Resources, Inc. (PRI) Gas Hills Project was conducted between 1992 and 1994. Based on WDEQ completeness review comments dated July, 1996, the following proposed vegetation sampling methodology is designed to enhance or replace the current permit vegetation information. The previously collected data will not be resubmitted since no corresponding reference area data was provided. BKS Environmental Associates, Inc. will conduct the 1997 sampling.

**Mapping**

All vegetation community types, including disturbed and reclaimed areas, were originally delineated on a topographic base map at a scale of 1"=1000'. This original mapping was used as a basis for remapping the area on a 1"=500' photo base map during the Fall, 1996. Disturbed and reclaimed areas were more easily visible on the photographic base map. Defined areas were field checked during remapping in Fall, 1996. Small areas will be refined during cover sampling in 1997, if necessary.

A tabular summary of the acreage of each vegetation mapping unit to be disturbed by mining will be provided, if that acreage can be determined. These disturbance acreages, however, may be part of the operational plan as it is developed. Otherwise, acreages for the study area, as a whole, and the "modified extended reference area" will be determined during summarization of the 1997 fieldwork. For purposes of this methodology, the following current Permit Area acreages are provided.

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Vegetation Type	Permit Area Acreage
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Mixed Sagebrush-Grassland	4255
Rough Breaks	2022
Bottomland Sagebrush	495
Upland Grassland	101
Reclaimed	873
Disturbed	310
Reservoirs	17
Wetlands	<u>27</u>

TOTAL	8100
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**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
December 13, 1996 (cont.)**

**Species List**

A species list for the 1997 study area, based on the 1992-1994 and 1997 assessments, will be compiled. All nomenclature will follow that currently in use at the Rocky Mountain Herbarium in Laramie, Wyoming. Any encountered federally designated threatened and endangered species, state plants of concern, noxious weeds, and primary selenium indicators will be identified. A computer search of the Wyoming Natural Heritage database will be conducted prior to fieldwork to determine possible habitat for rare species previously located near the Beaver Rim. Since rare plants have been found in the Beaver Rim area of Wyoming, potential habitat within the study area will be surveyed during the 1997 fieldwork to determine existence of any rare plant individuals.

**Reference Area (s)**

During the 1992-1994 vegetation assessments, no reference or control areas were established. During the 1997 assessment, a "modified extended reference area" will be utilized. An area was selected based on the WDEQ site visit on October 4, 1996; that area encompasses three of the four affected area vegetation types. The Rough Breaks reference area was selected in a separate location from the main body of the "modified extended reference area" due to suitability of that particular vegetation type. The study area, i.e., possible affected area, will consist of the remaining portions of the Permit Area, since the exact location of the proposed disturbed area may change over the life of the mine.

Some reclaimed areas will be reaffected during mining operations. However, reference areas for these areas will not be established. Instead, a cover and production standard will be proposed, based on consultation with the WDEQ, when those areas are scheduled to be affected based on the operational plan. The vegetation map, however, will indicate when a specific reclaimed area was reseeded and under which program or applicable permit. The originally submitted data on the UPZ and Buss-Cap/Bengal reclaimed areas will not be resubmitted.

The proposed "modified extended reference area" for the Mixed Sagebrush - Grassland, Upland Grassland and Bottomland Sagebrush is outlined on the attached map (sent under separate letter). No Rough Breaks vegetation type will be sampled within this portion of the "modified extended reference area" due to its lack of representativeness to the majority of Rough Breaks within the Permit Area. The Rough Breaks "modified extended reference area" is outlined on the attached map (sent under separate letter). Some sample points for Mixed Sagebrush - Grassland may be included in this latter area.

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
December 13, 1996 (cont.)**

**Qualitative Description**

All disturbed areas within the 1997 study area and reference area (s) will be qualitatively described. Due to the difference in growth medium and potential for reclamation success, reclaimed areas in the eastern portion of the study area will be described separately from the reclaimed areas in the western portion. Previously delineated Badlands has been combined with Rough Breaks on the vegetation map and for sampling purposes.

Possible "wetland" vegetation types will be delineated on the vegetation map, wherever located. Small, unmappable pockets at the current map scale within ephemeral drainages will be described in the text only. However, these areas will not be included in any vegetation sampling since the permit document will state that these areas will be avoided in the operational plan.

**Quantitative Description**

Four vegetation types will be sampled within the 1997 study area: Bottomland Sagebrush, Mixed Sagebrush-Grassland, Rough Breaks, and Upland Grassland. Both the reference area(s) and study or affected area will be sampled in 1997, and the representative nature of the reference area vegetation type to the affected area type will be determined. Minimum and maximum sample numbers for this project will follow WDEQ Guideline 2.

**Cover**

A minimum of 20 transects for cover will be sampled within each vegetation type within the affected area. A minimum of 15 transects for cover will be sampled within each vegetation type within the reference area. If statistical adequacy is not obtained, as defined in WDEQ Guideline 2 with the minimum number, additional samples will be collected in increments up to the maximum number of 50, if necessary. All field sampling for cover will occur after June 15, 1997, depending upon overall weather conditions.

Sample locations for cover will be chosen by randomly selecting points within a grid of the 1997 affected area or reference area, respectively. Grid intervals will not exceed 100 feet on the ground. Random sample location coordinates will be plotted on a map and located in the field by pacing from known localities. Random numbers between 1 and 360 will be generated to orient the transect. A compass will then be used in the field to orient the transect to the nearest 1/8 of 360 degrees.

Sample hits will be read at 1 meter intervals along the entire length of the 50 meter transect. These first hit (50) readings will constitute the absolute cover values for total vegetation and total cover. In addition, litter, rock and bare ground percentages will be recorded. Transects that exceed designated vegetation boundaries will be randomly reoriented to be within the sampled type.

**1997 Vegetation Sampling Methodology  
Power Resources, Inc., Gas Hills Project  
December 13, 1996 (cont.)**

**Production**

Since PRJ has chosen to utilize the extended reference area approach, no production sampling will be necessary for the baseline vegetation assessment.

**Shrub Density**

Even though shrub density sampling is not required for non-coal sites, this data will be taken at the time of cover sampling to ensure adequate use of field time. Summarization of that data, however, may not be included in the report submittal for the permit. It is assumed that this area is not part of any wildlife critical winter range; thus, shrub density information is not necessary.

Shrub density data will be collected in conjunction with randomly selected cover transects, wherever possible. All shrubs, full or half, will be counted within 50 centimeters either side of the 50 meter cover transect (1 meter x 50 meter belt transect). Sample adequacy will not be calculated on shrub density transects; the number of belt transects will equal the number of cover transects for a given vegetation type. No shrub height measurements will be collected.

**Tree Density**

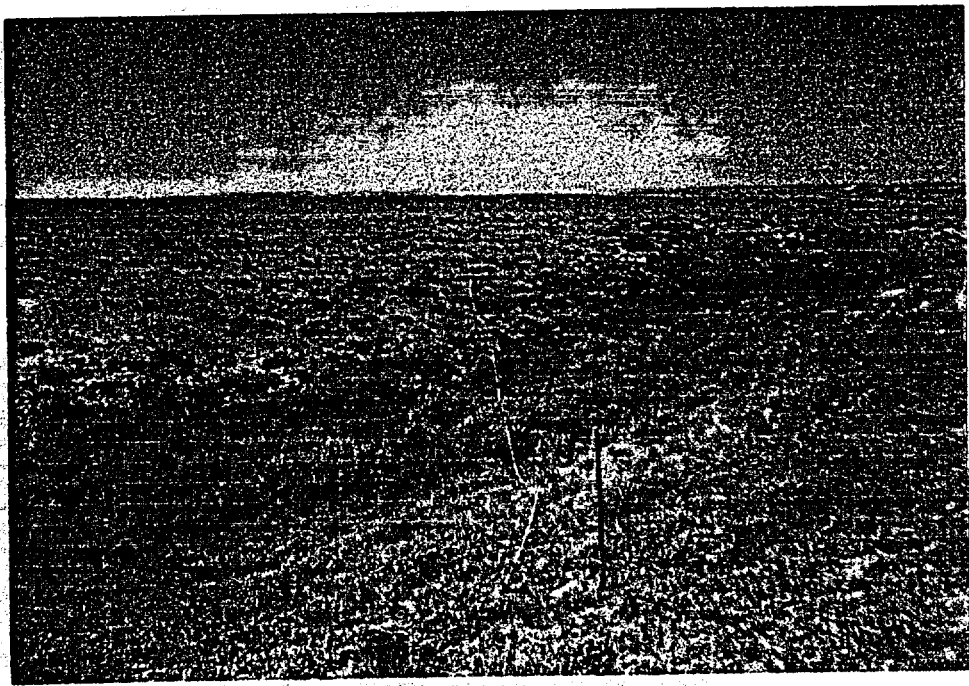
Due to the general sparsity or lack of tree individuals within the study area, a complete census will be taken, where appropriate. The exception of this may include the willow individuals within West Canyon Creek or juniper on the side slopes within Rough Breaks; willows will likely be described as a clumped group rather than individuals. Tree height will be determined by use of a clinometer, where appropriate. Tree diameter at breast height will be determined by a diameter tape, where appropriate. All tree locations (individuals or groups) within the study area will be plotted on the vegetation map.

**This vegetation sampling methodology correctly documents previous discussion as stated above and is hereby approved.**

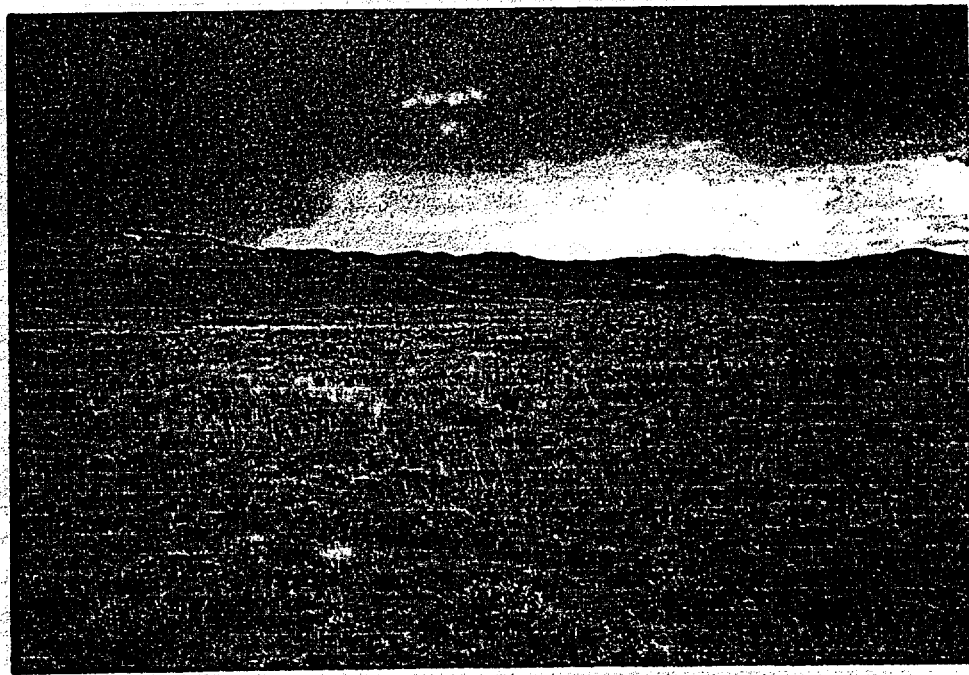
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Jack Smith  
WDEQ, Land Quality Division

# **ADDENDUM D8-2 PHOTOGRAPHS**



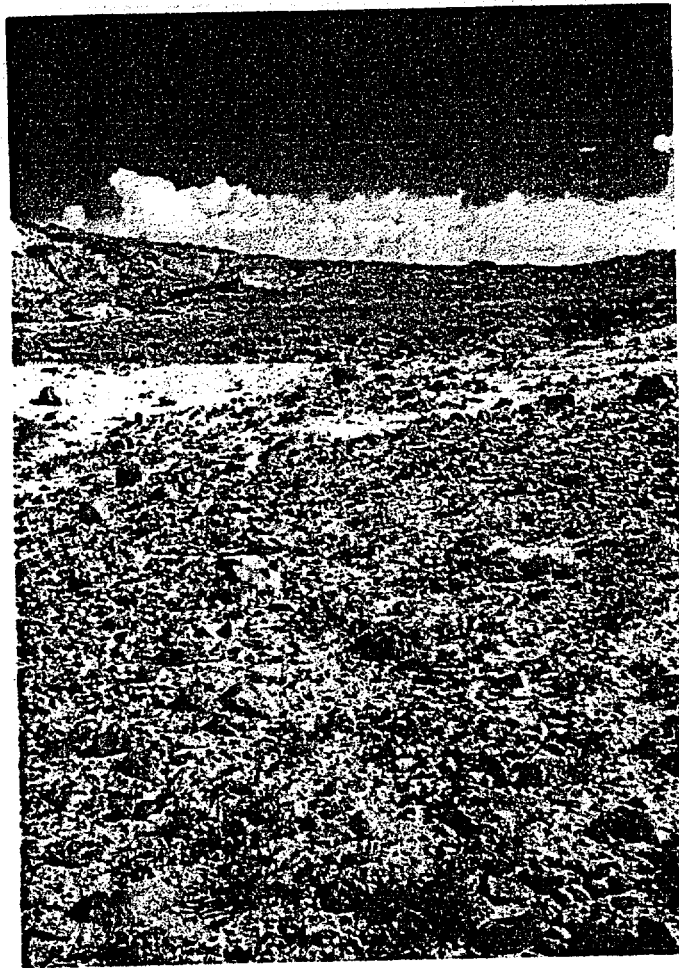
**Big Sage Affected Area**



**Mixed Shrub Grassland Affected Area**



**Rough Breaks East Affected Area**



**Rough Breaks West Affected Area**



**Upland Grass Affected Area**

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SOILS MAP  
FREMONT AND NATRONA COUNTIES,  
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**D-01**



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**D-02**