

CHAPTER 9  
VEGETATION INFORMATION

9.1 INTRODUCTION

The native vegetation of the Navajo Mine Permit Area is characteristic of the Colorado Plateau salt-desert shrub ecosystem. Salt-desert shrub ranges occur in Utah, Nevada, Western Colorado, Northeastern Arizona, and Northwestern New Mexico. This ecosystem contains a large number of salt tolerant species and a significant shrub component. Common shrubs present include numerous species of saltbush (Atriplex spp.), rabbitbrush (Chrysothamnus spp.), Mormon tea (Ephedra spp.), and snakeweed (Gutierrezia sarothrae). The grass community is generally dominated by the warm season species of galleta (Hilaria jamesii) and alkali sacaton (Sporobolus airoides) and the annual, cheatgrass (Bromus tectorum). The only cool-season grass of any significance is Indian ricegrass (Oryzopsis hymenoides). Prevalent forb species include globemallow (Sphaeralcea spp.), buckwheat (Eriogonum spp.), and Russian thistle (Salsola kali).

9.2 VEGETATION MAPPING AND SAMPLING

The first step in characterizing the vegetation on the Navajo Mine was to produce a map that divided areas into representative units. This was accomplished by producing a range site map for the entire permit area. Range sites are separate vegetation communities found on rangelands and are defined as follows:

A distinctive kind of rangeland, which in the absence of abnormal disturbance and physical site deterioration has the potential to support a native plant community typified by an association of species different from that of other sites. This differentiation is based upon significant differences in kind or proportion of species, or total productivity (Society for Range Management, 1974).

Site-specific range sites were identified on the Permit Area by aerial photography interpretation followed by ground truthing. Pace transects were run on undisturbed areas to obtain data on species composition and frequency of species occurrence. This information along with site-specific data on soils, geology, and topography were used to define individual range site delineations. Classification of areas disturbed by mining at the time of the mapping work were determined by interpretation from 1964 aerial photographs depicting pre-mining conditions and regional range surveys. Disturbed areas that could not be determined from aerial photo interpretation or surrounding vegetation communities were classified as disturbed.

The map showing the distribution and extent of the eight range sites found on the Navajo Mine Permit Area are presented as EXHIBITS 9-1a through 9-1f.

Sampling of the vegetation on the eight range sites occurred in 1983, 1984, 1985, and 1986. In 1987, a partial range survey was conducted by Drs. M. K. Wood and K. W. Allred on approximately 2,670 acres of land in Area IV N. The survey area also included the area from the IV North permit boundary to the leasehold line. This chapter will characterize the vegetation of the Permit Area based on the 1985-86 and 87 data. The vegetation data printouts for the five sample years can be found in Permit NM-0003C, Chapter 16, as Appendices 16-A, B, C, H and I.

### 9.3            **METHODOLOGY**

All of the range surveys cited above were conducted using the same methodology to collect the following information:

1.    Vegetation cover, frequency, and constancy for each species in the herbaceous stratum for each plant community.
2.    Total annual production for each species in the herbaceous stratum for each plant community.
3.    Vegetative cover, frequency, constancy, and density for each species in the shrub stratum for each plant community in which the shrub stratum is present.
4.    Total annual production for each palatable species in the shrub stratum for each plant community in which the shrub stratum is present.

The following methodologies were utilized to assure that data was collected in a timely and statistically adequate manner.

#### 9.3.1        Vegetation Cover

Vegetative cover by species for grasses, forbs and shrubs was determined by utilizing a 30 meter line intercept transect. Continuous readings recording intercepted length of live vegetation were taken along the entire length of the transect. The intercepted length of each plant was recorded to the nearest 1 mm. Each ten, three meter subsection counted as one sample/transect.

### 9.3.2 Frequency

Frequency was obtained by species for grasses, forbs and shrubs. The 30 meter tape was divided into ten subplots each three meters in length. The number of subplots in which a given species was present was recorded as a relative percentage.

### 9.3.3 Constancy

Constancy was calculated for each species by dividing the number of transects in which a species was recorded by the total number of transects within each vegetative type. Constancy values were recorded as a relative percentage.

### 9.3.4 Production

Production for grasses, forbs, and shrubs was harvested by species within a 10 centimeter x 10 meter quadrat (1 meter square). The longest edge of the quadrat was placed to the right of and adjacent to a previously selected random location along the 30 meter tape. All plant biomass within the vertical projection of the quadrat was clipped regardless of rooting location. The clipped green weight was recorded to the nearest one-half gram. Sample adequacy for production was based on these field weights. Each quadrat counted as one sample.

The clipped biomass was oven-dried at 60° C to a constant weight and recorded to the nearest one-tenth gram. All calculations of Animal Unit Month's (AUM's) are reported on a per acre basis using the oven-dried weights. AUM figures were computed by multiplying production by their appropriate Proper Use Factor (PUF). PUF values for each species were supplied by the Bureau of Indian Affairs (BIA), Shiprock Agency and the Bureau of Land Management (BLM), Farmington Resource Area Office. The products of PUF values times production/acre values for each species were totalled by vegetation type.

AUMs per acre for each vegetation type was then calculated using the formula:

$$AUM/acre = \frac{(PUF \times production)/acre}{28lbs/day \times 30days/month}$$

#### 9.3.5 Density

Density for shrubs was determined by counting the number of rooted individuals by species within one meter of either side of the 30 meter transect. Data are expressed in numbers per acre.

### 9.3.6 Sample Adequacy

Sample adequacy for vegetative cover and production was determined based on the formula:

$$n = \frac{(z)^2 2s^2}{[(d) (\bar{x})]^2}$$

Where: n = Number of samples (minimum sample size)

s<sup>2</sup> = Sample standard deviation

d = Precision level for desired percentage of the sample mean (expressed as a decimal).

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x = Sample mean

z = Value for specified confidence level.

The values of z and d are 1.28 and 0.20 respectively.

If, after 40 samples, sample adequacy had not been met at the desired level of accuracy, no further sampling was conducted for that range site and the sample size was considered adequate. Also see Section 9.4.9 for additional discussion.

### 9.3.7 Randomization

Selection of the starting point, direction of the line intercept transect and the location of the production quadrant along the transect was completely random. The starting point for the line transect was determined by overlaying the vegetative map with a grid, assigning coordinate axis and then selecting the coordinate values from random numbers table. A minimum of 15 sampling points was selected for each vegetative type. Following collection of data from these 15 sampling points, sample adequacy was calculated for vegetative cover and production from each vegetation type. If additional sampling points were needed to meet sample adequacy, the random selection procedures was repeated.

Direction of the transect was randomly selected by running the transect in the direction of the position of the watch second hand at the exact time that the starting point for the line transect was located in the field. If the transect extended into another vegetative type, another random direction was chosen at that point by the above method to continue the transect to its 30 meter length within that vegetative type.

Location of the production quadrat along the line transect was determined by selection of numbers from a random numbers table. This number was determined prior to going to the field.

## 9.4 RESULTS AND DISCUSSION

The Navajo Mine Permit Area is delineated into eight range sites:

1. Alkali Wash
2. Arroyo Shrub
3. Badlands
4. Calcareous Sands
5. Dunes
6. Sands
7. Saline Sands
8. Thinbreaks

TABLE 9-1 summarizes the perennial cover, production and shrub density data for the 1985 and 1986 vegetation surveys (see Permit NM-0003C, Chapter 16, Appendices 16-A and I for the data). TABLE 9-2 summarizes the perennial cover, production, and shrub density data for the 1987 vegetation survey (see Permit NM-0003C, Chapter 16, Appendix 16-H for the data).

The following sections below are a discussion of the data from each range site using 1985 data. See Permit NM-0003C, Chapter 16, Appendix 16-A for the data.

### 9.4.1 Alkali Wash Range Site

Alkali Wash range sites occupy approximately 27.4 percent of the Permit Area and are typically located in washes and major drainages as well as at the base of Badlands. Terrain is nearly level to moderately sloping ranging from zero to three percent. The soils are shallow and unsuitable for salvage because of heavy clays and high sodic levels. These conditions made the site very unproductive.



TABLE 9-1

1985-86 COVER, PRODUCTION AND SHRUB DENSITY DATA BY RANGE SITE  
FOR NAVAJO MINE (AREA I - III)

Range Site	Acreage <sup>2</sup>	Percent of Study Area <sup>2</sup>	Percent Cover <sup>1</sup> 1985 <sup>3</sup>	1986 <sup>3</sup>	Prod. <sup>1</sup> (lbs/ac) 1985 <sup>3</sup>	1986 <sup>3</sup>	Shrub Density (#/ac) 1985 <sup>3</sup>	1986 <sup>3</sup>
Alkali Wash	5630.1	29.6	1.0	0.7	150	97	263	524
Arroyo Shrub	266.3	1.4	2.2	1.9	343	239	1474	1212
Badlands	5211.7	27.4	0.4	0.3	103	22	153	278
Calcareous Sands	589.6	3.1	1.7	2.0	314	215	1456	1588
Dunes	1122.2	5.9	2.7	2.4	308	294	1474	2460
Sands	2174.0	11.4	2.5	2.0	363	216	2420	1968
Saline Sands	2162.7	11.4	3.2	2.2	336	194	1386	764
Thinbreaks	1864.0	9.8	1.8	1.0	334	106	1337	1396
<b>TOTALS:</b>	19020.6	100.0						

<sup>1</sup> Perennial vegetation only.

<sup>2</sup> Acreage and percentages are based on the leasehold area from Area I through Area IVN. This includes the Permit Area plus the areas within Area IVN included from the Permit Area. It does not include the industrial site area next to the power plant nor the right-of-way areas of Navajo Mine.

<sup>3</sup> The vegetation data comes from the range surveys completed before the addition of lease Amendment IV and portions of North Area IV to the permit area. For vegetation information on the areas in IVN that were added to the Permit Area in 1986, refer to TABLE 9-2.

TABLE 9-2

1987 COVER, PRODUCTION AND SHRUB DENSITY DATA BY RANGE SITE  
FOR NAVAJO MINE AREA IVN.

Range Site	Acreage <sup>2</sup>	Percent of Study <sup>2</sup>	Percent Cover <sup>1</sup>	Production <sup>1</sup> (lbs/ac)	Shrub Density <sup>1</sup> (#/ac)
Alkali Wash	1135	42.5	1.6	229	1683
Arroyo Shrub	104	3.9	3.6	1195	3037
Badlands	786	29.4	0.7	252	504
Calcareous Sands	0	0.0	0.0	0	0
Dunes	75	2.8	3.5	1223	2813
Sands	146	5.5	2.8	852	6301
Saline Sands	37	1.4	3.5	850	1089
Thinbreaks	387	14.5	3.4	1018	3171
<b>TOTALS:</b>	2670	100.0			

<sup>1</sup> Perennial vegetation only.

<sup>2</sup> Acreage and percentages are based on the range survey completed during the summer of 1987 for those areas added in 1986 to the Permit Area, and for all those areas east of IVN which were outside the Permit Area, but within the Navajo Leasehold.

<sup>3</sup> Calcareous Sands range sites were not encountered during the 1987 vegetation survey.

Total vegetation cover on the range site was 4.5 percent with one percent perennial vegetation and 3.5 percent contributed by annuals. The site is dominated by such annual species as Salsola kali and Atriplex powellii, which comprise 1.9 percent and 0.90 percent cover, respectively. The highest cover values for perennials were recorded for Eriogonum corymbosum (0.20 percent), Atriplex corrugata (0.17 percent), and Sporobolus airoides (0.13 percent).

The Alkali Wash range site had a total average production of 1008 pounds per acre. Annuals made up 858 pounds per acre with perennials contributing only 150 pounds per acre. Top producing annual species were Salsola kali and Atriplex powellii at 506 and 270 pounds per acre, respectively. Atriplex corrugata at 49 pounds per acre and Sporobolus airoides at 17 pounds per acre were the highest producing perennial species.

The average shrub density for this site was 263 plants per acre. Atriplex corrugata had a mean density of 19.2 per acre and Atriplex canescens had a density value of 22 per acre.

#### 9.4.2 Arroyo Shrub Range Site

Arroyo Shrub range sites are found on level or nearly level (zero to 2 percent slopes) terrain located next to stream beds in major drainages, such as Cottonwood Wash, and occupy approximately one percent of the Permit Area. The soils are stratified sands and often have high Sodium Adsorption Ratio values. Production is still high on the site because of the deep, well-drained soil proximity to water.

Total vegetation cover averaged 3.4 percent. Perennial vegetation made up 2.2 percent with annuals contributing 1.2 percent. Sarcobatus vermiculatus (0.5 percent), Oryzopsis hymenoides (0.4 percent), and Chrysothamnus nauseosus (0.4 percent) were the highest cover values. Salsola kali with a cover value of 0.7 percent was the highest for the annuals.

Total production on the site averaged 555 pounds per acre. Perennial vegetation comprised 343 pounds per acre with annual vegetation making up 212 pounds per acre. The highest perennial production values came from Chrysothamnus nauseosus (84 pounds per acre), Oryzopsis hymenoides (77 pounds per acre), and Gutierrezia sarothrae (46 pounds per acre). Salsola kali had a production figure of 179 pounds per acre or one-third of the total production.

Shrub density was the second highest of the eight range sites with a value of 1474 plants per acre. Gutierrezia sarothrae had a mean density of 680 plants per acre followed by Chrysothamnus nauseosus at 229 plants per acre.

#### 9.4.3 Badlands Range Site

The Badlands range site consist of exposed, weathered shales with steep to moderately undulating topography (10 to 60 percent). These sites, generally occur between plateau edges and major drainages and from approximately 27 percent of the Permit Area. This is the most unproductive of the eight range sties, and none of the soil material is suitable for salvage because of the high clay content and high sodium values.

Total vegetation cover on this site averaged 2.1 percent. Annual vegetation made up 1.7 percent and perennial vegetation comprised 0.4 percent of the total cover. The highest cover values were recorded for the annual species of Atriplex powellii (0.90 percent) and Salsola kali (0.50 percent). The extremely low value of perennial cover was reflected in the two highest species of Eriogonum corymbosum and Atriplex corrugata at 0.09 and 0.07 percent cover, respectively.

While total production seemed reasonable at 615 pounds per acre, only 103 pounds per acre was from perennial plant species, the lowest figure for the eight range sites. Annual production was 511 pounds per acre led by Atriplex powellii at 361 pounds per acre and Salsola kali at 73 pounds per acre. The top producing perennial species were Atriplex obovata (68 pounds per acre) and Eriogonum corymbosum (9 pounds per acre).

Shrub density on Badlands was low in comparison to the other sites at 153 plants per acre. Atriplex corrugata had the highest shrub density of 62 plants per acre followed by Suaeda torreyana at 46 plants per acre.

#### 9.4.4 Calcareous Sands Range Site

These range sites occupy level to gently rolling terrain (zero to 5 percent slopes). It is similar to the Saline Sands range site except that its soil profile generally has a caliche subsoil horizon. The largest continuous block of this type of the site is on the south plateau of Area III. Calcareous Sands range sites make up approximately 3.6 percent of the Navajo Mine Permit Area.

Total vegetation cover on the range site was somewhat low at 2.2 percent. Perennial vegetation contributed the majority of the cover at 1.7 percent with annuals making up 0.5 percent. Perennial species with the highest cover value were Oryzopsis hymenoides (0.7 percent), Atriplex confertifolia (0.5 percent), and Hilaria jamesii (0.4 percent). The only annual species with significant cover was Salsola kali at 0.4 percent cover.

Total production for calcareous sands range sites averaged 459 pounds per acre. Only 145 pounds per acre came from annual vegetation, while perennial vegetation made up 314 pounds per acre. Perennial species were led by Oryzopsis hymenoides at 137 pounds per acre followed by Atriplex confertifolia at 91 pounds per acre. The highest producing annual species was Salsola kali at 127 pounds per acre.

These range sites had a high shrub density value of 1,456 shrubs per acre. Most of the density came from Atriplex confertifolia at 1,176 plants per acre.

#### 9.4.5 Dunes Range Site

The Dunes range site is one of the more productive found on the Navajo Mine Permit Area. Dunes form gently rolling terrain (zero to 5 percent) located on the leeward side of ridges, bluffs, or plateaus. Dunes soils are deep and composed of well-drained sands. Dunes range sites comprise approximately 6.4 percent of the Permit Area.

Total vegetation cover of these sites was relatively high at 3.4 percent. Most of the cover was perennial vegetation (2.7 percent) with annuals making up only 0.7 percent. The highest cover values were recorded by Oryzopsis hymenoides (0.8 percent), Artemisia filifolia (0.4 percent), and Hilaria jamesii (0.3 percent). Salsola kali had the highest cover value of the annual species at 0.4 percent.

Total production on the Dunes range site averaged 383 pounds per acre, with perennials making up 308 pounds per acre and annuals comprising 75 pounds per acre. Oryzopsis hymenoides and Artemisia filifolia were the highest producing perennials at 104 and 70 pounds per acre respectively. The only annual of any significance was Salsola kali with production at 59 pounds per acre.

Shrub species had a density value of 1,474 plants per acre on the Dunes range sites. Gutierrezia sarothrae had by far the highest value of 1,130 plants per acre followed by Artemisia filifolia at 76 plants per acre.

#### 9.4.6 Sands Range Site

The Sands range sites are usually located on the leeward and lower windward side of ridges and plateaus occupying approximately 13.1 percent of the Permit Area. Soils, aeolian in nature, are moderately deep and well-drained. Terrain is flat to gently, rolling slopes (zero to 5 percent).

The Sands range site had a total vegetation cover of 2.9 percent. Annual vegetation contributed only 0.4 percent with perennial vegetation making up the vast majority with 2.5 percent cover. Over 60 percent of the total cover came from three species: Oryzopsis hymenoides (0.90 percent), Hilaria jamesii (0.60 percent), and Gutierrezia sarothrae (0.40 percent). Salsola kali was the annual with the highest cover value of 0.3 percent.

Total production on this range site averaged 455 pounds per acre. Perennial vegetation contributed 363 pounds per acre to the total, with annuals contributing only 89 pounds per acre. The highest producing annual species was Salsola kali at 79 pounds per acre. The four top producing perennials were: Oryzopsis hymenoides (124 pounds per acre), Gutierrezia sarothrae (65 pounds per acre), Hilaria jamesii (64 pounds per acre), and Sporobolus airoides (59 pounds per acre).

The Sands range site had the highest shrub density of the eight range sites at 2,420 plant per acre. The highest density values were recorded by Gutierrezia sarothrae at 1,965 plants per acre and Atriplex confertifolia at 256 plants per acre.

#### 9.4.7 Saline Sands Range Site

The Saline Sands range sites form the largest expanse in the plateau of Area IV North. Total area occupied by this vegetation type is approximately 12.4 percent of the Permit Area. Terrain is level to gently rolling (zero to 5 percent slopes).



The site is usually located atop large plateaus, downwind from strongly alkali affected sites (i.e., Badlands, Alkali Wash), or surrounding such sites. Soil types are moderately deep and soils of these sites tend to be alkaline in nature, thereby supporting vegetation species which are moderately salt tolerant.

Total vegetation cover on this range site was one of the highest for all eight sites at 4.5 percent. Perennial vegetation made up 3.2 percent with annuals comprising the remaining 1.3 percent. Cover of the perennial vegetation was dominated by grass species as follows: Oryzopsis hymenoides (1.0 percent), Hilaria jamesii (0.6 percent), and Sporobolus airoides (0.6 percent).

The only annual producing any significant cover was Salsola kali at 0.9 percent.

Production of all vegetation on the Saline Sands range site averaged 525 pounds per acre. Annuals produced 188 pounds per acre of that total with perennial vegetation making up the balance of 336 pounds per acre. Sporobolus airoides (112 pounds per acre), Oryzopsis hymenoides (96 pounds per acre), and Hilaria jamesii (53 pounds per acre) were the highest producing perennial species. The only annual species contributing any significant production was Salsola kali at 153 pounds per acre.

Shrub density on this range site was 1,386 shrubs per acre. Gutierrezia sarothrae and Atriplex confertifolia had the highest densities with 965 and 239 plants per acre, respectively.

9.4.8 Thinbreaks Range Site

Thinbreak topography includes exposed sandstone outcrops and associated thin soils of the immediate surrounding area. Thinbreaks range sites occupy approximately 9.1 percent of the Permit Area. These sites usually occur along ridges and rock outcrops between plateaus and major drainages or plateaus and Badlands, as well as butte and mesa tops. Slopes vary from two to nine percent. Typical soils are shallow sandy deposits overlaying sandstone. The soil surface is usually covered with thin, broken fragments of sandstone.

Thinbreaks range site had a total vegetation cover value of 2.4 percent. Perennial vegetation species made up 1.8 percent and annuals 0.6 percent. The perennials with the highest cover values were Atriplex confertifolia (0.6 percent), Sporobolus airoides (0.4 percent), and Oryzopsis hymenoides (0.3 percent). Only Salsola kali had a substantial cover value for the annuals at 0.4 percent.

Total plant production on this site averaged 430 pounds per acre with perennials contributing 334 pounds per acre and annuals 96 pounds per acre. Top producing perennial species included Atriplex confertifolia (109 pounds per acre) and Sporobolus airoides (63 pounds per acre). Salsola kali led the annuals with a production of 71 pounds per acre.

Shrub density on the Thinbreaks range site averaged 1,337 plants per acre. Atriplex confertifolia was recorded at 845 plants per acre and Gutierrezia sarothrae at 241 plants per acre.

#### 9.4.9 Sample Adequacy

Sample adequacy for production and cover on all the range sites, was met by obtaining statistically sufficient number of samples or by taking 40 samples as explained in Section 9.3.6. Because of the tremendous variability between transects, statistical sample adequacy requirement on some range sites would have required several hundred samples. Discussions with the Office of Surface Mining (OSM) on this issue at other BHP projects in New Mexico resulted in an agreement that 40 samples would be the maximum number of samples taken on any one range site.

Copies of data printouts (years 1983-87) can be found in Permit NM-0003C, Chapter 16, Appendices 16-A, B, C, H and I.

#### 9.5 **WILDLIFE HABITAT**

The lease area is delineated into five wildlife habitat types:

1. Uplands,
2. Badlands,
3. Alkali Wash,
4. Arroyo Shrub, and
5. Reclaimed Areas.

Wildlife habitat descriptions are presented below in detail and interface with the general descriptions provided in Section 10.3.1 of CHAPTER 10, WILDLIFE.

#### 9.5.1 Uplands

The sandy upland habitats, which occur on approximately 7,913 acres (42 percent) of the North Area and Areas II through IV North, are dominated by perennial species such as Indian ricegrass (Oryzopsis hymenoides), galleta (Hilaria jamesii), alkali sacaton (Sporobolus airoides), and saltbush (Atriplex confertifolia), which provide approximately two to four percent cover and 300-360 pounds production per acre. The most common annual is Russian thistle (Salsola kali). Snakeweed (Gutierrezia sarothrae) and saltbush are the primary species of the 1400-2400 shrubs per acre. The uplands are comprised of the current vegetation classification. These areas were classified as calcareous, choppy sands, sandy, sandy saline and thinbreak by Westinghouse (1975) and as upland flats and dunes by Battelle (1975).

#### 9.5.2 Badlands

Badlands habitat is dominated by barren soil and moderate to relatively steep slopes. Badlands occurs on approximately 5,212 acres (27 percent) of the North Area and Areas II through IV North. Most of the approximate two percent vegetation cover in this habitat is comprised of annuals such as Atriplex powellii and Russian thistle. Shrub density on badlands is also relatively low with approximately 150 plants per acre comprised primarily of mat saltbush (Atriplex corrugata) and Suaeda torreyana. This habitat is on the badlands range site of the current vegetation classification and Westinghouse (1975) studies. It was identified as transition habitat by Battelle (1975) studies. It includes the rimrocks, rock outcrops, and rougher topography on the lease. Rock outcrops on the lease vary from small scattered areas where rocks barely break through the surface to the larger rimrocks on the edges of mesas and buttes.

### 9.5.3 Alkali Wash

The alkali wash habitat (27 percent) of the North Area and Areas II through IV North, is located in the flats of the major drainages and at the base of badlands, has shallow, heavy clay soils and is dominated by annual species such as Russian thistle and Atriplex powellii. Perennials contribute only approximately 150 pounds per acre, while annuals provide over 850 pounds per acre. Shrub density on the alkali wash habitat is approximately 263 shrubs per acre and is comprised primarily of saltbush. Playas are included within the alkali wash type. This type habitat is identified as alkali wash for the current vegetation classification, and was classed as shaley saline by Westinghouse (1975), and as lowland and some upland flats by Battelle (1975).

### 9.5.4 Arroyo Shrub

Arroyo shrub habitat, which occurs on approximately 266 acres (one percent) of the North Area and Areas II through IV North, is located adjacent to stream beds or river washes in the major drainages such as Cottonwood Wash. Greasewood (Sarcobatus vermiculatus), rabbitbrush (Chrysothamnus nauseosus), and Indian ricegrass are the primary perennials, and Russian thistle the primary annual. Total vegetation cover is approximately 3.4 percent, and production is approximately 555 pounds per acre. Snakeweed (680 plants per acre) and rabbitbrush (229 plants per acre) were the primary contributors to the 1,474 shrubs per acre on this habitat. Salt-cedar (Tamarix chiliansis) occurs on the edges of the dry streambeds in the arroyo shrub habitat. This habitat type was included in the riparian community in Battelle's (1975) report and was not identified by Westinghouse (1975). Battelle's riparian communities also included off lease areas along the Chaco and San Juan Rivers that are not typical of the lease, and do not support the lush vegetation

commonly associated with the connotation of riparian.

#### 9.5.5 Reclaimed Areas

The various reclaimed areas in the northern portion of the lease (pre-law and interim areas) provide another type of habitat for wildlife. These areas are now most similar to the upland sandy areas with the inclusion of some wheatgrass (Agropyron spp.). Saltbush is the most common shrub; greasewood and salt-cedar also occur in the drainage bottoms and depressions in reclaimed areas.

### 9.6 **THREATENED AND ENDANGERED PLANT SPECIES SURVEYS**

Surveys for threatened and endangered plant species on the Navajo Mine Permit Area took place on the following dates:

1. Area I, II, III, and IV North: June 6-8 and September 7-10, 1983,
2. Thirty-three acres adjacent to the Navajo Mine: May 30 to June 5, 1985,
3. Area IV North: August 1987,
4. Block B and amendment area: May 30 to June 5, 1989, and
5. Blocks A, C, and D: May 15-16, 1991
6. Dixon Extension update May 22-25 2001
7. Area IV North: May – June 2004

The surveys were conducted by Drs. Richard Spellenberg, Plant Taxonomist, (1983, 1985, 1989, 1991) and Kelly W. Allred (1987), New Mexico State University (NMSU). Prior to the field surveys, Dr. Spellenberg prepared a list of "sensitive" plant species which might occur on the permit area. This list was compiled by checking existing Federal and State lists, conducting a complete literature search on "sensitive" species known to occur in the Four Corners Region and by a herbarium search of selected institutions.

Following the background work, on-site surveys were conducted over the entire permit area. Habitat identified as having a high potential for "sensitive" species was thoroughly searched and all parts of the permit area were viewed. Plants were identified in the field, their habitat noted and a subjective estimate of their relative frequency was made. Plants which could not be accurately identified during the field search, or were of some interest to New Mexico botanical studies, were collected, pressed, and later identified at NMSU. A few plant species that were particularly difficult to identify were sent to a specialist for determination. Collected plants have been deposited as specimens in the NMSU Herbarium.

Results from the survey showed that no endangered or threatened plant species were found on the Navajo Mine permit area (Spellenberg, 1983, 1985; Allred, 1987). See Permit NM-0003C, Chapter 16, Appendices 16-D, E, H, J and K for survey reports.

Surveys for Knowlton's Pincushion cactus (*Pediocactus knowltonii*) were conducted in both 1985 and 1991. Based on the information for the cacti, there is no suitable habitat on the Navajo Mine and the mine is out of habitat range (Spellenberg, 1985, 1991). See Permit NM-0003C, Chapter 16, Appendices 16-E and K for survey reports.

The 1983 and 1985 plant survey reports (Spellenberg, 1983, 1985) suggested that Navajo Mine contact the New Mexico Heritage Program regarding (Proatriplex pleiantha, formerly Atriplex pleiantha) and Oenothera caespitosa spp. navajoensis as to their status. As of September 1998, both Proatriplex pleiantha and Oenothera caespitosa spp. Navajoensis have been removed from the Navajo Nation and the USFWS Endangered Species Lists. There are no known threatened and endangered plant species within Navajo Mine lease boundary. For documentation concerning P. pleiantha and O. caespitosa navajoensis, see Permit NM-0003C, Chapter 16, Appendices 16-F and G.

The 2001 plant survey report (Ecosphere, 2001,) was conducted to update earlier surveys in the Area III and 4 north areas when the Dixon Extension area was added. There were no known threatened and endangered plant species found within the Navajo Mine lease boundary. For documentation, see Appendix 9-A.

During May and June of 2004 Ecosphere Environmental Services. was contracted to conduct an updating survey for threatened and endangered species of Area IV North. Their report (Ecosphere 2004), which is found in Appendix 9-B, documents the identification of several populations of Asclepias sanjuanensis. This plant is listed in Group 4 of the Navajo Nation Endangered Species List. Inclusion in this group signifies that the Navajo Nation Department of Fish and Wildlife does not have enough information to determine whether listing as threatened or endangered is necessary. This plant species is not on any other federal or state listing.



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Spellenberg, R. 1989. A report on the threatened, endangered or otherwise sensitive plants on 830 acres of land, the "Block B and Amendment Area", on the east side of the central portion of the Navajo Mine, San Juan County, New Mexico. 29 pages. [Permit NM-0003C, Chapter 16, Appendix 16-J]

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Westinghouse. 1975. Terrestrial Survey of Navajo Mine Lease Associated with the Four Corners Power Plant. Environmental Systems Department Westinghouse Electric Corporation, Pittsburg, PA. [Permit NM-0003C, Chapter 17, Appendix 17-A]

Wood, M.K. and K.W. Allred. 1987. Vegetation survey, Navajo Mine, Area IV North. 11 pages. [Permit NM-0003C, Chapter 16, Appendix 16-H]

**Appendix 9-A**

**A Survey for Threatened, Endangered and Sensitive Species Report for South  
Dixon Extension Area**

**A SURVEY FOR THREATENED,  
ENDANGERED AND SENSITIVE SPECIES**

**For the Proposed:**

**NAVAJO MINE 654 ACRE DIXON PIT LEASE  
EXTENSION PROJECT  
SAN JUAN COUNTY, NEW MEXICO**

**Prepared For:**

**BROKEN HILLS PROPRIETARY COMPANY  
FRUITLAND, NEW MEXICO**

**Prepared By:**

**ECOSPHERE ENVIRONMENTAL SERVICES  
FARMINGTON, NEW MEXICO  
DURANGO, COLORADO**

**JULY 2001**

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## EXECUTIVE SUMMARY

In April of 2001, Broken Hills Proprietary Company retained Ecosphere Environmental Services to conduct a threatened/endangered/sensitive species survey for the proposed Navajo Mine Lease Extension located on Navajo Tribal Trust land in San Juan County, New Mexico. The purpose of the survey was to adhere to the Endangered Species Act of 1973, as amended; and Navajo Nation code requirements for endangered species (17NNC507). Ecosphere Environmental Services consulted with the Navajo Natural Heritage Program for site specific information prior to initiating a field survey of the proposed project area. No federally or Navajo Natural Heritage Program listed threatened, endangered, or sensitive species, or critical habitats of listed species were observed during the onsite investigation. Threatened/endangered/sensitive species clearance is recommended for the proposed lease extension project.

## PROJECT DESCRIPTION

Broken Hills Proprietary Company (BHP) P.O. Box 1717 Fruitland, New Mexico retained Ecosphere Environmental Services (Ecosphere) to conduct a threatened/endangered/sensitive (TES) species survey for the proposed **Navajo Mine 654 Acre Dixon Pit Lease Extension Project** (Navajo Mine Lease Extension). Between May 22-25, 2001, Don Hyder and Pete Skartvedt of Ecosphere conducted the TES survey of the proposed Navajo Mine 654 acre Dixon Pit lease extension project. Although Ecosphere surveyed for TES fauna species during the field survey, the primary focus of the survey was TES flora species. A report of TES fauna species for the proposed lease extension was prepared by Hawks Aloft Inc. on February 6, 2001.

The Navajo Mine Lease Extension consists of approximately 654-acres located within area IV of Navajo Mine and would encompass North Cottonwood Wash and Burnham Road. North Cottonwood Wash is proposed to be diverted to the east side of the lease extension site. The diversion will require construction of a 275-foot wide by 4,270-foot long channel (approximately 27 acres).

The purpose of the survey was to adhere to requirements protecting sensitive species occurring within the Navajo Nation and to comply with the Endangered Species Act of 1973, as amended. Ecosphere consulted with the Navajo Natural Heritage Program (NNHP) for site specific information prior to initiating a field survey of the proposed project area. As such, the objectives of the survey were as follows:

1. Compile a list of Navajo Nation TES species (as identified by the NNHP) and federally listed TES species potentially occurring in the project area.
2. Provide a physical and biological description of the project area.
3. Determine the presence of listed TES species in the project area. Determine the presence of critical habitat for listed or sensitive species in the project area.

4. Assess potential impacts the proposed action may have on any listed or sensitive species, or critical habitat, present in the project area.

## LOCATION

The proposed Navajo Mine Lease Extension and channel diversion are located on Navajo Tribal Trust land approximately 17 miles southwest of Kirtland, New Mexico. The project area is found on the Hogback South and Kirtland SW 7.5-minute USGS topographic quadrangle maps. Project area maps are provided in Appendix A. The legal coordinates for the proposed project are as follows:

Township 27 North, Range 16 West, Sections 26, 27, 34, and 35  
New Mexico Principal Meridian (NMPM)  
San Juan County, New Mexico.

## AFFECTED ENVIRONMENT

The proposed lease extension is an irregularly shaped parcel located primarily on shale badlands. The project area has an approximately equal amount of flat terrain and moderate to steep (10-60%) eroding shale hills. North Cottonwood Wash cuts through the northern portion of the project area for a distance of approximately 1.5 miles. This sandy, ephemeral wash is one of the major drainages in the area. The depth of the wash varies from approximately 5-30 feet deep by 10-35 feet wide.

The channel diversion for North Cottonwood Wash begins outside the northeast corner of the mine extension boundary. From a cut bank on the south side of the wash, the new channel will run approximately 1,500 feet southwest to the eastern boundary of the mine extension over moderately undulating (5-8%) terrain. The new channel will follow the eastern border of the lease extension for approximately 1,800 feet before turning east to pass through a saddle in a sandstone ridge. After crossing the saddle the constructed channel will run approximately 1,000 feet southeast over flat terrain to rejoin the existing wash channel.

Geology of the area is predominantly a lower member of the Kirtland Shale Unit. There are small patches of eolian sand deposits near the southern boundary of the proposed Navajo Mine Lease Extension. The main channel of North Cottonwood Wash contains alluvial cobble, gravel, and sand deposits. Rock outcrops of sandstone with interbedded clay layers occur throughout the proposed Navajo Mine Lease Extension. The most notable outcrop is an approximately 1,500-foot long formation of sandstone spires and low buttes (approximately 60 feet high) along the eastern border of the project area.

Much of the soil in the project area consists of weathered shale with high clay content. Most of this soil is moderately to highly alkaline. Small areas near the southern end of the project area contain soils with a higher sand content derived from eolian deposition. Although the proportion of clay is lower in these soils, the alkalinity level is high. Soils near the main channel of North Cottonwood Wash are deep, well-drained stratified sands.

In addition to North Cottonwood Wash, a number of small ephemeral washes and rills occur in the project area. All of these drain into North Cottonwood Wash except for a small area at the southern end of the project area which drains towards an unnamed tributary of Cottonwood Wash south of the project area boundary.

During the 1980s the vegetation throughout the Navajo Mine area was surveyed and classified for a baseline study by Drs. M. K. Wood and K. W. Allred. Five of the vegetative community types delineated in that survey are found in the proposed lease extension; Alkali Wash, Arroyo Shrub, Badlands, Saline Sands, and Thinbreaks. Because of high aridity and poor soil quality, all of these communities are relatively unproductive and exhibit low species diversity. Trees are not present within the project area boundaries.

The Alkali Wash community type occupies approximately 20% of the project area along North Cottonwood Wash, small drainages, and at the base of badlands. Annuals such as Russian thistle and atriplex dominate this community type with an estimated 10-20% cover. There is less than 5% cover by perennials such as buckwheat and alkali sacaton.

The Arroyo Shrub Community is found near the main channel of North Cottonwood Wash and comprises approximately 5% of project area vegetation. Production is relatively high within this community type due to slightly higher moisture availability. Shrubs such as greasewood, rabbitbrush, and snakeweed provide coverage of an estimated 50-60%. Grasses such as Indian ricegrass, sand dropseed, and little barley occur in higher densities within this community than elsewhere in the project area.

The Badlands community type covers the largest amount (approximately 60%) of the project area. It is the most unproductive of the five community types due to high clay and sodium content. Completely bare soil occurs in large patches of up to one acre. Shrubs are totally absent in this community with the exception of isolated individuals of spiny horsebrush and mat saltbush. Annual saltbush and Russian thistle are the most commonly occurring species but still provide less than 5% cover in this community. Other forbs present include pretty daisy, yellow bee plant, halogeton, tumble mustard, and several species of globemallow.

Saline Sands vegetation is present in approximately 5% of the project area. Many plants here are moderately salt tolerant. Species diversity is higher within this community type than elsewhere in the project area. Shrub coverage ranges from an estimated 10-20% and consists of broom snakeweed, four-winged saltbush, rabbitbrush and shadscale. Forbs present include desert bahia, desert marigold, yellow bee plant, buckwheats and sand verbena. Although forb diversity is high, total coverage is less than 5%. Grass diversity



is also high in this community and coverage ranges from approximately 5-10%. Species present include Indian ricegrass, galleta, alkali sacaton, and foxtail barley.

The Thinbreaks community type is present on rock outcrops and adjacent zones of thin soil. Shrubs present include shadscale, rabbitbrush, and snakeweed with approximately 10% cover. Herbaceous cover is less than 5% and is composed of desert bahia, annual saltbush, and scorpionweed. Grass coverage by Indian ricegrass and alkali sacaton is also less than 5%.

Several species of plants considered to be invasive occur in the project area. Halogeton and Russian thistle are the most prevalent of these species, occurring on flat terrain in the Alkali Wash and Badland communities. Cheat grass is predominant in areas that support grass and herbaceous vegetation such as the Saline Sands and Arroyo Shrub communities. Tamarisk is present in small, intermittent patches along the main channel of North Cottonwood Wash

Livestock (cattle) were present in the project area at the time of the biological survey. Wildlife in the vicinity of the project area includes a variety of mammals, birds, and reptiles common to San Juan County. Appendix C provides a list of the more common wildlife occurring in the area. Jackrabbits were observed in the project area. Several coyote burrows are present in the project area. A raven nest with fledglings present was observed in a telephone pole near the west edge of the mine extension. Four small, abandoned prairie dog colonies were found during the TES survey. All of the colony sites are less than 100 feet by 100 feet and contain less than 10 burrows. All of the sites appear to have been abandoned for a year or more. There are no large cliffs or trees in or adjacent to the project area. As Ferruginous hawks are one of the few raptors that will nest on the ground in open country, the project area does provide suitable nesting and foraging habitat for Ferruginous hawk. This species has been observed in the project area in the past. For other raptor species, the proposed project area is limited to potential foraging habitat.

### **THREATENED AND ENDANGERED FLORA**

In following the guidelines of the Endangered Species Act of 1973, as amended, a search was made for TES flora species potentially occurring in the project area. The NNHP was consulted regarding the presence of "species of concern" in the project area. Species of concern include species on the Navajo Endangered Species List (NESL) and/or federally protected, candidate, and other rare species. According to the NNHP, two sensitive flora species have the potential to occur in the project area. These species are addressed below. No listed, candidate or sensitive species were found in the project area during the biological survey. The NNHP consultation letter is provided in Appendix D.

**Mancos milkvetch** (*Astragalus humillimus*)

Status: Federally Endangered; NESL Group 2

Brief Description: Stems forming clumps (mats) with persistent spiny leaf stalks; leaves with 7-11 oval leaflets; petals lavender to purplish. Blooms late April and early May.

Known Distribution: San Juan County, New Mexico and Montezuma County, Colorado.

Habitat: Occurs in cracks of Point Lookout Sandstone of the Mesa Verde Group at 5,000-6,500 feet elevation.

Remarks: The Mesa Verde Group geologic formation is not present in the project area. Therefore, the project area does not provide habitat for the Mancos milkvetch. No Mancos milkvetch were found during surveys of the project area.

**Mesa Verde cactus** (*Sclerocactus mesae-verdae*)

Status: Federally Threatened; NESL Group 3

Brief Description: Stems mostly solitary, sometimes in clusters, 3-11 cm tall, oval depressed-globose; central spines none or rarely 1, radial spines 8-10; flowers cream to pink; fruit green turning tan. Flowers late April and early May.

Known Distribution: San Juan County, New Mexico and Montezuma County, Colorado.

Habitat: Salt desert scrub communities at 4,900 to 6,000 feet in the Fruitland and Mancos Shale formations. Occurs on barren clay hills often with cryptogamic soils.

Remarks: Geology of the project area consists of Kirtland Shale. The survey was conducted during the flowering period for Mesa Verde cactus. No Mesa Verde cacti were found in the project area during the biological surveys.

## THREATENED AND ENDANGERED FAUNA

In following the guidelines of the Endangered Species Act of 1973, as amended, a search was made for TES fauna species in the project area. The NNHP was consulted regarding the presence of "species of concern" in the project area. According to the NNHP, no federally listed fauna species are known to occur in or near the project area. Seven species of concern have been identified as potentially occurring the project area. These species are described below. No TES fauna species or signs thereof, were observed in the project area. A report of TES fauna species for the proposed Navajo Mine Lease Extension was prepared by Hawks Aloft Inc. on February 6, 2001.

**Black-footed ferret (*Mustela nigripes*)**

Status: Federally Endangered; NESL Group 2

Description: Head and body 38-46 cm, tail 13-15 cm. Weight of two known males 964 and 1078 g. The skull has 34 teeth. The weasel-like mammal is recognized by its yellowish brown to buffy body, its black forehead, black-tipped tail and black feet.

Known distribution and habitat: The black-footed ferret once survived in western North and South Dakota, eastern Montana, Wyoming and Colorado. It possibly extended into Nebraska and south to Oklahoma and New Mexico. This species was considered extirpated from the wild; however, efforts are now being made to reintroduce black-footed ferrets. Black-footed ferrets inhabit arid prairies and prairie dog towns.

Remarks: Small, less than 10 acres in size, prairie dog colonies occur in the project area. Additionally, these colonies appear abandoned. Therefore, the project area does not provide potential habitat for Black-footed ferret.

**Golden eagle (*Aquila chrysaetos*)**

Status: NESL group 3; Migratory Bird Treaty Act (MBTA); Eagle Protection Act (EPA)

Distinguishing features: Brown with golden wash over back of head and neck; dark bill; tail faintly banded.

Distribution and habitat: The Golden eagle is found year around throughout much of the San Juan Basin. Inhabits mountainous or hilly terrain, hunting over open country.

Remarks: Open terrain vegetated with low growing shrubs and grasses provide potential foraging habitat for Golden eagle, therefore, this raptor species may be seen occasionally in the project area. This species has been identified as occurring within one mile of the project area. There are no cliffs or large rock outcrops in the project area to offer potential perch or nest sites for Golden eagles. No Golden eagles were seen in the project area during the biological surveys.

**Ferruginous hawk (*Buteo regalis*)**

Status: Federally Protected; NESL group 3; MBTA

Distinguishing features: Rust back and shoulders; paler head; white tail washed with pale rust. Wings are long, broad. Rusty leggings form a conspicuous V against whitish underparts.

Distribution and habitat: Year around in northern Arizona and northern New Mexico. Winters in southern Arizona, southern New Mexico and California. Breeds in northern United States up into Canada. Inhabits dry, open country and roosts in trees, on poles or even on the ground.

Remarks: May nest on open ground or badland spires and occasionally electric utility poles. Although the area does provide potential nesting habitat for Ferruginous hawks, no nesting sites were located in the project area. No Ferruginous hawks were observed during the biological surveys. A report of TES fauna species for the Lease Extension Area was prepared by Hawks Aloft Inc. in February of 2001.

**Peregrine Falcon (*Falco peregrinus*)**

Status: NESL Group 4; MBTA

Distinguishing Features: Long pointed wings, dark head with "mustaches" below each eye; adults with a 3.5 foot wingspan, slate gray above and barred below.

Distribution and habitat: The distribution of the Peregrine Falcon is throughout the continental United States. The breeding range extends from Canada to Alaska and into Baja California and Central Mexico. Preferred habitats are open country and cliff areas.

Remarks: No Peregrine falcons were observed during the biological surveys. This species generally prefers nesting habitat that is in close proximity to water with extensive, high inaccessible vertical cliffs with great topographic variability. According to Ellis (1982), Peregrine falcons prefer vertical cliffs over 100 feet in height. Due to the absence of permanent surface water and cliffs, the project area does not contain potential nesting habitat for Peregrine falcon.

**Southwestern willow flycatcher (*Empidonax traillii extimus*)**

Status: Federally Endangered; NESL group 2; MBTA

Distinguishing Features: Upper parts brownish-olive, whitish throat contrasts with pale olive breast; belly pale yellow. Lacking an eye ring.

Distribution and habitat: A subspecies that ranges from southern California to Arizona, New Mexico, Southwestern Colorado, extreme southern portions of Nevada and Utah, and western Texas. Dense riparian habitats near surface water or saturated soil.

Remarks: There are no perennial water resources, wetlands or riparian areas in the project area. No Southwestern willow flycatchers were observed during the field survey. The project area does not represent potential habitat for this species.

**Mountain Plover** (*Charadrius montanus*)

Status: Proposed Threatened; NESL group 4; MBTA

Distinguishing features: Somewhat like a small Killdeer, but with no breast-rings. In breeding season, has a white forehead and line over the eye, contrasting with a dark crown. In nondescript winter plumage, has pale legs, light wing stripe and dark tail band. In flight shows white underwings.

Distribution and habitat: Western Great Plains. Breeding range occurs in southern Wyoming, eastern Colorado and northeastern New Mexico. Winter range is from central California to central Mexico. Common in small flocks in dry upland habitats, often far from water. Prefers semi-arid plains, grasslands, and plateaus. In winter, usually found on bare dirt fields.

Remarks: The general topography and minimal vegetative cover in approximately 20% of the project area within North Cottonwood Wash represents potential Mountain plover nesting habitat. The most likely time for Mountain plover to occur in the project area would be during breeding season (March-May). No Mountain plovers or nests were observed in the project area during the biological surveys conducted by Ecosphere during May of 2001. A report of TES fauna species for the Lease Extension Area was prepared by Hawks Aloft Inc. in February of 2001.

**Pronghorn** (*Antilocapra americana americana*)

Status: NESL group 3

Description: A pale tan, medium-sized mammal; distinguished by its large white rump patch, white lower sides, 2 broad white bands across throat, and slightly curved horns, each with a single prong projecting forward.

Known distribution and habitat: Occurs in the western states from Montana to Texas to eastern California. Inhabits open prairies and sagebrush plains.

Remarks: No pronghorn or signs thereof were seen in the project area. Pronghorn are not known to utilize the project study area on a regular basis as forage within the project area is limited. Pronghorn are not expected to be affected by development of the proposed lease extension.

## SURVEY METHODS AND MATERIALS

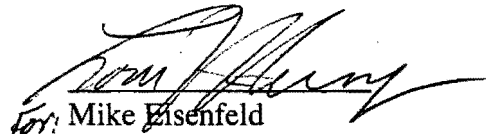
A pedestrian field survey of the proposed **Navajo Mine 654 Acre Dixon Pit Lease Extension Project** including the proposed North Cottonwood Wash diversion channel was conducted by Don Hyder and Pete Skartvedt of Ecosphere between May 22-25, 2001. The survey consisted of parallel pedestrian transects at 15-foot intervals over the project area. All plants, animals, animal sign and habitat were recorded. Binoculars were used to search the area for raptors.

## POTENTIAL IMPACTS

There was no evidence of any listed or sensitive flora or fauna species, or critical habitats thereof, in the proposed project area. No raptors or raptor nests were observed during the biological survey. No impacts to TES Navajo Mine 654 Acre Dixon Pit Lease Extension Project.

## CERTIFICATION

It is believed by Ecosphere that the proposed action would not violate any of the provisions of the Endangered Species Act of 1973 as amended, or adversely impact any of the species identified on the NESL. Conclusions of this report are based on actual field examination and are correct to the best of my knowledge.

  
For: Mike Eisenfeld  
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**APPENDIX A**

**MAPS**

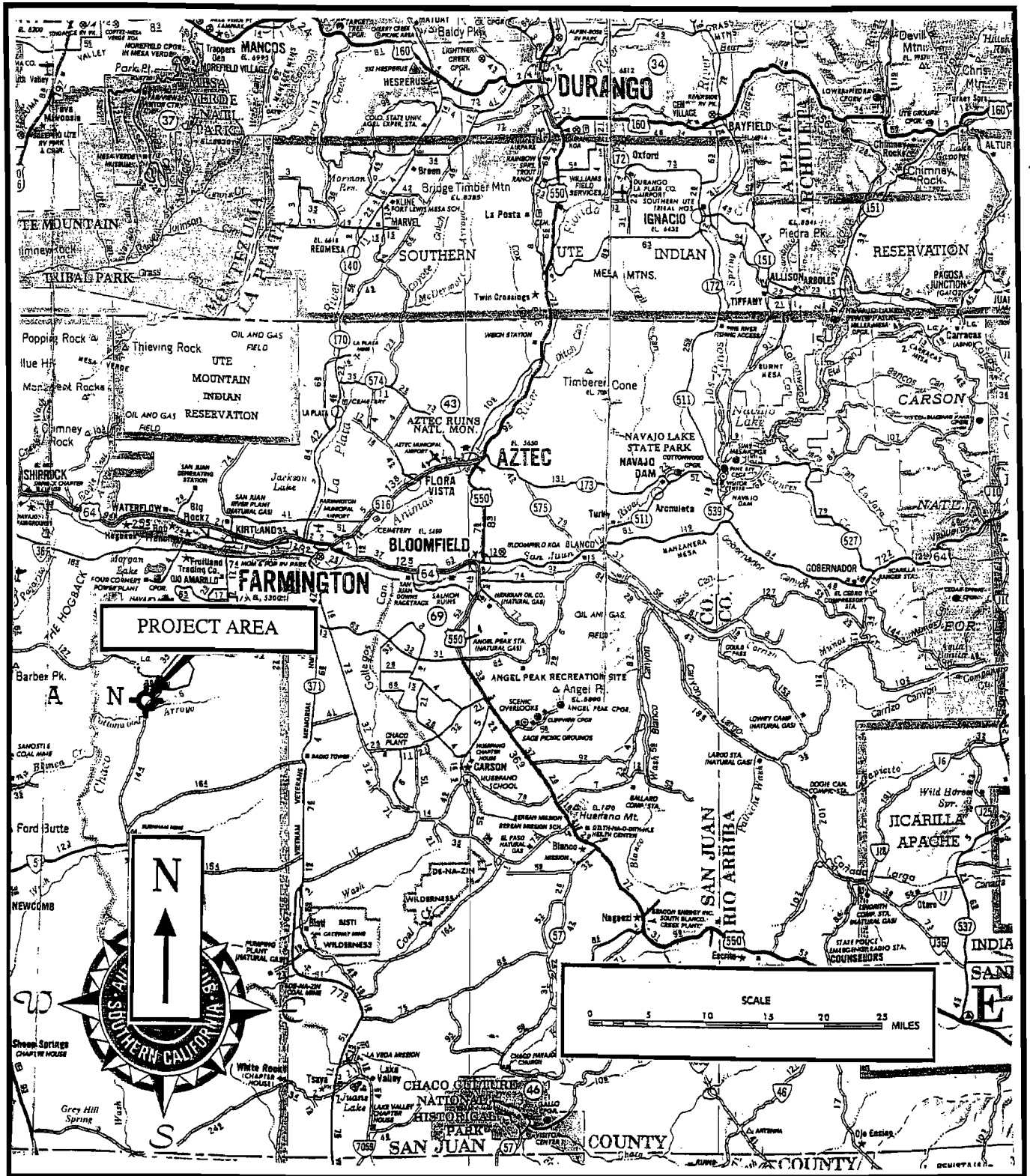
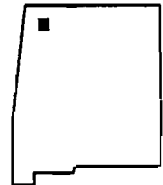


FIGURE 1.0  
VICINITY MAP

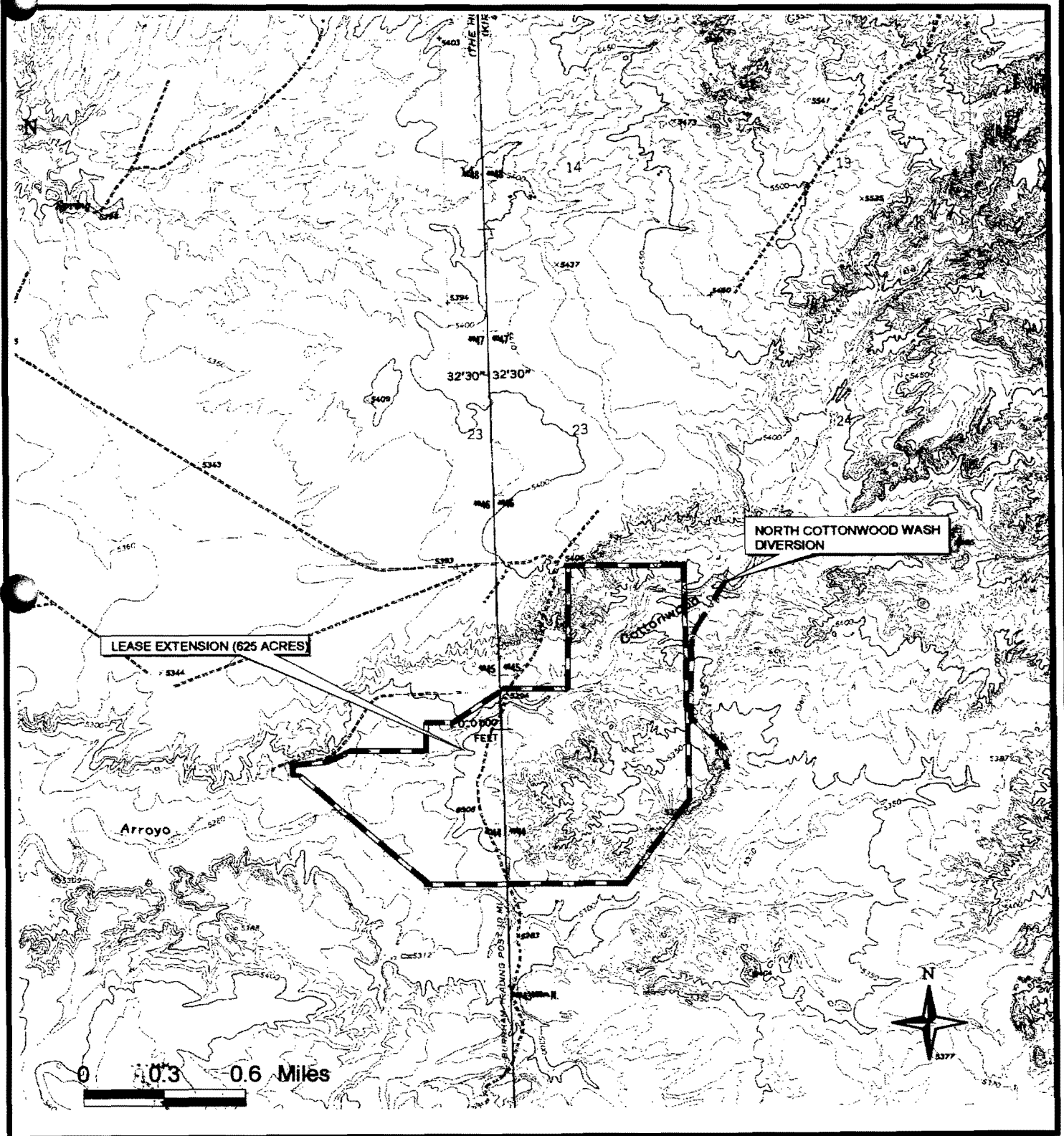
BROKEN HILLS PROPRIETARY COMPANY  
 NAVAJO MINE 654 ACRE DIXON PIT LEASE  
 EXTENSION PROJECT  
 SAN JUAN COUNTY, NEW MEXICO

QUAD LOCATION  
NEW MEXICO



USGS 7.5 MINUTE  
TOPOGRAPHIC SURVEY MAP

THE HOGBACK SOUTH &  
KIRTLAND SW QUADRANGLES  
SAN JUAN COUNTY, NEW MEXICO



**FIGURE 2**  
**PROJECT AREA MAP**

**BROKEN HILLS PROPRIETARY COMPANY**  
**NAVAJO MINE 654 ACRE DIXON PIT LEASE EXTENSION PROJECT**  
**SAN JUAN COUNTY, NEW MEXICO**

**APPENDIX B**

**PLANTS OCCURRING IN THE 654 ACRE DIXON PIT  
LEASE EXTENSION PROJECT AREA**

## Grasses

<i>Aristida purpurea</i> Nutt.	Red three-awn
<i>Bromus tectorum</i> L.	Cheatgrass
<i>Eremopyrum triticeum</i> (Gaertn.) Nevski.	Annual wheatgrass
<i>Hilaria jamesii</i> (Torr.) Benth.	Galleta grass
<i>Hordeum jubatum</i> L.	Foxtail barley
<i>Hordeum pusillum</i> Nutt.	Little barley
<i>Oryzopsis hymenoides</i> (R. & S.) Ricker	Indian ricegrass
<i>Sitanion hystrix</i> (Nutt.) J.G. Smith	Squirrel-tail
<i>Sporobolus airoides</i> Torr.	Alkali sacaton
<i>Sporobolus cryptandrus</i> Torr. & Gray	Sand drop seed
<i>Sporobolus giantius</i> Nash	Giant drop seed
<i>Stipa neomexicana</i> (Thurb.) Scribn.	Needle & thread grass
<i>Vulpia octoflora</i> (Walter.) Rydb.	Six-weeks fescue

## Forbs

<i>Abronia fragrans</i> Nutt.	Sand verbena
<i>Allium sp.</i> L.	Wild onion
<i>Ambrosia acanthicarpa</i> Hook.	Bur Ragweed
<i>Astragalus mollissimus</i> Torr.	Milkvetch
<i>Atriplex powellii</i> Wats.	Annual saltbush
<i>Atriplex saccaria</i> Wats.	Annual saltbush
<i>Chaenactis stevioides</i> Hook.& Arno.	Chaenactis
<i>Cleome lutea</i> Hook.	Yellow beeplant
<i>Cryptantha crassisepala</i> (Torr.& Gray) Greene	Cryptantha
<i>Cymopterys fendleri</i> Gray	Biscuitroot
<i>Cymopterys purpurascens</i> (Gray) Jones	Biscuitroot
<i>Descurainia pinnata</i> (Pursh) Britt.	Tansy mustard
<i>Descurainia sophia</i> (L.) Webb.	Tansy mustard
<i>Dithyrea wislizenii</i> Engelm.	Spectacle-pod
<i>Draba reptans</i> (Lam.) Fern.	Whitlow grass
<i>Erigeron bellidiastrum</i> Nutt.	Pretty Daisy
<i>Eriogonum cernuum</i> Nutt.	Nodding buckwheat
<i>Eriogonum gordonii</i> Benth. in DC.	Gordon buckwheat
<i>Eriogonum scabrellum</i> Reveal	Buckwheat
<i>Gaillardia pinnatifida</i> Torr.	Blanketflower
<i>Galium coloradense</i> Wight	Bedstraw
<i>Gilia inconspicua</i> (J.E. Sm.) Sweet	Gilia
<i>Gilia polycladon</i> Torr.	Gilia
<i>Halogeton glomeratus</i> C.A. Mey in Ledeb.	Halogeton
<i>Kochia scoparia</i> (L.) Schrad.	Summer cypress
<i>Lappula occidentalis</i> (Wats.) Greene	Stickseed
<i>Leucelene ericoides</i> (Torr.) Green.	Roseheath
<i>Lupinus pusillus</i> Pursh.	Lupine

<i>Lygodesmia grandiflora</i> (Nutt.) T. & G.	Lygodesmia
<i>Malacothrix sonchoides</i> (Nutt.) Torr. & Gray	Desert dandelion
<i>Mentzelia albicaulis</i> Dougl.	Stickleaf
<i>Nama hispidum</i> Gray	Nama
<i>Oenothera caespitosa</i> Nutt.	Evening primrose
<i>Oenothera pallida</i> Lindl.	Evening primrose
<i>Oenothera</i> sp.	Evening primrose
<i>Penstemon angustifolius</i> Nutt.	Penstemon
<i>Phacelia crenulata</i> Torr.	Scorpionweed
<i>Plantago patigonica</i> Jacq.	Plantain
<i>Platyschkuria integrifolia</i> (Gray) Rydb. var. <i>oblongifolia</i> Ellison	
<i>Rumex hymenosepalus</i> Torr.	Wild rhubarb
<i>Salsola iberica</i> Sennen & Pau	Russian thistle
<i>Sisymbrium altissimum</i> L.	Tumblemustard
<i>Solanum rostratum</i> Dunal	Buffalobur
<i>Sphaeralcea grossulariaefolia</i> (H. & A.) Rydb.	Globemallow
<i>Sphaeralcea coccinea</i> (Nutt.) Rydb.	Globe mallow
<i>Sphaeralcea parvifolia</i> Nels.	Globe mallow
<i>Stanleya pinnata</i> (Pursh) Britt.	Princes plume
<i>Stephanomeria exigua</i> Nutt.	Wirelettuce
<i>Streptanthella longirostris</i> (Wats.) Rydb.	Twistflower
<i>Townsendia incana</i> Nutt.	Daisy
<i>Tragopogon dubius</i> Scop.	Goatsbeard

### Shrubs

<i>Artemisia filifolia</i> Torr.	Sagebrush
<i>Atriplex canescens</i> (Pursh) Nutt.	Four winged saltbush
<i>Atriplex confertifolia</i> (Torrey & Frem.) S. Wats.	Shadscale
<i>Atriplex cuneata</i> (A. Nels)	Saltbush
<i>Atriplex obovata</i> Moq.	Saltbush
<i>Chrysothamnus nauseosus</i> (Pall.) Britt.	Rubber rabbitbrush
<i>Ephedra torreyana</i> Wats.	Mormon tea
<i>Eriogonum corymbosum</i> Benth.	Wild buckwheat
<i>Eriogonum leptophyllum</i> (Torr.) Woot. & Standl.	Wild buckwheat
<i>Gutierrezia sarothrae</i> (Pursh) Britt. & Rusby	Broom snakeweed
<i>Sarcobatus vermiculatus</i> (Hook) Torr.	Greasewood
<i>Suaeda torreyana</i> Wats.	Seepweed
<i>Tamarix ramosissima</i> Ledebour	Tamarisk
<i>Tetradymia spinosa</i> Hook. & Arno.	Horsebrush

**Cacti - Yucca**

*Opuntia polyacantha* Haw.

*Sclerocactus parviflorus* Clover & Jotter

*Sclerocactus whipplei* (Englm.) Britt. & Rose

*Yucca angustissima* Engelm.

Prickly pear cactus

Sclerocactus

Whipple fishhook

Soapweed

**Trees**

None

**APPENDIX C**

**ANIMALS EXPECTED IN OR NEAR PROJECT AREA**



**ANIMALS POTENTIALLY OCCURRING IN OR NEAR THE  
654 ACRE DIXON PIT LEASE EXTENSION PROJECT AREA**

**MAMMALS**

*Ammospermophilus leucurus*  
*Canis latrans*  
*Cervus elaphus*  
*Dipodomys spectabilis*  
*Erethizon dorsatum*  
*Lepus californicus*  
*Mephitis mephitis*  
*Myotis sp.*  
*Odocoileus hemionus*  
*Perognathus flavus*  
*Spermophilus spilosoma*  
*Sylvilagus auduboni*  
*Vulpes vulpes*

Whitetail antelope squirrel  
Coyote  
American elk  
Bannertail kangaroo rat  
Porcupine  
Blacktail jackrabbit  
Striped skunk  
Bat  
Mule deer  
Silky pocket mouse  
Spotted ground squirrel  
Desert cottontail  
Red fox

**BIRDS**

*Apelocoma coerulescens*  
*Buteo jamaicensis*  
*Carpodacus mexicanus*  
*Cathartes aura*  
*Chordeiles minor*  
*Colaptes auratus*  
*Corvus corax*  
*Eremophila alpestris*  
*Euphagus cyanocephalus*  
*Falco sparverius*  
*Gymnorhinus cyanocephalus*  
*Pica pica*  
*Sialia mexicana*  
*Sturnella neglecta*  
*Sturnus vulgaris*  
*Turdus migratorius*  
*Zenaidura macroura*  
*Zonotrichia leucophrys*

Scrub Jay  
Red-tailed Hawk  
House Finch  
Turkey Vulture  
Common Nighthawk  
Northern Flicker  
Common Raven  
Horned Lark  
Brewer's Blackbird  
Sparrow Hawk  
Piñon Jay  
Black-billed Magpie  
Western Bluebird  
Western Meadowlark  
Starling  
Robin  
Mourning Dove  
White-crowned Sparrow

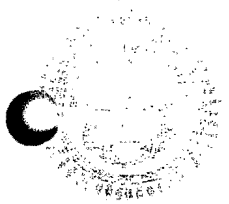
**REPTILES**

*Crotalus viridis*  
*Crotaphytus collaris*  
*Phrynosoma douglassi*  
*Pituophis melanoleucus*  
*Sceloporus stansburiana*  
*S. graciosus*

Prairie rattlesnake  
Collared lizard  
Short-horned lizard  
Bull snake  
Side-blotched lizard  
Sagebrush lizard

**APPENDIX D**

**NAVAJO NATURAL HERITAGE PROGRAM  
SPECIES OF CONCERN CONSULTATION LETTER**



# THE NAVAJO NATION

P. O. BOX 9000 • WINDOW ROCK, ARIZONA 86515 • (520) 871-6000

KELSEY A. BEGAYE  
PRESIDENT

TAYLOR McKENZIE, M.D.  
VICE PRESIDENT

April 26, 2001

Don Hyder, Biologist/ Farmington Office  
108 N. Behrend  
Suite A  
Farmington, New Mexico 87401  
(505) 327-3088

**SUBJECT: Lease Extension of the Broken Hills Proprietary Company (BHP) Navajo Mine.**

Mr. Hyder:

The following information on species of concern<sup>1</sup> is provided in response to your 04 April 2001 request concerning the subject project, which consists of a lease extension (approximately 654 acres) of the BHP Navajo Mine in San Juan County, New Mexico. The extension is located within Area IV of Navajo Mine and would encompass North Cottonwood Wash and Burnham Road. North Cottonwood Wash will be diverted to the east side of the lease. The diversion will require construction of a ditch encompassing an area approximately 4,270 feet in length and approximately 275 feet in width for a total area of approximately 27 acres.

At this time, the Navajo Fish and Wildlife Department (NFWD) has no record of species of concern occurring on the project sites.

Each 7.5-minute quadrangle containing project boundaries is addressed separately below. These species lists are quadrangle-specific rather than project-specific. Potential for species has been determined primarily on quadrangle-wide coarse habitat characteristics and species range information. Your project biologist should determine habitat suitability at the project sites.

A total of 09 species are identified in the quadrangle-specific lists. They are:

1. Antilocapra americana (Pronghorn); NESL group 3.
2. Aquila chrysaetos (Golden Eagle); NESL group 3; MBTA; EPA.
3. Astragalus humillimus (Mancos Milk-vetch); NESL group 2; ESA endangered.
4. Buteo regalis (Ferruginous Hawk); NESL group 3; MBTA.
5. Charadrius montanus (Mountain Plover); NESL group 4; ESA proposed threatened; MBTA.

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<sup>1</sup>"Species of concern" include protected, candidate, and other rare or otherwise sensitive species, including certain native species and species of economic or cultural significance. For each species, the following tribal and federal statuses are indicated: Navajo Endangered Species List (NESL), federal Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), and Eagle Protection Act (EPA). No legal protection is afforded species with only ESA candidate or NESL group 4 status; please be aware of these species during surveys and inform the NFWD of observations. Documentation that these species are more numerous or widespread than currently known, and addressing these species in project planning and management is important for conservation and may contribute to ensuring they will not be uplisted in the future. Species without ESA or NESL legal protection (e.g., NESL group 4 species) are only included in responses on an irregular basis and may not be included in this response. Please refer to the NESL for a list of group 4 species; contact me if you need a copy.

6. Empidonax traillii extimus (Southwestern Willow Flycatcher); NESL group 2; ESA endangered; MBTA.
7. Falco peregrinus (Peregrine Falcon); NESL group 4; MBTA.
8. Mustela nigripes (Black-footed Ferret); NESL group 2; ESA endangered. Potential for the black-footed ferret should be evaluated if prairie-dog towns of sufficient size (per NFWD guidelines) occur in the project area.
9. Sclerocactus mesae-verdae (Mesa Verde Cactus); NESL group 3; ESA threatened.

#### **THE HOGBACK SOUTH, NM QUADRANGLE**

**Project Sites: 654 Acre Lease Extension Area.**

At this time, the Navajo Fish and Wildlife Department (NFWD) has no record of species of concern occurring on the project sites.

Species of concern known to occur within one mile of the project sites include:

1. Aquila chrysaetos

Additional species of concern with potential to occur on the 7.5-minute quadrangle include:

2. Buteo regalis
3. Charadrius montanus
4. Empidonax traillii extimus
5. Falco peregrinus
6. Mustela nigripes
7. Astragalus humillimus
8. Sclerocactus mesae-verdae

#### **KIRTLAND SW, NM QUADRANGLE**

**Project Sites: 654 Acre Lease Extension Area.**

At this time, the Navajo Fish and Wildlife Department (NFWD) has no record of species of concern occurring on the project sites.

Species of concern known to occur within one mile of the project sites include:

1. Buteo regalis

Additional species of concern with potential to occur on the 7.5-minute quadrangle include:

2. Antilocapra americana
3. Aquila chrysaetos
4. Charadrius montanus
5. Mustela nigripes

**ALL QUADRANGLES/ PROJECT SITES:**

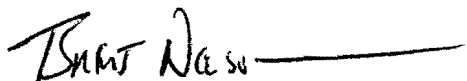
Biological surveys should be conducted during the appropriate season. Surveyors on the Navajo Nation must be permitted by the Director, NFWD. Contact Jeff Cole at (520) 871-7068 for permitting procedures. Questions pertaining to surveys should be directed to the NFWD Zoologist (David Mikesic) for animals at 871-7070, and Botanist (Daniela Roth) for plants at 871-6472.

Potential impacts to wetlands should also be evaluated. The U.S. Fish & Wildlife Service's National Wetlands Inventory (NWI) maps should be examined to determine whether areas classified as wetlands are located close enough to the project site(s) to be impacted. In cases where the maps are inconclusive (e.g., due to their small scale), field surveys must be completed. For field surveys, wetlands identification and delineation methodology contained in the "Corps of Engineers Wetlands Delineation Manual" (Technical Report Y-87-1) should be used. When wetlands are present, potential impacts must be addressed in an environmental assessment and the Army Corps of Engineers, Phoenix office, must be contacted. NWI maps are available for examination at the NFWD's Natural Heritage Program (NHP) office, or may be purchased through the U.S. Geological Survey (order forms are available through the NHP). The NHP has complete coverage of the Navajo Nation, excluding Utah, at 1:100,000 scale; and coverage at 1:24,000 scale in the southwestern portion of the Navajo Nation.

The information in this report was identified by the NFWD's biologists and computerized database, and is based on current data. It should not be regarded as the final statement on the occurrence of any species, nor should it substitute for on-site surveys. Also, because the NFWD's information is continually updated, any given information response is only wholly appropriate for its respective request.

An invoice for this information is forthcoming from the Navajo Division of Finance.

If you have any questions I may be reached at (520) 871-6489.



Brent Nelson, Data Manager  
Natural Heritage Program  
Navajo Fish and Wildlife Department

xc: file/chrono

**THREATENED, ENDANGERED, AND SENSITIVE (TES)  
FLORA SURVEY REPORT**

**BHP BILLITON – NAVAJO MINE; AREA IV NORTH  
SAN JUAN COUNTY, NEW MEXICO**



San Juan milkweed (*Asclepias sanjuanensis*)

**Prepared for:**

**BHP Navajo Coal Company  
Navajo Mine, New Mexico Operations  
PO Box 1717  
Fruitland, NM 87416**

**Prepared by:**



**ECOSPHERE ENVIRONMENTAL SERVICES**

**August 2005**

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## **1.0 PROJECT DESCRIPTION**

Ecosphere Environmental Services (Ecosphere) conducted a threatened, endangered, and sensitive (TES) flora species survey for BHP Billiton Navajo Coal Company (BNCC) in support of future mining activities at the Navajo Mine. Biologists from Ecosphere completed pedestrian transect surveys of Area IV North of the Navajo Mine, located within the Navajo Indian Reservation, in May 2004. Field data summarizing the presence and absence of TES flora species were collected to provide the Office of Surface Mining (OSM) with data necessary to prepare National Environmental Protection Act (NEPA) documentation for proposed coal extraction activities in Area IV North. With this purpose in mind, biologists from Ecosphere focused on plants with special protection or conservation status according to federal, state, and Navajo Nation government agencies.

## **2.0 STUDY AREA**

### ***2.1 Location***

Area IV North is located on the Navajo Mine approximately 15 miles southwest of Farmington, New Mexico. Area IV North is found on the Hogback S, Kirtland SW, Newcomb NE, and The Pillar NW 7.5-minute USGS Quadrangles (Figure 1).

### ***2.2 Physical Description***

The study area is located within the Colorado Plateau province, on the west edge of the San Juan Basin. Topography in the area includes flats and tablelands with moderate to considerable relief associated with incised washes and canyons. The study area is within the Chaco Wash watershed with shallow soils, steep hills, and rock outcrops. Although this area is intersected by several drainages, the drainages are dry much of summer. The only standing surface water present within the boundaries of Area IV North is a stock pond located at the southern border of the study area. Most precipitation in the area occurs from July through October in localized, short-duration, high-intensity thunderstorms.



### 2.3 *Vegetation*

Area IV North is comprised of Great Basin desert-scrub habitat (Dick-Peddie 1993). Great Basin desert-scrub habitat is a cold desert ecosystem dominated by a variety of shrubs with a sparse under story of forbs and grasses, with bare ground dominating in poor, alkaline soils (Fitzgerald et al. 1994, Dick-Peddie 1993). Galleta grass (*Hilaria jamesii*) and alkali sacaton (*Sporobolus airoides*) are sparsely represented among forbs and shrubby vegetation. Broom snakeweed (*Gutierrezia sarothrae*) is abundant, as is annual saltbush (*Atriplex* spp.), rubber rabbitbrush (*Chrysothamnus nauseosus*), sagebrush (*Artemisia filifolia*), milkvetch (*Astragalus mollissimus*), and greasewood (*Sarcobatus vermiculatus*). Salt cedar (*Tamarix* spp.), cottonwood (*Populus* spp.), and Russian olive (*Elaeagnus angustifolia*) are sparsely scattered throughout the study area and occur only within several intermittent drainages. The project area also contains a few strips of riparian vegetation, primarily willows (*Salix* spp.), at the confluence of Pinabete Wash and Chaco Wash.

### 3.0 **COMPILATION OF DATA AND METHODOLOGY**

Prior to the field surveys a list of all federal state and Navajo Nation listed rare and protected plant species with potential to occur in San Juan County was secured (Table 1). Key field diagnostics of plants were studied at the San Juan College herbarium where specimens of these plants are available for observation. Notes were taken at the herbarium to ensure that these plants could be accurately identified if encountered during field surveys. All plant species seen in Area IV North during the 2 weeks of transect work were identified. This was done by either keying plants to species with the aid of regional floras (Weber and Whittmann 2001) or by personal consultation with a local plant identification expert (Ecosphere, unpublished document, 2005).

Pedestrian surveys of the entire survey area were conducted concurrently with another study of the flora and vegetation characteristics in Area IV North (Ecosphere, unpublished document, 2005). During this concurrent study, 199 transects were randomly selected throughout Area IV North and all potential habitat types were sampled. As these were read, a list of plants for all of Area IV was compiled. As transects were walked to inventory plants and sample vegetation characteristics, additional time was spent searching for TES plants. The TES surveys

focused on identified suitable habitat, as well as species-rich habitats and in unique micro-habitats such as in sand dunes, along drainages, and in soil-filled seams below rock slicks.

#### **4.0 ENDANGERED, THREATENED AND SENSITIVE SPECIES**

According to the New Mexico Rare Plant Council, there are 18 plant species in San Juan County, New Mexico listed as rare (Table 1). For the purpose of this report, the term rare refers to a taxon that is narrowly endemic to a specific geographic feature (e.g., rock outcrops) or subset area of a phytogeographic region (e.g., southern Rocky Mountains, northern Chihuahuan desert). It can be locally abundant within its narrow range, but typically will not extend more than 100 miles in length of range. Included on this list are all federally listed threatened and endangered plants and species listed on the Navajo Endangered Species List (NESL).

#### **5.0 RESULTS**

Biologists from Ecosphere were aware of the possible occurrence all 18 plant species (Table 1). Special attention was given to the following four plant species known to occur near Area IV North. The remaining plant species (Table 1) occur in other areas of San Juan County but are not likely to occur in Area IV North.

##### **5.1 *Abronia bolackii***

This rare plant species was only recently described (Atwood et al. 2002). It is known from only four locations in San Juan County, New Mexico. One of these locations is 10 miles SSW of Waterflow on the Navajo Mine Lease land west of the Neck region. This is approximately two miles from the Area IV North survey area. Since this is near the Area IV North survey area, special attention was given to areas with gypsiferous clay lens soils of the Ojo Alamo Formation, a preferred substrate for this plant. This species differs from *Abronia fragrans*, a common plant in Area IV North, by having rhizomes, occurring in colonies, and having a shorter corolla tube. Whenever patches of *Abronia* were encountered that appeared to be clonal, these were closely examined. No *A. blackii* plants were observed in Area IV North.

##### **5.2 *Asclepias sanjuanensis***

This milkweed was encountered at four widely dispersed locations in Area IV North. Eight or more individual milkweed plants were encountered at each of these locations. The stems of this perennial milkweed grow from a woody taproot and are 4-8 cm. tall. Stems are typically prostrate with leaves 2-4 cm long. Diagnostic characteristics of this milkweed are the white, tomentulose leaf margins, and a terminal inflorescence with reddish-violet flowers. This milkweed flowers in April and has mature fruits in mid to late May (Ecosphere 1995). The characteristic habitat of this plant is sandy soil, sometimes occurring in pinyon-juniper woodlands.

In Area IV North this plant occurs in sandy soil within dune habitats along small sandy gullies. There is no federal, State of New Mexico, or Navajo Nation protection for this species. The State recommends that these plants be protected from land use impacts when possible. The Navajo Nation Department of Fish and Wildlife (NNDFW) does not currently have sufficient information to support this species being listed as Group 2 or Group 3 (G2 or G3) on the NESL. According to Daniela Roth, NNDFW Botanist, this species may be locally abundant or more abundant than was previously thought, and therefore it is currently listed as NESL Group 4. However, the NNDFW does request that discoveries be reported in order to further assess the status of this plant on the reservation. Based on what is currently known about this plant, it is unlikely that any special protection measures for this species would be applied by the NNDFW on mining in Area IV North (Daniela Roth, pers. comm., 2004).

### 5.3 *Proatriplex pleiantha*

*Proatriplex pleiantha* is an annual herb with alternate, succulent, petioled, and entire leaves (Welsh 2003). This species has been collected from 15 locations in Montezuma County Colorado, from one location in San Juan County Utah, and from 15 locations in San Juan County New Mexico. All but four of the New Mexico collections are from between Chinle Wash and Cottonwood Arroyo. This cluster of collections for this species in San Juan County includes collections from the Navajo Mine Lease (Marron, Tascheck, Knight, Inc. and Ecosphere Environmental Service, Inc., unpublished document 1991). The 1991 report summarized the taxonomic history of this rare plant species (first called *Atriplex pleiantha*), and had maps of the known locations for this plant on and near the Navajo Mine

The 1991 report surveyed two areas for *P. pleiantha*: Areas A and B. Area A was a badland area situated west and adjacent to the Navajo Mine Lease, included 2,300 acres of land east of Chaco River and included the Navajo Mine Lease section known as “the neck.” In these areas 31 of 52 *P. pleiantha* locations were reported to occur on Navajo Mine Lease lands. It is of significance that this cluster of locations is considered the “core cluster” of *P. pleiantha* individuals for San Juan County, where densities are relatively high. The other area surveyed in 1991 was 2,939 acres of land located east of the Navajo Mine, in the Cottonwood Arroyo Drainage, in an area just south of the Navajo Indian Irrigation Project. In this area 21 locations of *P. pleiantha* were discovered, but these locations were more scattered and were less concentrated than in Area A.

Since *P. pleiantha* occurs about 2 miles northeast of Area IV North, it was expected to occur in this survey area. In preparation of the Area IV North floristic survey the following information on the potential habitat for this plant was obtained from the literature. Stutz and Chu (1998) summarized the status of *P. pleiantha* and considered it to be abundant enough to not be officially classified as rare or threatened. Foote (1989) did work on the germination success and requirements of this species. Stutz et al. (1990) reported that *P. pleiantha* plants often occur in clusters within areas 10-50 m<sup>2</sup> in size. *Proatriplex pleiantha* plants located in the vicinity of Area IV North region occurred in densities as great as 50-80 plants per m<sup>2</sup>.

*P. pleiantha* is loosely associated with stratigraphic horizons of the Kirtland formation, Mancos shale, Lewis shale and Morrison formation (Adrian Hunt, Museum of Natural History pers. comm.). The typical habitat for this plant is badland landscape, occurring in association with other halophytic plants such as summer cypress (*Kochia scoparia*), soapweed (*Suaeda torreyana*), annual saltbush (*Atriplex obovata*), poverty weed (*Monolepis nuttalliana*) and inland saltgrass (*Distichlis spicata*). Whenever these plant species were located (occasionally) and whenever these stratigraphic horizons were encountered (seldom), a more intense search was made for this plant species. No *P. pleiantha* was observed in Area IV North.

#### **5.4 *Puccinellia parishii***

This grass occurs in alkali swales. This grass is to be looked for among halophytic plants such as summer cypress (*Kochia scoparia*), soapweed (*Suaeda torreyana*), annual saltbush

(*Atriplex obovata*), poverty weed (*Monolepis nuttalliana*) and inland saltgrass (*Distichlis spicata*). It has not yet been located in Area IV North.

### **5.5 Other Rare Plants**

In regard to the other rare plants in San Juan County (Table 1), Cottam's milkvetch (*Astragalus cottamii*) and Mancos milkvetch (*Astragalus humillimus*) occur about 10 miles southwest of Area IV North. However, these occur on very different substrates and are not expected on BHP lease lands. Mesa Verde cactus (*Sclerocactus mesae-verdae*) also occurs about 6 miles west-northwest of Area IV North, but since it occurs on very different substrates it, too is not expected to occur on BHP lease lands.

## **6.0 DISCUSSION**

No plant species listed by the USFWS under the authority of the Endangered Species Act of 1973 or by the New Mexico Rare Plant Council were observed in Area IV North. However, San Juan milkweed (*Asclepias sanjuanensis*) was observed in several areas of Area IV North. San Juan milkweed is listed on the NESL as a Group 4 species according to the Navajo Nation Natural Heritage Program, and it is likely to occur within the sandy regions of the proposed study area.

## 7.0 SELECTED REFERENCES

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**Table 1. Rare Plant Species Known To Occur In San Juan County, New Mexico.**

<b>Species</b>	<b>Family</b>	<b>Federal</b>	<b>State of NM</b>	<b>Navajo Nation</b>
<i>*Abronia bolackii</i>	Nyctaginaceae	-	Species of concern	-
<i>Aletes maddougallii ssp. breviradiatus</i>	Brassicaceae	-	Species of concern	-
<i>Aliciella formosa</i>	Polemoniaceae	Species of concern	Endangered	-
<i>*Asclepias sanjuanensis</i>	Asclepiadaceae	-	Species of concern	Group 4
<i>Astragalus chuskanus</i>	Fabaceae	-	Species of concern	-
<i>Astragalus cottamii</i>	Fabaceae	-	-	-
<i>Astragalus humillus</i>	Fabaceae	Endangered	Endangered	Group 2
<i>Astragalus micromerius</i>	Fabaceae	-	Species of concern	-
<i>Astragalus naturitensis</i>	Fabaceae	-	Species of concern	Group 4
<i>Astragalus oocalycis</i>	Fabaceae	-	Species of concern	-
<i>Pediocactus knowltonii</i>	Cactaceae	Endangered	Endangered	-
<i>Penstemon breviculus</i>	Scrophulariaceae		Species of concern	-
<i>Penstemon lentus</i>	Scrophulariaceae	-	-	-
<i>Phlox cluteana</i>	Polemoniaceae	-	Species of concern	-
<i>*Proatriplex pleiantha</i>	Chenopodiaceae	-	Species of concern	-
<i>*Puccinellia purshii</i>	Poaceae	Species of concern	Endangered	Group 3
<i>Sclerocactus cloveriae ssp. brackii</i>	Cactaceae	Species of concern	Endangered	-
<i>Sclerocactus mesae-verde</i>	Cactaceae	Threatened	Endangered	Group 3

Source: New Mexico Rare Plant Technical Council

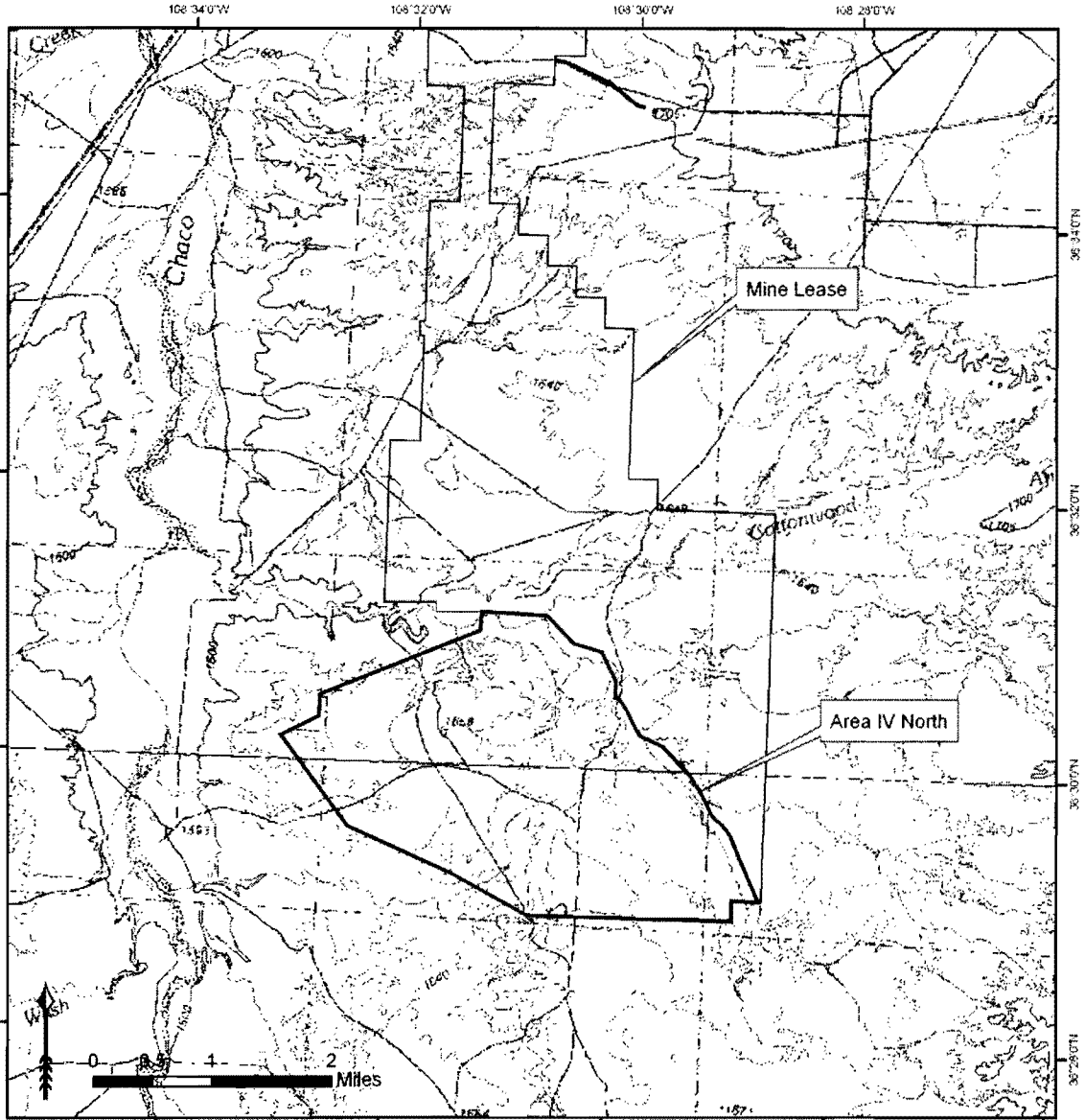


FIGURE 1

**VICINITY MAP  
AREA IV NORTH**



Ecosphere  
Environmental  
Services

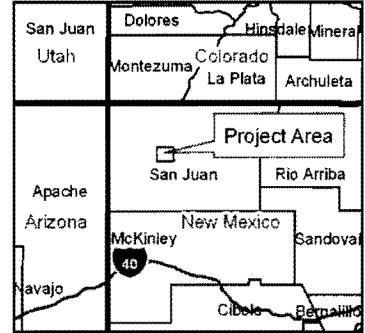
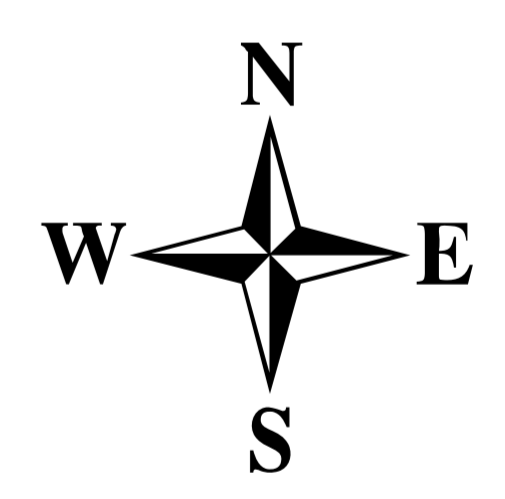
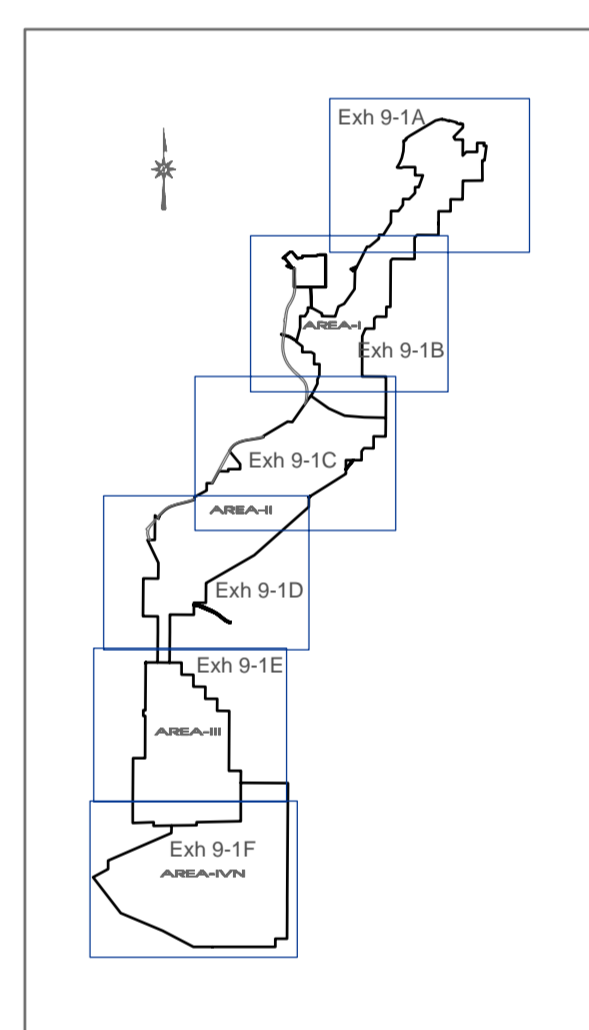
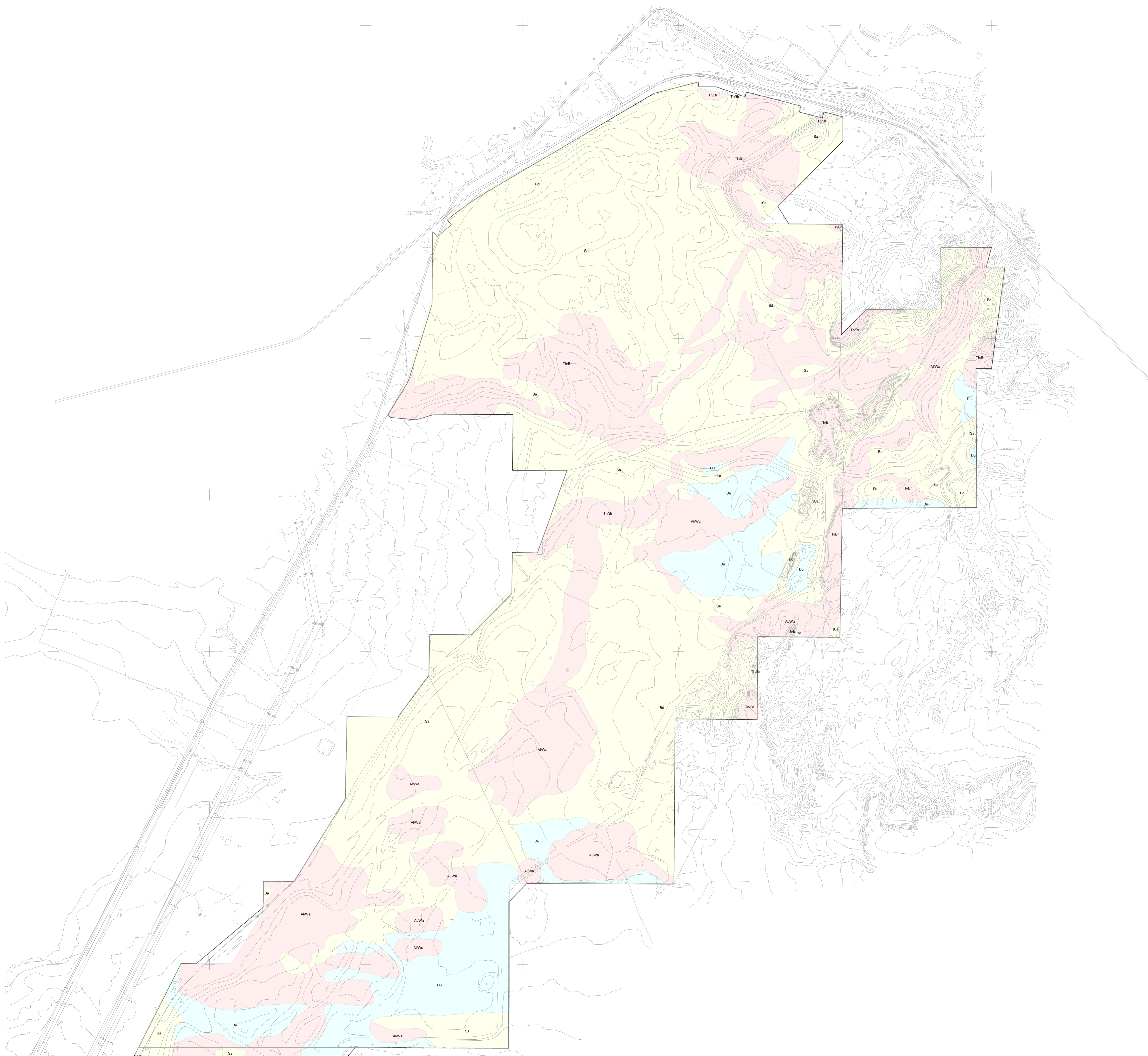



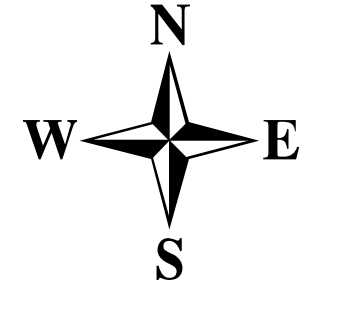
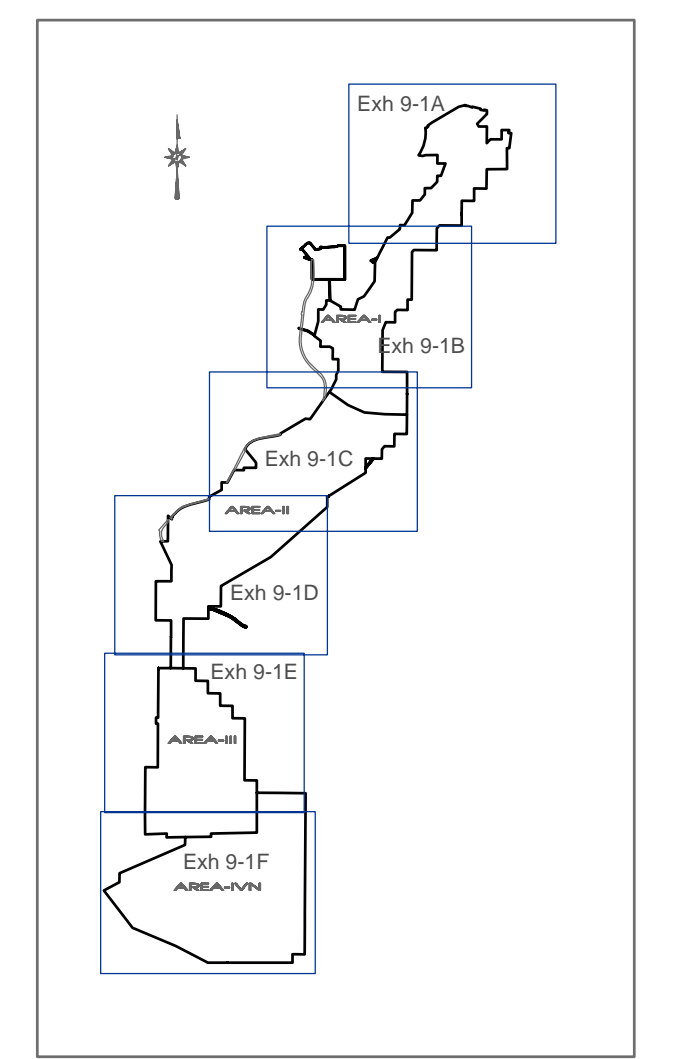
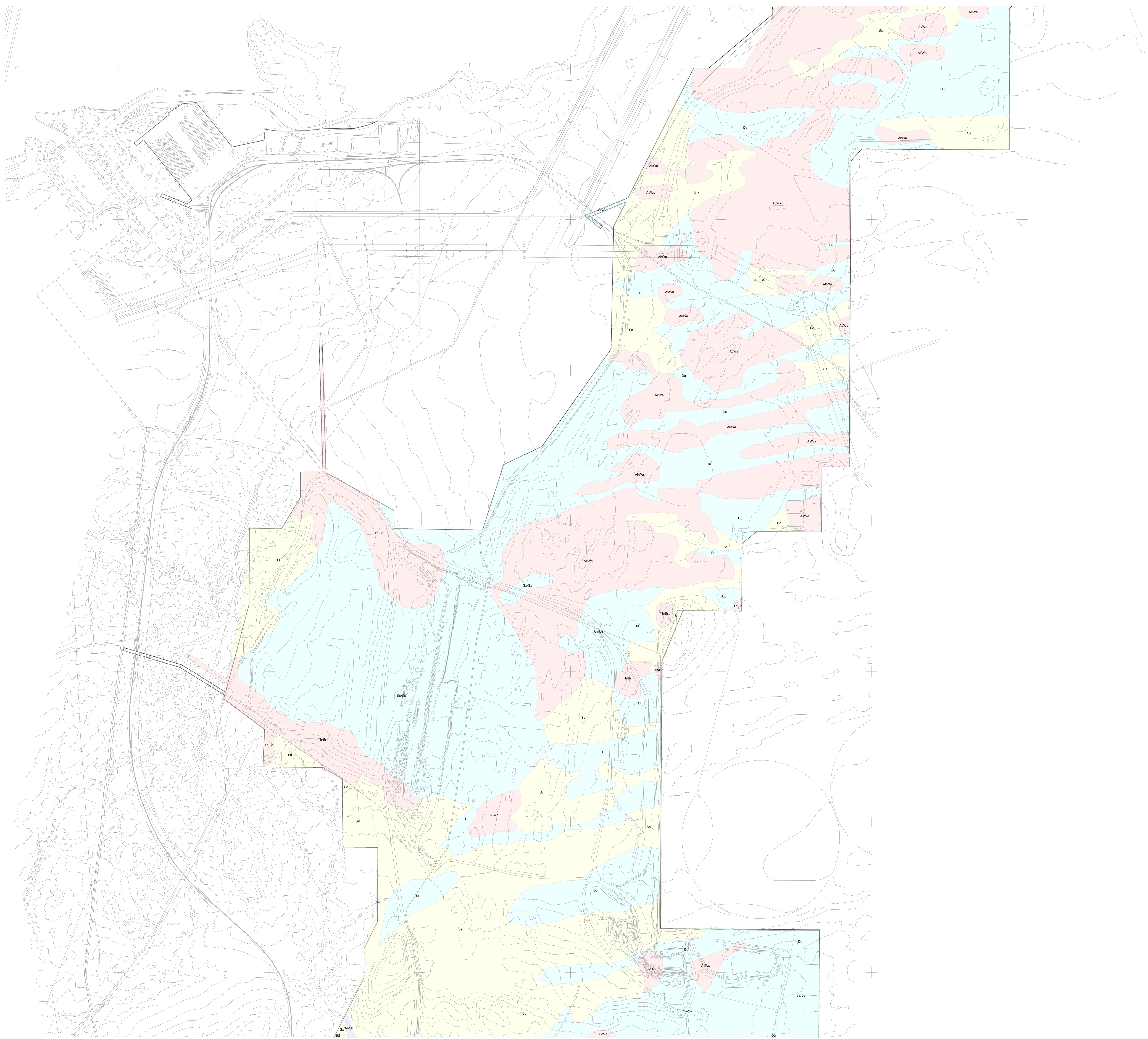
Figure 1.





Legend	
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<span style="display:inline-block; width:10px; height:10px; background-color: #6495ed; border: 1px solid black;"></span>	Ca/Sa
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REV	DATE	BY	DESCRIPTION	NO.	REV.
1	4/23/04	PJF	UPDATED EXHIBIT AND SUBMITTED TO O&M FOR REVIEW	XX	MC
<b>EXHIBIT 9-1A</b>					
<b>BHP NAVAJO COAL COMPANY</b>					
					
P. O. BOX 1717 FRUITLAND, NEW MEXICO 87416					
<b>NAVAJO MINE</b>					
<b>RANGE SITES</b>					
PREPARED BY	DATE	DRAWN BY	SCALE		
APPROVED BY	DATE		1" = 500'		
	Apr 11 23, 2004				

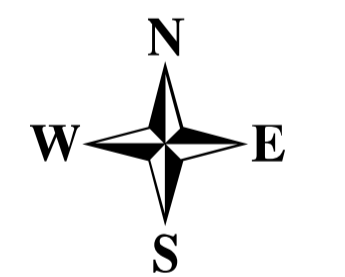
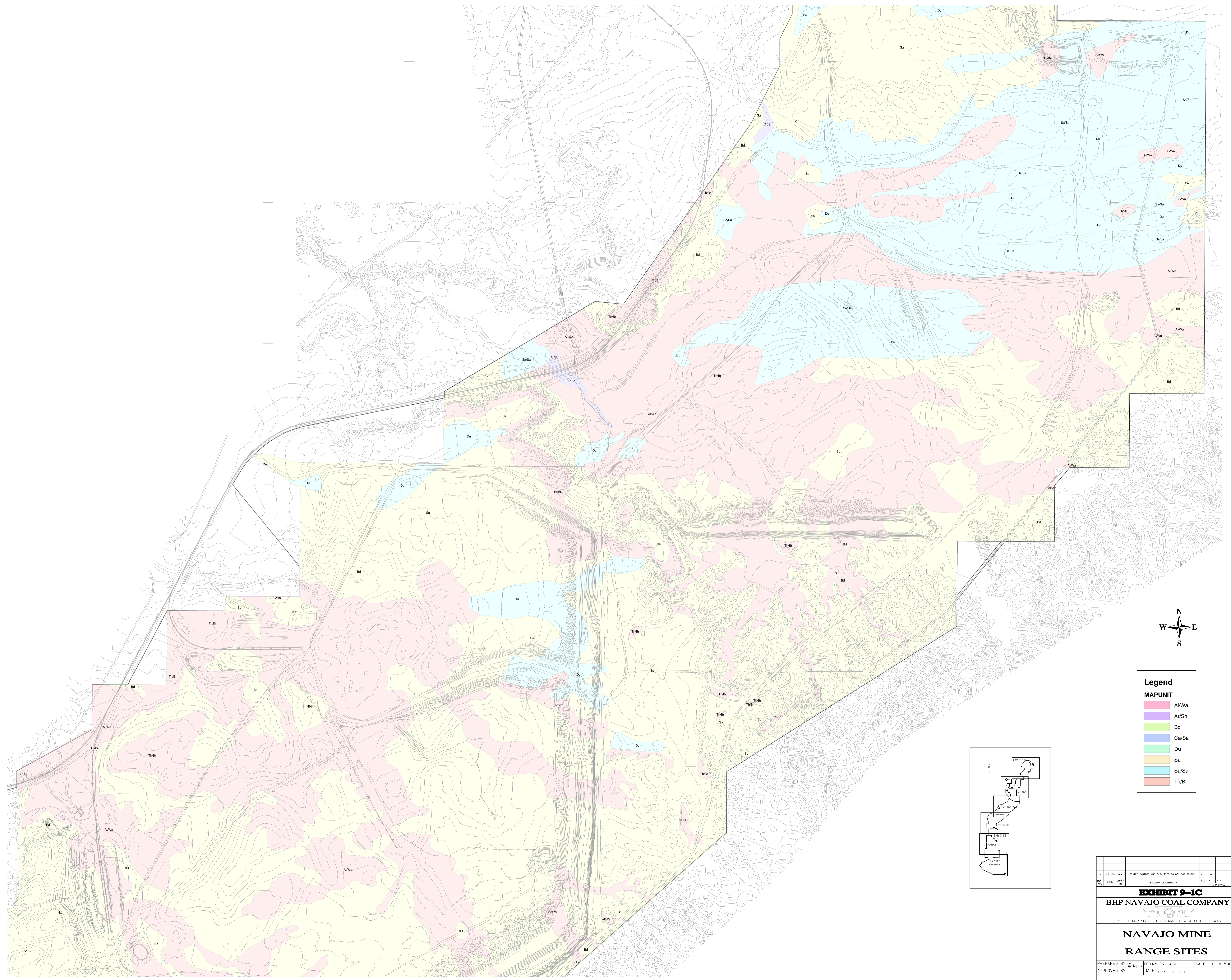


**Legend**

**MAPUNIT**

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<span style="display:inline-block; width:15px; height:10px; background-color: #6495ed; border: 1px solid black;"></span>	Ca/Sa
<span style="display:inline-block; width:15px; height:10px; background-color: #90ee90; border: 1px solid black;"></span>	Du
<span style="display:inline-block; width:15px; height:10px; background-color: #fffacd; border: 1px solid black;"></span>	Sa
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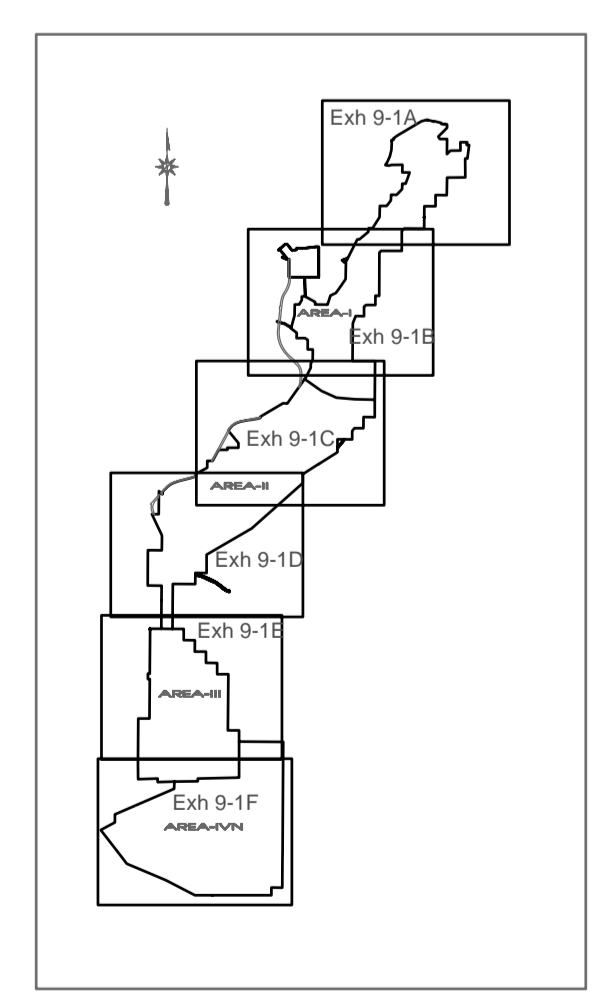
REV	DATE	DRAWN BY	REVISION DESCRIPTION	AA	MC
<b>EXHIBIT 9-1B</b>					
<b>BHP NAVAJO COAL COMPANY</b>					
P. O. BOX 1717 FRUITLAND, NEW MEXICO 87416					
<b>NAVAJO MINE</b>					
<b>RANGE SITES</b>					
PREPARED BY	Kent	DRAWN BY	pjuf	SCALE	1" = 500'
APPROVED BY		DATE	Apr 13 23, 2024		



**Legend**

**MAPUNIT**

AI/Wa
Ar/Sh
Bd
Ca/Sa
Du
Sa
Sa/Sa
Th/Br



REV	DATE	BY	DESCRIPTION	CHK	DATE
1	4-23-04	PJF	UPDATED EXHIBIT AND SUBMITTED TO OSM FOR REVIEW	NA	NA
2			REVISION DESCRIPTION	CS	2.5.02.04
3					02/20/04

**EXHIBIT 9-1C**

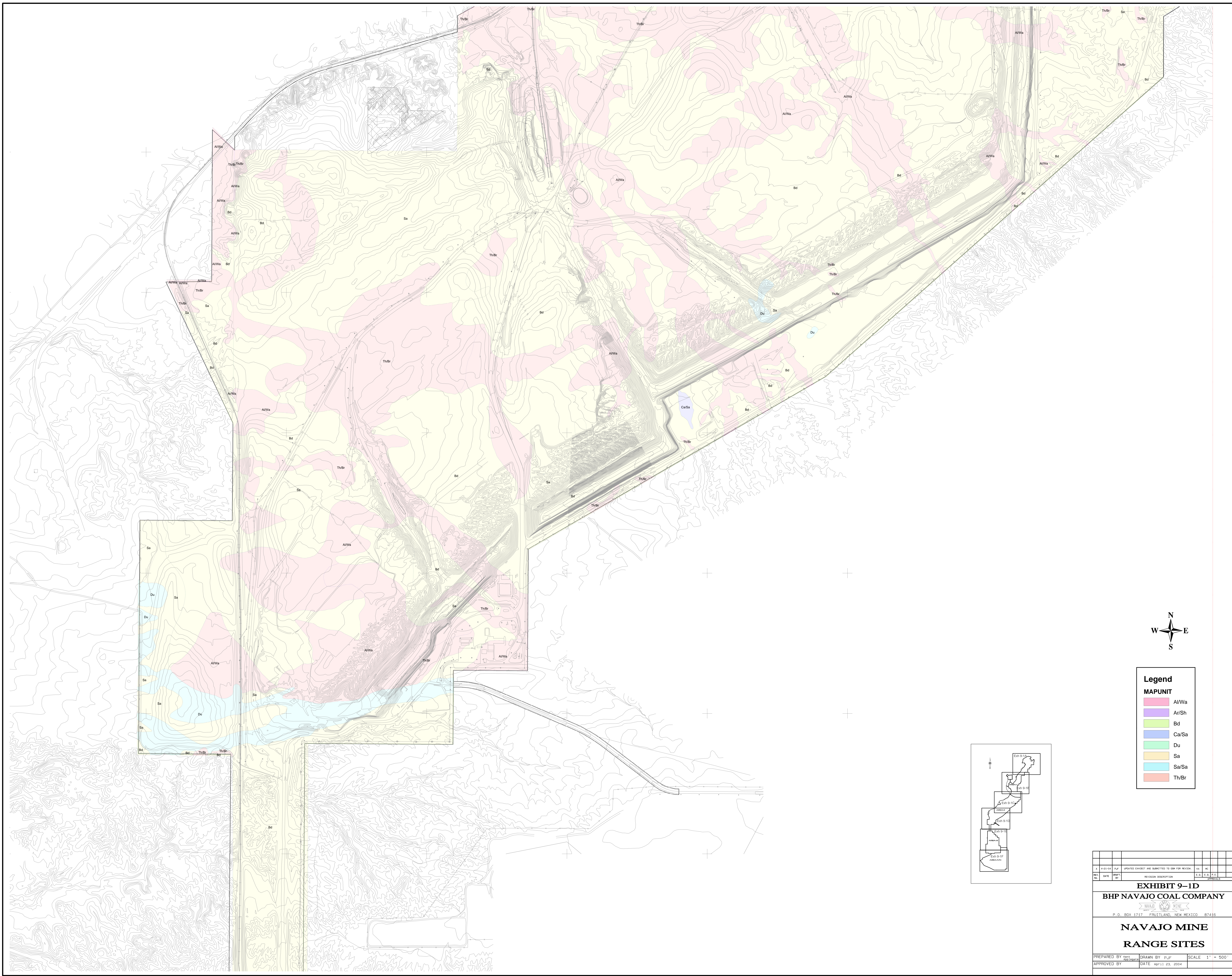
**BHP NAVAJO COAL COMPANY**

P. O. BOX 1717 FRUITLAND, NEW MEXICO 87416

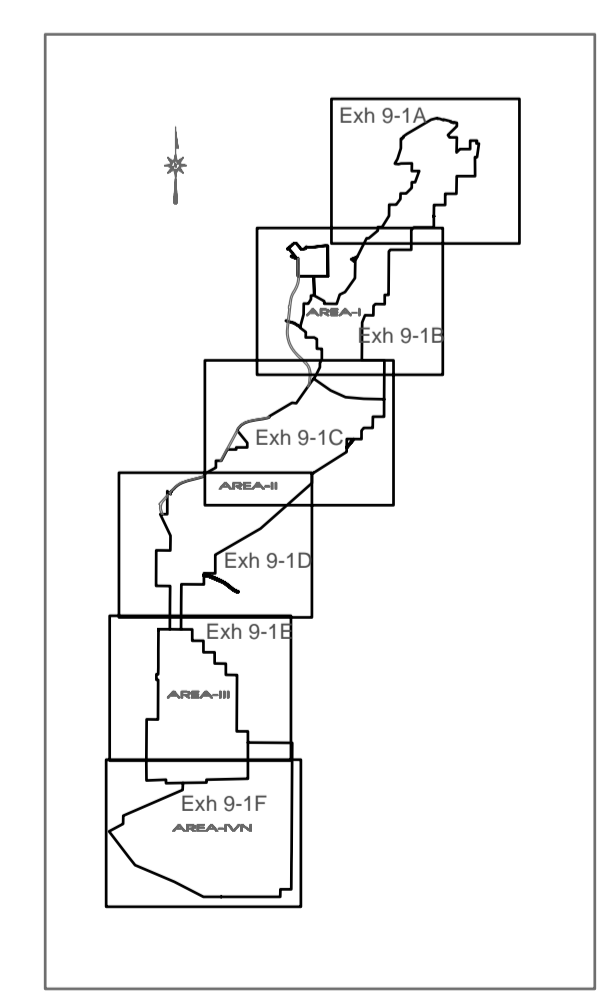
**NAVAJO MINE**


**RANGE SITES**

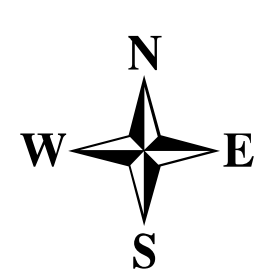
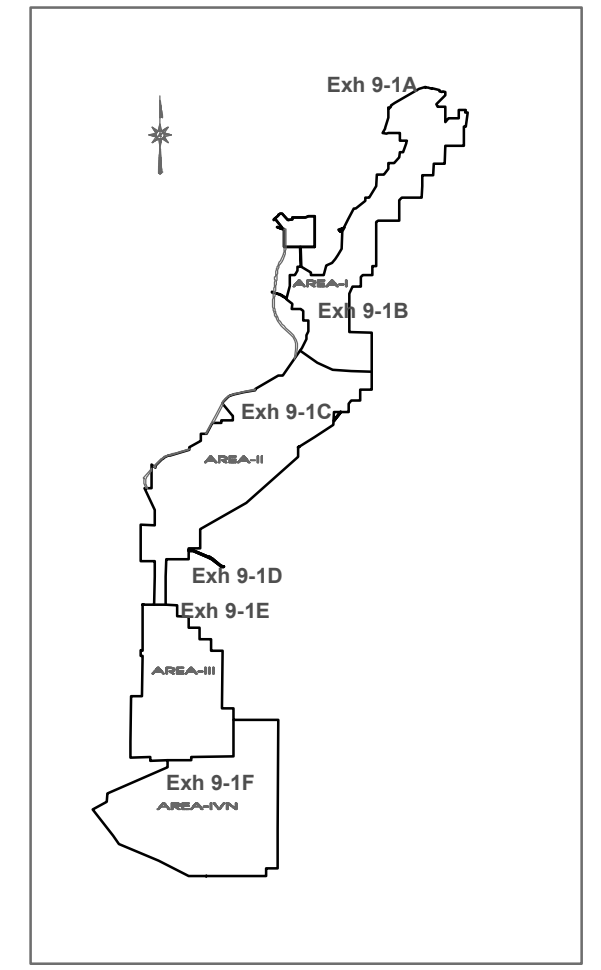
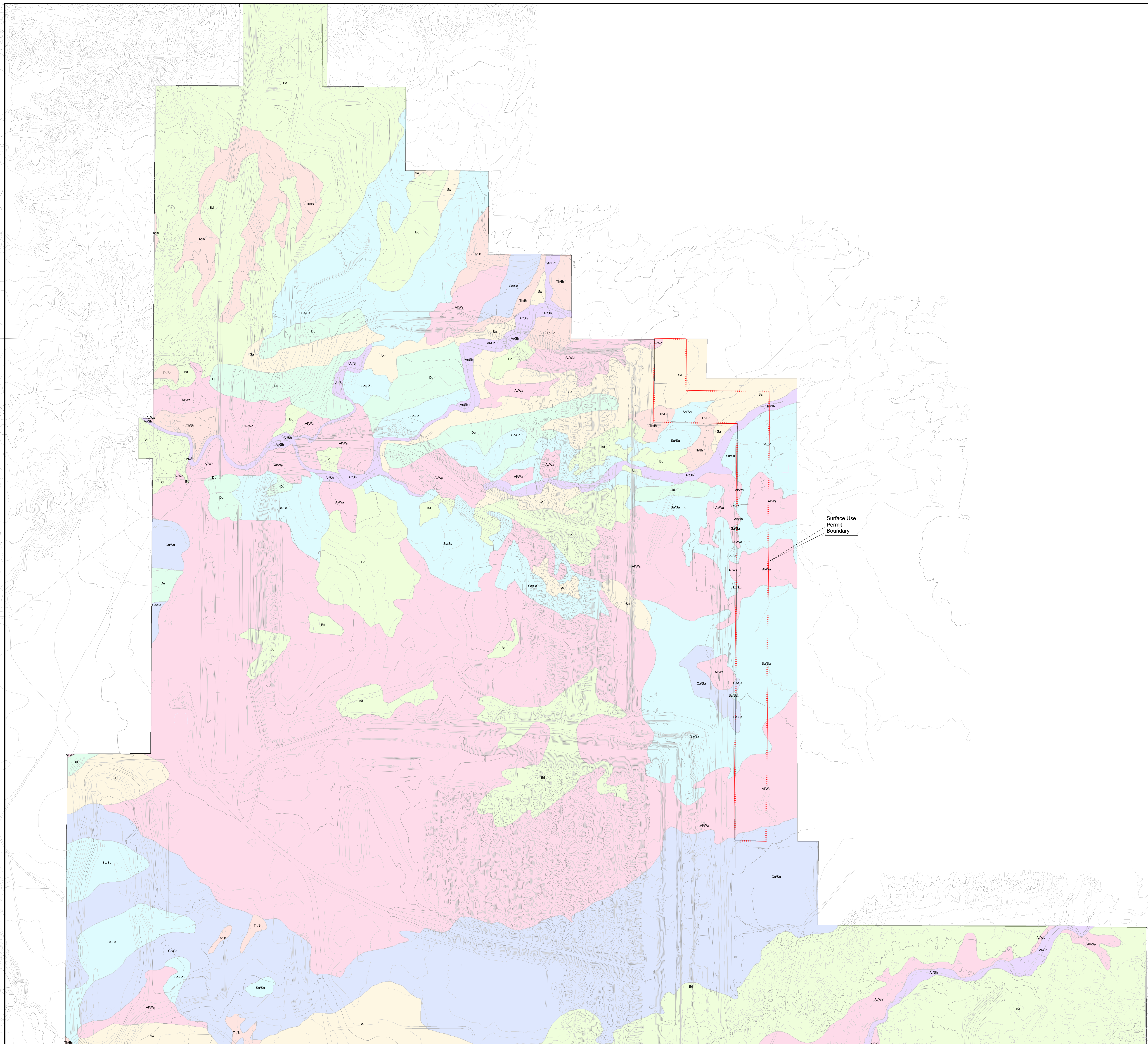
PREPARED BY	DATE	DRAWN BY	SCALE
055109040	Apr 11 23, 2004	PJF	1" = 500'
APPROVED BY	DATE		



Legend	
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<span style="display:inline-block; width:10px; height:10px; background-color: #90ee90; border: 1px solid black;"></span>	Bd
<span style="display:inline-block; width:10px; height:10px; background-color: #6495ed; border: 1px solid black;"></span>	Ca/Sa
<span style="display:inline-block; width:10px; height:10px; background-color: #90ee90; border: 1px solid black;"></span>	Du
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<span style="display:inline-block; width:10px; height:10px; background-color: #add8e6; border: 1px solid black;"></span>	Sa/Sa
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REV	DATE	BY	DESCRIPTION	APP	SCALE
1	4-21-04	PJF	UPDATED EXHIBIT AND SUBMITTED TO OSM FOR REVIEW	AK	1" = 500'
<b>EXHIBIT 9-1D</b>					
<b>BHP NAVAJO COAL COMPANY</b>					
 P. O. BOX 1717    FRUITLAND, NEW MEXICO    87416					
<b>NAVAJO MINE</b>					
<b>RANGE SITES</b>					
PREPARED BY	KSC	DRAWN BY	PJF	SCALE	1" = 500'
APPROVED BY		DATE	Apr 11 23, 2004		



**Legend**

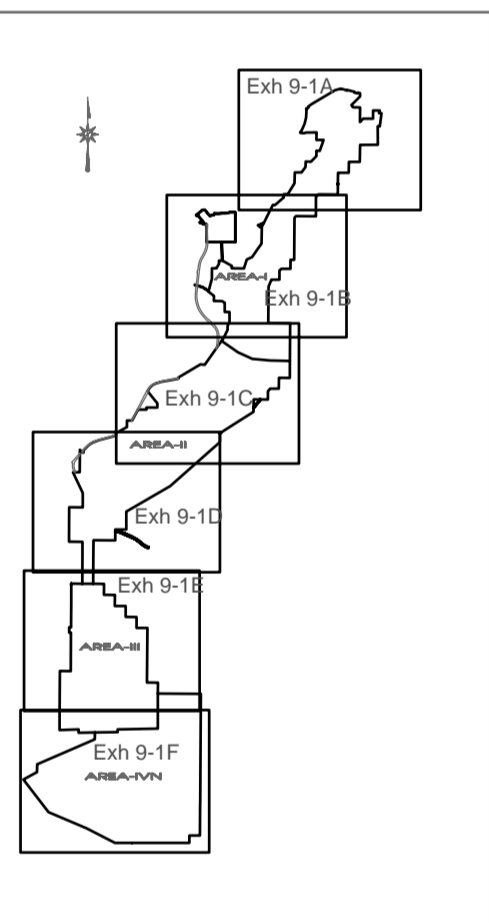
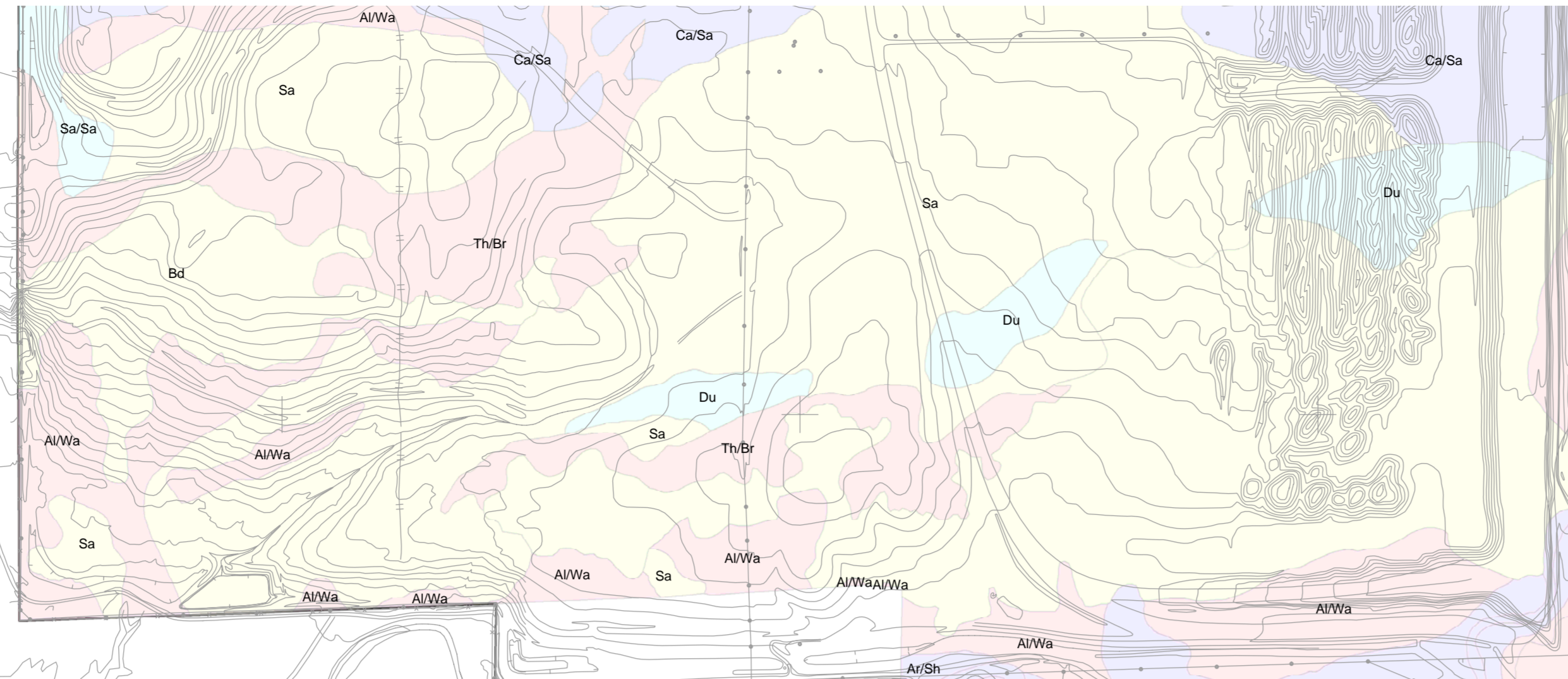
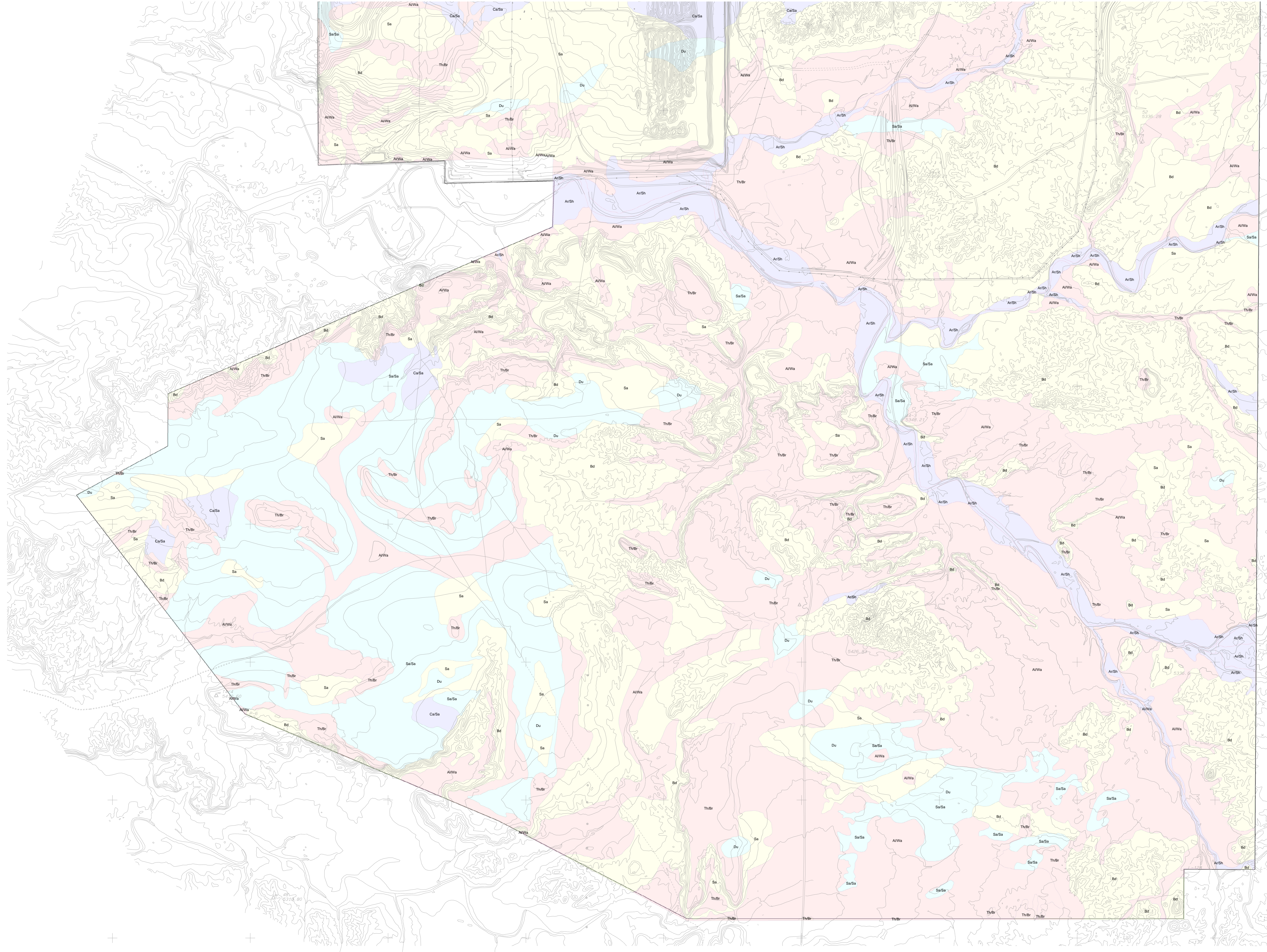
- - - - - IBR DATA-09
- BNCC\_BaseVeg**
- MAPUNIT**
- Al/Wa
- Ar/Sh
- Bd
- Ca/Sa
- Du
- Sa
- Sa/Sa
- Th/Br

REV	DATE	BY	DESCRIPTION	APP	DATE	BY	DESCRIPTION
1	01-04	PJP	UPDATES EXHIBIT AND SUBMITTED TO OSM FOR REVIEW	KA	02		
2	04-23	PJP	REVISED DESCRIPTION	SC	03		

**EXHIBIT 9-1E**  
**BHP NAVAJO COAL COMPANY**

NAVAJO MINE  
 RANGE SITES

PREPARED BY: NAME DRAWN BY: PJP SCALE: 1" = 500'  
 APPROVED BY: NAME DATE: April 23, 2004



**Legend**

**MAPUNIT**

AI/Wa	AI/Wa
AI/Sh	AI/Sh
Bd	Bd
Ca/Sa	Ca/Sa
Du	Du
Sa	Sa
Sa/Sa	Sa/Sa
Th/Br	Th/Br

NO.	DATE	BY	DESCRIPTION	SCALE	INCHES	FEET
1	4-11-04	P.L.C.	UPDATED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
2	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
3	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
4	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
5	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
6	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
7	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
8	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
9	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"
10	4-11-04	P.L.C.	REVISED EXHIBIT AND SUBMITTED TO BLM FOR REVIEW	1"	1"	1"

**EXHIBIT 9-1F**  
**BHP NAVAJO COAL COMPANY**  
 P.O. BOX 1717 FORTLAND, NEW MEXICO 87416

**NAVAJO MINE**  
**RANGE SITES**

PREPARED BY P.L.C. DRAWN BY P.L.C. SCALE 1" = 500'  
 APPROVED BY DATE 4-11-04