WordPerfect Document Compare Summary

Original document: X:\Western Fuels Nucla\latest 2006 permit files\2.04.9 Soil ResourceA 28march06.wpd
Revised document: @PFDesktop\:MyComputer\X:\Western Fuels Nucla\Permit Revision 2009\Adequacy Response #1\Final Files\2.04.9 Soil Resources 28JUN10.wpd
Deletions are shown with the following attributes and color:
~~Strikeout~~, Blue RGB(0,0,255).
Deleted text is shown as full text.
Insertions are shown with the following attributes and color:
Double Underline, Redline, Red RGB(255,0,0).
Moved blocks are marked in the new location, and only referenced in the old location.
Moved block marks are shown in the following color:
Orange RGB(255,200,0).

The document was marked with 310 Deletions, 339 Insertions, 1 Move.

SECTION 2.04.9
SOIL RESOURCE INFORMATION

Soil Resources-COMPARISON 28JUN10.wpd

(Revised June 2010)

SECTION 2.04.9
SOILS RESOURCE INFORMATION

(Revised June 2010)

Table of Contents

~~Soils Resource Information~~

Tables

~~Attachments~~

Attachments

Maps

(Revised June 2010)

Map 2.04.9-1 Soils Baseline Map

Map 2.04.9-2 Topsoil Balance Map as of February 2008

Section 2.04.9

Soils Resource Information

~~**Introduction**~~

1. Introduction

This section addresses the soil resources on the permit area, stripping procedures, and the salvage depths and salvage calculations. Section 2.05.4(2)(d) addresses the topsoil replacement and preparation items prior to seeding. Both Sections address prime farmland soils separately.

This report presents information about the soil resources on the New Horizon Mine study area in Montrose County, Colorado. Soil maps and data contained in this report have been prepared to assist WFC and the Colorado ~~Department~~Division of ~~Minerals~~Reclamation, Mining and ~~Geology~~Safety (~~CDMG~~CDRMS) in examining the soil resources of the area with respect to their potential use in mined land reclamation efforts.

Detailed soil surveys of the study area were conducted in 1988, 1996 and 1998. These Order 1 soil surveys, with sampling, were conducted by ERT/Peabody Coal (1988), and Intermountain Resource Inventories Inc. (IRI Inc.)(1996 and 1998) on approximately 575, 80, and 430 acres, respectively. Surveys conducted in 1996 and 1998 included re-surveying portions of the 1988 survey in addition to additional areas. The final survey is a composite of these three surveys and is represented in Map 2.04.9-1. Map 2.04.9-1 also shows the boundaries of the original surveys. Soil in map units of the 1998 survey differ from those in the 1988 and 1996 survey as a result of recent changes in soil taxonomy (USDA - NRCS, 1999). These changes resulted in soils being classified differently than in the 1998 and 1996 survey. Based on these detailed soil surveys, recommended topsoil salvage depths were determined for each soil mapping unit.

2. Objectives

The basic objectives of this study are to characterize the physical and chemical properties of site soils and depths to which they may be salvaged as a source of topsoil for reclamation purposes. Thus, the site-specific characteristics of the soil that may influence soil salvage, stockpiling, and redistribution were inventoried. This inventory entailed the following:

- Determination and delineation of soil mapping units.
- Description and sampling of representative horizons of each soil series and higher taxonomic units for chemical and physical characteristics.
- Interpretation of the analytical results and site-specific characteristics to determine suitability and depth of soils for topsoil materials.

This report presents field and laboratory methodology used in the study as well as:

- A soil map delineating soil mapping units
- Map unit descriptions
- Taxonomic unit descriptions
- Chemical and physical data
- Recommended topsoil salvage depths for each soil series and soil mapping unit
- Prime farmland assessment

3. General Nature of the Area

The New Horizon Mine soil study area is located within the Colorado Plateau Physiographic Province, Canyon Land Section, in southwest Colorado. It is within USDA Major Land Resource

Area 35, Colorado and Green Rivers Plateau (USDA-SCS, 1978). Average elevation is about 5,700 feet.

4. Climate

The New Horizon Mine soil study area is located in an "ustic-aridic" soil moisture regime and a "mesic" soil temperature regime (Hawn, 1987).

The mean annual precipitation ranges from 10 to 14 inches. Were it not for the presence of irrigation water throughout most of the study area, the soils would have soil moisture deficits during the growing season as a result of the quantity and distribution of precipitation. Periods of peak precipitation occur in the spring and early summer months.

Mean annual air temperature is about 46 to 48 degrees F. The average frost-free period is about 130 days. Additional climatological data is contained in Section 2.04.8 of this permit application.

5. Geology

A detailed discussion of the New Horizon geology is presented in Section 2.04.6 of this application. Appropriate sections are summarized in the following text. The Nucla Syncline (San Miguel Syncline) is a northwest trending geologic structure which contains the coal reserves of the study area. This shallow, broad syncline is a simple fold with gently dipping flanks.

The Cretaceous-age Dakota Sandstone is the youngest formation found in the study area, with the exception of Quaternary deposits. The overlying upper Cretaceous Mancos shale (a soft, homogeneous, dark-gray fissile rock) is not found in the study area. The Dakota consists primarily of resistant yellowish to gray, fissile sandstone, and conglomeratic sandstones interbedded with dark gray carbonaceous shales, impure coal, and a basal conglomerate. It forms resistant but thin sandstone ledges that are scattered throughout the study area. These ledges are often exposed at the surface or are encountered within a few feet of the surface.

The deposits of Quaternary age consist of wind deposited material, streamlain alluvium, and local slopewash. Deposits of a light-red sandy loam and loam loessial material mantle the nearly flat mesa-like surface on the west side of the study area.

6. Soils and Geomorphology –1988

The study area occupies the part of the gently sloping western portion of "First Park," an irrigated area adjacent to Nucla on the east, south, and west. The study area is shown in Map 2.04.9-1. The ephemeral drainages generally cross the study area from northeast to southwest. Numerous small man made ponds have been created along many of these drainages. Calamity Draw flows from east to west along the southern border of the study area. Sewage lagoons for the town of Nucla are located adjacent to Calamity Draw. Tuttle Creek flows from east to west along the northern border of the study area. Many of the irrigation ditches which cross the study area empty into Calamity Draw and Tuttle Creek.

Aquolls and Aquepts soils were found primarily as a result of flood irrigation accumulating in the drainages. These soils have characteristics indicating they are wet throughout most of the soil profile for most of the year.

Gently sloping uplands comprise most of the study area. Progresso and Pinon soils are found on these areas. Pinon is less than 20 inches to bedrock, whereas Progresso is 20 to 40 inches. Progresso soils developed in residuum from interbedded sandstone and shale and have well developed Bt argillic horizons and underlying Bk calcic horizons. The Barx soil is found as an inclusion with Progresso and Pinon. Pinon soils are developing in thin residuum from sandstone in areas where sandstone ledge rock is near or at the surface. Weathered shale bedrock is often found beneath the relatively thin sandstone ledge rock. Pinon soils have a zone of secondary calcium carbonate accumulation.

The Barx soil is deep (40 to 60 inches to either sandstone or shale bedrock) to very deep (greater than 60 inches to either sandstone or shale bedrock) and has a well developed Bt argillic and Bk calcic horizon. It has loam, sandy clay loam, or clay loam textures in the Bt particle size control section, and is developing in wind deposited loess over residuum from sandstone and shale at depth in the soil profile. The Barx soil is found on the gently sloping mesa-like surface in the southeast corner of the study area.

7. Soils and Geomorphology – 1996

The study area included the Garvey and Burbridge properties located within the original 1988 survey. This survey updated map unit delineations and provided detailed topsoil salvage depths for the above properties.

8. Soils and Geomorphology – 1998

The study area included the Morgan property located within the original 1988 survey and additional areas north of BB Road that were not surveyed in 1998. This survey updated map unit delineations and provided detailed topsoil salvage depths on the Morgan property as well as detailed baseline soil information on properties located north of BB Road. The geology and geomorphology are similar to that located in the original 1988 survey.

9. Methodology

Tasks performed to accomplish project objectives included:

- review of existing soils information
- detailed field mapping of soils
- soil sampling and profile description
- evaluation of soils for reclamation potential

The methodology used during the soil surveys followed standard techniques and procedures of the National Cooperative Soil Survey.

In connection with the 1988, 1996, and 1998 studies, samples were collected in the field and analyzed in the laboratory in accordance with CDMG-approved procedures for topsoil analyses as outlined in Table 2.04.9-1. The information presented in Table 2.04.9-1 is a synthesis of material from the approved scope-of-work, InterMountain Laboratories (IML's) and Colorado State University Soil Lab standard procedures for soil analysis. Sample site locations were selected to most accurately represent the sampled soil series and to provide for adequate sample site distribution

across the projected disturbance areas. Transition zones between map units, road edges, fence rows, or previously disturbed areas were avoided. Representative profiles were selected on the basis of medial characteristics for physical and chemical soil characteristics, parent material, landscape position, and vegetation. The major soil horizons (A, E, B, and C) were separately described, sampled, and analyzed. Portions of paralithic material (Cr), if present, were also described, sampled, and analyzed for characterization purposes and possible subsequent use as a topsoil substitute if needed.

Surface and subsoil horizons (A and B horizons) were sampled to represent no greater than about six inches of soil material per sample. Sub-horizons (B1, B2, etc.), greater than three inches within any major horizon, were separately sampled and analyzed. In the substratum (C horizon), natural horizons (C1, C2, and so forth) were subdivided such that individual samples did not represent greater than about 18 inches of soil material.

Table 2.04.9-1

: Parameters and Analytical Procedures Utilized For Topsoil Analysis

Parameter-Units	Procedures-Reference
Sample Preparation	Text Moved Here: 1 Samples were air dried at less than 35^0 c. Clods were broke up prior to grinding and sieving of samples. Large coarse fragments were removed. Sample material was sieved. Remaining rock coarse fragments left on the 10 mesh (2 mm) sieved were removed. Remaining soil clods left on the 10 mesh screen were ground until the sample just passed the screen. Excessive grinding of sample material was avoided during the entire sample preparation procedure.
End Of Moved Text Subsampling of sieved (less than 2 mm) soil materials for analysis	USDA Handbook 60, 1954 Diagnosis and Improvement of Saline and Alkali Soils. pp. 83-84. U.S. Salinity Laboratory Staff
Coarse fragment content, percent by weight	USDA Handbook 436, Soil Taxonomy. App. 1, pg. 472; Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, page 9 and 12-13.
PH	USDA Handbook 60, Method (21A), page 102, and page 84: Method (2).
Conductivity in mmhos/cm @ 25^o C	USDA Handbook 60, Method (3a), page 84, and Method (4b) page 89-90.
Preparation of saturation extract and saturation percent determination	USDA Handbook 60, Methods 2 and 3a, pages 84 and 88, and 27a and b, page 107.
Particle-Size Analysis in Percent clay, silt, sand, and very fine sand (vfs= 0.05-0.1mm)	~~Text Was Moved From Here: 1~~

~~Texture~~ ~~Soluble Ca, Mg, and Na, meq/1~~ ~~Sodium- Adsorption Ratio~~ ~~Carbonates, Percent~~ ~~Organic Matter, Percent~~ ~~Procedures Reference~~	~~USDA Handbook 60, 1954~~ ~~Diagnosis and Improvement of Saline and Alkali Soils. pp. 83-84. U.S. Salinity Laboratory Staff.~~ ~~USDA Handbook 436,~~ ~~Soil Taxonomy.~~ ~~App. 1, pg. 472; Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, page 9 and 12-13.~~ ~~USDA Handbook 60, Method (21A), page 102, and page 84: Method (2).~~ ~~USDA Handbook 60, Method (3a), page 84, and Method (4b) page 89-90.~~ ~~USDA Handbook 60, Methods 2 and 3a, pages 84 and 88, and 27a and b, page 107.~~ Hydrometer Method. ASA Mono. No. 9, part. 1, Method 43-5, pages 562-566. Two hour and 8-hour settling times were used for clay. Sieve analysis used for vfs (140-270) mesh. ASA Mono. No. 9, Part 1 pages 554-556. Black, 1965 and 1982.
Texture	USDA Handbook 18, pages 205-223.
Soluble Ca, Mg, and Na, meq /1	Extraction of Ca, Mg, and Na by USDA Handbook 60, Method (3a), page 84. Analysis by atomic adsorption spectrophotometry.
Sodium- Adsorption Ratio	USDA Handbook 60, page 26.
Carbonates, Percent	USDA Handbook 60, Method (23c), page 105
Organic Matter, Percent	A.S.A. Monograph No. 9, 1982, Part 2, Method 29-3.5.2, page 570.

Physical properties, and, where possible, chemical properties of each horizon within the sampled profile were described and recorded in the field on standard SCS "232" soil description forms. These properties included:

- depth and thickness of horizons
- relative position of soil horizons
- type and nature of horizon boundaries
- color (dry and moist) of horizons
- texture (fine earth fraction)
- coarse fragment content (type - gravel, cobble, sandstone channer, etc.; size (2mm-3", 3"-10", greater than 10"); and percent (%) by volume, if significant)
- soil structure (type, size, and grade)
- soil consistence (dry, moist, and wet)
- roots (number, size, and depths)
- clay films, if present (number, thickness, occurrence)
- effervescence with 0.1N HCl (none, slight, moderate, strong, violent)
- mottles, if present (number, size, distinctness, color)
- soil moisture characteristics at the time of sampling

In addition, at each soil sampling site, the following parameters were also described:

- vegetation
- parent material
- physiography (geomorphic position)
- relief, if significant
- elevation (obtainable from topographic maps)
- slope
- aspect
- erosion condition
- permeability
- internal drainage class
- depth to ground water, if encountered
- salts or alkali
- surface stoniness

The sampling site location and number were plotted on the field map as accurately as possible.

One 2-quart sample was taken to represent each natural soil horizon or contrasting layer within the depth to 72 inches or bedrock, whichever was shallower.

Samples were collected from hand-dug pits, three-inch diameter auger holes or backhoe trenches that were dug at all soil sampled sites. The sampled soil material was placed in clean, labeled, polyethylene plastic or Tyvek® bags, and was kept cool and as dry as possible to limit chemical changes. The upper horizons of many profiles were moist upon sampling and were air dried prior to shipment to IML in Sheridan, Wyoming (1988) or Colorado State University (1996 and 1998) for analysis. Each sample was split at the laboratory with one portion being used for analysis and the archival portion retained for additional tests, if necessary. The analysis of the samples is shown in Attachment 2.04.9-7.

10. Prime Farmland ~~Determination~~

~~**The Montrose County NRCS district office in Norwood, Colorado, was contacted for determination**~~**Determinations**

10.1 Prime Farmland Determination - 1988 and 1998

The Norwood office of the NRCS provided WFC with documentation that list the definitions and criteria for categorizing soils as prime farmland for the initial permit. See Attachment 2.04.9-4 and Attachment 2.04.9-5. These documents list the standards set by both the U.S. Department of Agriculture, Natural Resource Conservation Service and the State of Colorado, Natural Resource Conservation Service. This data was later found to be erroneous and was revised by the NRCS in 2008.

Peabody Coal Company conducted the initial soil survey for the mine in 1988, which included all lands in the original permit area. These lands are those properties south of BB Road and east of 2700 Road. Intermountain Resource Inventories Inc. conducted the soil survey for the expansion

of the mine to the expanded permit boundary, which included lands north of BB Road and west of 2700 Road. The results of these surveys can be found in Map 2.04.9-1, Attachment 2.04.9-1, Attachment 2.04.9-2, and Attachment 2.04.9-3. Soil type 70B and D70B lists Barx soil as a major component and Barx as a secondary component (30 percent of map unit) in 98E on Map 2.04.9-1. Barx soil is listed as a prime farmland soil in the "Soil Survey of San Miguel Area, Colorado" if the soil is irrigated by an adequate and dependable water supply. For the initial permit area east of 2700 Road and south of BB Road, Dean Stindt of the NRCS stated that the area of Barx soil type was potential for prime farmland but only if it had an adequate and dependable supply of water. After he did an inspection of the property in 1992, he concluded that the historic practices did not include intensive irrigation management and there was not adequate supply of water for the Barx soil type in this area to be considered prime farmland soils. This letter is found in Attachment 2.04.9-6. The map showing what area this applies to is also included in this Attachment. The area is basically only the initial southeast portion of the current permit area of approximately 274 acres. Soil type 98E is a renaming of the original 70B soil type covered in the 1992 letter. This letter is no longer valid for the entire permit area, since prime farmland has been identified in the areas west of 2700 Road, as explained below.

10.2 Prime Farmland Determination - 2008

In early 2008, The Norwood office of the NRCS determined that the Begay, Barx and Darvey soil types (equivalent to the 98A and 98E soils in the permit area "west" of 2700 Road), met the qualifications of "Prime Farmland" as defined by the USDA, provided that they were previously irrigated and managed for prime farmland and were of sufficient size to be economic. See letter from Dave Dearstyne of the NRCS dated February 11, 2008 in Attachment 2.04.9-6. Part of the reason for this reversal was due to a typographical error in the previous NRCS documentation. Based on this conclusion, a major effort was made to revise the topsoil handling procedures to account for the prime farmland soils. This work was done in the latter part of 2008 and the early part of 2009 under Technical Revision 57, which was submitted to the DRMS in March 2008 . Very specific and detailed soil stripping and replacement procedures were developed in this Revision accounting for the prime farmland soils in the permit area. It was later realized by all parties that the term "prime farmland", as described in the previous letters, needed clarification. Basically, prime farmland only exists where there is an adequate and dependable supply of water and the

land must be economically viable to irrigate and farm. This is important since some areas of prime farmland ~~status for the study area. In addition, onsite evaluations were made to determine whether~~soil may exist which are not truly prime farmlands. Examples of these situations follow:

a) Areas which may have not been historically farmed in the past for any number of reasons
b) Areas which are too small to irrigate efficiently and economically
c) Areas which may have been irrigated in the past but the water no longer exists to permit an adequate and dependable supply.

This issue was clarified in the August 4, 2009 letter from Jim Boyd of the NRCS to Dan Mathews of the DRMS, which is also included in Attachment 2.04.9-6. Basically, Jim Boyd states that prime farmlands lose this status if an adequate and dependable supply of water does not exist.

Therefore, all previous references to prime farmland have now been referred to as prime farmland soils. Each individual parcel is then subject to evaluation to determine if it truly meets the definition of prime farmland. WFC acknowledges that all 98A and 98E soils are potential prime farmlands and all of these soils will be handled under the detailed topsoil stripping, handling, storage and replacement procedures of this Section 2.04.9 and Section 2.05.4 2(d), as of February 2008, when the determination of potential prime farmland was made by the NRCS.

As of February, 2008, the eastern portion of the Morgan fields in the permit area, which are in prime farmland soils (west of 2700 Road and south of BB Road) has been backfilled with Bench 1 substitute subsoil. It is also demonstrated that the subsoil placed in this area meets the suitability criteria outlined in Table 2.04.9-2. See Attachment 2.05.4(2)(d)-1 for Walsh Environmental Scientist and Engineers Report.

The following terms are put forth to further clarify the whole prime farmland issue:

10.3 Definition of Terms

1) Prime Farmland Soils - Soils that have the best physical and chemical characteristics and other requirements necessary to produce sustained high yields of crops when proper management,

including water management, and acceptable farming methods are applied. In the case of the permit area, this refers to any 98A or 98E soils identified, which include the Barx or begay soil complexes. This term basically replaces all references to prime farmlands in correspondence prior to August, 2009. Any designation of prime farmland soils necessitates special stripping, handling and replacement procedures described later in this Section. If adequate water is available and other requirements are met such as 0-6% slopes, etc., these soils can result in prime farmland land (Irrigated Cropland) use.

2) Prime Farmlands - Prime Farmland means land which has been determined by the Division in Consultation with NRCS to meet the definition of Rule 1.04(95). In the reclamation plan, lands that meet this criteria have been designated as Irrigated Cropland (IC). For bond release, these lands must meet all the requirements of prime farmlands in the DRMS rules.

3) Irrigated Cropland - This is a pre-mine and post-mine land use category (IC) which applies to irrigated lands that meet the DRMS Cropland definition, of Rule 1.04(71)(a). All prime farmlands in the permit area will be reclaimed to irrigated cropland use.

10.4 Discussion of Individual Areas for Consideration to be Prime Farmland

1) Areas east of 2700 Road and south of BB Road

The original Peabody permit area consisted of a portion of the area south of BB Road and east of 2700 Road. This area was approximately 274 acres and was called the East Mine. The area contains a 21.0 acre area of D70B (Barx) soil which was mapped by Peabody for the original permit application. This area is not mapped as Barx soil under the NRCS mapping for the area, as shown on Map 2.05.4(e)-1. Under the NRCS mapping, only 1.19 acre area of Soil 15 (using NRCS naming) just barely extends into the permit area as shown on Map 2.05.4(e)-2. Soil 15 could be considered prime farmland soil. These areas could have been considered prime farmland, but after Dean Stindt did an inspection of the property in 1992, he concluded that there was not adequate supply of water nor was it historically managed to a high degree for this area to be considered prime farmland. These areas are both covered in the area that NRCS soil scientist Dean Stindt evaluated for the prime farmlands in his letter of October 14, 1992. See letter and map in

Attachment 2.04.9-6. Since the Stindt letter was based on a personal site visit and written evaluation, and he determined that no prime farmlands were present, and since both of these potential areas were in his area of study, WFC believes that this evaluation is still valid for this area. There was no special handling of the soils in this area based on these findings.

In the remaining area that was later added to the permit but still south of BB Road and east of 2700 Road, no soil mapping shows any prime farmland soils.

2) Morgan fields south of BB Road and west of 2700 Road

The fields southwest of the intersection of BB Road and 2700 Road have sufficient prime farmland soil (98E) such that the entire area of fields is considered prime farmland soil (total of 107.96 acres disturbed). These lands are owned by Morgan. As is seen from Map 2.04.9-1, some soils in these fields are not prime, but all fields in this area will be considered as such for reclamation. Although Western Fuels has mined the eastern portion of these areas prior to the prime farmland soils designation, all prime farmland soils on the Morgan property (which is the entire Morgan property in the permit area) will be restored to prime farmland standards.

3) Small area in northwest portion of permit area on WFC Property

There are 4.76 acres of 98A (northwest corner of permit) on the WFC property which is basically in a low lying bend area of Tuttle Draw. This area is considered prime farmland soil. Since water is available for irrigation, this area is also considered prime farmland. A portion of this area was stripped of soil in order to create Pond 013 prior to the prime farmland soil designation of this area in February of 2008 by the NRCS. The total disturbed area of prime farmland soils in this area will be 3.96 acres. Since Pond 013 will be in place for well after reclamation has taken place on the surrounding land, Western Fuels proposes building a 3.96 acre area of prime farmland immediately to the southeast of Pond 013. This 3.96 acre area encompasses both existing prime farmland soils that have not been excavated and a new area created from the stockpiled prime farmland soils from Pond 013. All soils stripping, handling, stockpiling and replacement will be done according to the prime farmland soil handling criteria described in Section 2.05.4 (2)(d). A detail of this area can be seen on Map 2.05.4-8.

4) North Edge of Benson West Property

In the area north of BB Road and west of 2700 Road, an area of 4.46 acres of 98E prime farmland soil (Map 2.04.9-1) exists on the northern edge of the Benson west property. This is not considered prime farmland according to NRCS requirements for prime farmland ~~existed.~~

due to a lack of appropriate water and other management.

5) Northern Edge of Lloyd property

An area of 1.90 acres of 98A prime farmland soil (Map 2.04.9-1) is shown on the north edge of the Lloyd property. Since the disturbed area has extended slightly north of the soil survey boundary, the disturbance area of this soil is assumed to be 0.84 acres. Nevertheless, the area is too small to be considered prime farmland and was never managed as prime farmland in the past. For this reason, this small tract is not considered prime farmland and the special handling procedures for prime farmland soil do not apply. This was verified by the NRCS in 2008. See NRCS letter dated June 27, 2008 in Attachment 2.04.9-10.

6) Area north of BB Road and east of 2700 Road

The area east of 2700 Road and north of BB Road has been fully reclaimed with topsoil and subsoil prior to the prime farmland determination of 2008. In this area, two areas of 98E soil exist. One is 16.94 acres and the other is 1.32 acres. Also, an area of 1.24 acres of 98A soil exists. These areas are located on the Benson property east of 2700 Road. None of these areas were ever managed as prime farmland prior to mining. The 16.94 acre parcel has been reclaimed to Irrigated Pasture, as desired by the landowner. The NRCS is not considering these areas prime farmland.

Therefore, the total area of prime farmland soils in the permit is 112.72 acres: 107.96 acres of the Morgan property in the permit area and 4.76 acres of Western Fuels land in the northwest corner of the permit. The total area of prime farmland to be reclaimed as part of the permit is 111.92, a combination of the 107.96 acres on the Morgans and 3.96 acres on the WFC property (not all of the 4.76 acres of prime farmland soils on the WFC property will be disturbed).

11. Evaluation of Soils for Reclamation Potential

The soils and parent materials on the study area were rated for suitability based on criteria presented in Table 2.04.9-2, Criteria for Evaluating Soil Suitability. These suitability criteria were approved by ~~CDMG~~DRMS in the ~~scope-of-work~~Permit Amendment for the expansion west of 2700 Road. Recommended topsoil salvage depths were generated for each sampled pedon and each component of a mapping unit. Salvage depths were determined following a detailed evaluation of pH, electrical conductivity, saturation percent, soil texture, Sodium Adsorption Ratio, calcium carbonate percent, and coarse fragment percent.

Topsoil salvage depths were based on average depths to the suspect parameter or average profile depths (if the entire profile was suitable) across the study area based on numerous soil profile descriptions obtained for each soil type.

Table 2.04.9-2

: Criteria for Evaluating Pre-Mine Soil Evaluations (Original Soil Suitability Sampling)

PARAMETER - UNITS	THRESHOLD SUITABILITY LEVEL[1]
PH	<6.1->7.8
Conductivity (mmhos/cm)	4.0[2]
Saturation percentage (%)	>80%
	<25%
Sodium adsorption ratio[3]	>4
Calcium carbonate percentage	15%
Selenium (ppm)	>2 ppm
Particle size[4]	All soil textures except:
	s, ls, sc, sic, c
Coarse fragments (%)	15%[5]

[1] The threshold levels are to be used as a guide in evaluating the suitability of a soil material for reclamation. An evaluation should take into account the "total system". Interactive parameters may either nullify or verify the significance of a potential problem.

[2] The actual maximum acceptable salt level will depend on the plant species proposed in the revegetation plan and the potential for upward salt movement.

[3] Specific level depends upon clay mineralogy, soil texture, and saturation percentage according to Dollhopf et al., 1983.

[4] The specific percentage of clay or sand allowed will depend upon clay mineralogy, organic matter content, consistence, soil lift, spoil characteristics, and size of sand fraction.

[5] These values may vary depending upon the plant species proposed for revegetation in specific locations (e.g., a soil with a high coarse fragment content throughout its profile may be completely salvaged if used for rangeland versus cropland postmine land use).

In cases where the Bench 1 material is used as the Lift B soil in prime farmland soils, it will meet the specifications for Lift B, as outlined in Table 2.04.9-2.

These suitability evaluations, based on averages across the study area, were used for topsoil volume determinations presented in the Topsoil Management Plan section of Section 2.05.4(2)(d), Topsoil (Redistribution). The number of profiles on which these averages are based is noted in the Soil Profile descriptions range of characteristics. The recommended topsoil salvage depths for each map unit are weighted averages of each major component of the map unit (those listed in the map unit name - for both consociationsassociations and complexes) as well as major soil inclusions as presented within the map units.

Results/Discussion

Prime Farmland Determination - 1988 and 1998

The Norwood office of the NRCS has provided WFC with documentation that list the definitions and criteria for categorizing soils as prime farmland, see Attachment 2.04.9-4 and Attachment 2.04.9-5. These documents list the standards set by both the U.S. Department of Agriculture, Natural Resource Conservation Service and the State of Colorado, Natural Resource Conservation Service. Peabody Coal Company and Intermountain Resource Inventories Inc. conducted soil surveys and the results can be found in Map 2.04.9-1, Attachment 2.04.9-1, Attachment 2.04.9-2, and Attachment 2.04.9-3. Soil type 70B and D70B lists Barx soil as a major component and Barx as a secondary component (30 percent of map unit) in 98E on Map 2.04.9-1. Barx soil is listed as a prime farmland soil in San Miguel County if the soil is irrigated by an adequate and dependable water supply. A letter dated October 14, 1992 (Attachment 2.04.9-6) from the Norwood NRCS representative states there is no prime farmland in this location because Barx soil does not have an adequate or dependable water supply for irrigation. Soil type 70B and D70B were covered under the 1992

~~letter. Soil type 98E is a resurvey of the original 70B soil type covered in the 1992 letter.~~

~~Conclusion: there is no prime farmland soil types in the WFC permit boundary.~~

12. Soil Survey Maps

The distribution of each soil map unit on the New Horizon Mine study area for 1988, 1996 and 1998 is provided as a composite on Map 2.04.9-1.

Typifying soil pedons (soil sample locations), as well as soil profile description locations are also denoted on Map 2.04.9-1. A complete soil identification legend, which identifies all mapping unit symbols, is ~~as~~on Attachment 2.04.9-1. A soil classification legend that identifies the taxonomy of each named soil component is in Attachment 2.04.9-2. A Taxonomic unit description of each named soil component is provided as Attachment 2.04.9-3 at the end of this section for the 1998 survey. Soil profile data sheets ~~are found in attachment~~for the 1998 survey are found in Attachment 2.04.9-9.To show the status of the site in February, 2008, and to define what procedures will be used for prime farmland, a new map has been created: Map 2.04.9-2 Topsoil Balance as of February 2008.

13. Soil Survey - 1988

This was the original soil survey done for the original mine permit area under Peabody Coal Company. The area of the survey is shown on Map 2.04.9-1. It is noted here that the 1988 survey consisted of the original permit area and a large area to the west. It also included an area on the Morgan property west of 2700 Road and south of the current portion of the Morgan property that is in the permit area. It is not known why this area was surveyed at that time, but presumably, it was under consideration that this area could later become part of the permit. No soil samples were taken in this area. The entire 1988 survey is included as Attachment 2.04.~~9-10.~~

9-1&2. There are no known data sheets for the 1988 survey. However, the survey on the Morgan property is valuable since it shows that the Barx Darvey soil (98E) continues to the south of the 1998 survey area, which does not cover 11.6 acres of the permit area on the Morgan property. The 1988 survey confirms that this soil is 98E, which is prime farmland.

14. Soil Survey - 1996

As the mine expanded to the west, an additional survey was conducted on the area immediately east of 2700 Road and south of BB Road. This is an area of 105.8 acres, which constituted the first amendment expansion of the mine. Most of this area was studied in the 1998 survey, but was re-done in 1996 to higher standards.

15. Soil Survey - 1998

This survey covered the amendment area west of 2700 Road (441.99 acres), and the area north of BB Road and east of 2700 Road. See Map 2.04.9-1 for the actual area. The soil test location descriptions are typical and consistent for soil in the area. The Order I survey is a refinement of the "not yet published" Order III soil survey that the NRCS has conducted in the area. Detailed map unit descriptions can be found in Appendix 2.04.9-9, Soil Map Unit Descriptions.

Map unit 98A occurs on alluvial terraces formed along Tuttle Creek. Profiles were described to 72 inches. Some areas may have soil deeper than 72 inches and yield a slightly greater amount of salvage material. This unit is considered prime farmland soil as of the 2008 NRCS determination.

Map unit 98B occurs on steep mesa side slopes. Hardness of bedrock varies depending on the underlying strata. Coarse fragments range from channersboulders to cobbles and are residual and colluvial in nature. Valleycity soil has the same physical and chemical properties as those soils similarly named in the survey area. Valleycity is outside the range of characteristics compared to the survey area, in that it occurs in an area of 5 to 8 inches mean annual precipitation.

Map unit 98C occurs on mesa summits, ridges and crests. Hardness of bedrock varies depending on the underlying strata.

Map unit 98D has thinner Quaternary eolian deposits than map unit 98E with a mean depth to bedrock of 30 inches. These deposits have developed cambic horizons, weak argillic horizons and secondary accumulations of carbonates. The accumulation of carbonates is reflected in a higher pPH in the Bk and Btk horizons. The pPH in A, Ap, ABt, Bw and Bt horizons (lLift layer 1A) averages 7.7 and in the Bk Btk and C horizons (lLift layer 2B) averages 8.1.

Map unit 98E consists of areas of deep Quaternary eolian deposits. These Quaternary deposits overlie Dakota Sandstone and Burro Canyon Formations with depth to bedrock ranging 40 inches too greater than 72 inches with a mean depth of 53 inches. These deposits have stabilized and formed cambic horizons and in some places weak argillic horizons. Additionally, they have developed secondary accumulations of carbonates. The accumulation of carbonates is reflected in a higher pPH in the Bk and Btk horizons. The pPH in A, Ap, ABt, Bw and Bt horizons (lLift layer 1A) averages 7.7 and in the Bk Btk and C horizons (lLift layer 2B) averages 8.2. Soil in this map unit is used primarily for irrigated pasture and hay crop. Barx soil is the second component (30 percent) in this map unit. BarxBarx/Darvey is a prime farmland soil in San Miguel County, Colorado if the soil is irrigated by an adequate and dependable water supply. In Attachment 2.04.9-6 is a letter from the Montrose County NRCS stating that BarxBarx/Darvey soil in the surveyoriginal permit area does not have an adequate or dependable water supply for irrigation. BarxBarx/Darvey soil iswas therefore not considered prime farmland soil in the survey area.original survey area. However, a revised assessment was made by the NRCS in February 2008 (Attachment 2.04.9-10).

As of February 15, 2008, the entire field south of BB Road and west of 2700 Road containing this unit is considered prime farmland soil since it is more than 67% prime farmland soil type, and is being handled as such by the Western Fuels - Colorado LLC. This property is entirely owned by Morgan.

Map unit 98F occurs in natural drainage areas that eventually form shallow valleys on the mesa and on the ~~floodplain of~~low lying area near Tuttle Creek. Depth to bedrock varies widely in this map unit. Haplargids with varying depths to bedrock form on drainage side slopes. Endoaquepts are formed where irrigation water has accumulated in drainage bottoms. In a few naturally occurring areas of water accumulation Endoaquolls have formed.

Eolian sands are intermixed with Cretaceous Dakota and Burro Canyon Formations in map unit 98G. Soil is generally moderately deep with significant inclusions of shallow soil on convex slopes. Soil salvage in this map unit may yield slightly less than predicted.

Map unit 98H occurs on mesa side slopes that are not as steep as those found in map unit 98B. Hardness of bedrock varies depending on the underlying strata. Wahweap soil has the same physical and chemical properties as those soils similarly named in the survey area. Wahweap is outside the range of characteristics compared to the survey area, in that it occurs in an area of 7 inches mean annual precipitation.

Table 2.04.9-3 represents average depths and ~~p~~PH of lift layers for soil salvage materials in the 1998 survey area and which lie~~s~~ in the proposed future area of disturbance as of February 2008. Weighted average lift depth is based on the percent of each soil component including inclusions for each map unit. Appendix 2.04.9-9 lists the percent composition for each soil type in a map unit. Weighted average lift depths are used to calculate volume of salvage material in table 2.04.9-4. Lift layer ~~one~~A is a combination of the following horizons where present: A, Ap, Ag, AB, AC, Bw, and Bt if the ~~p~~PH of those horizon was less than 8.0. Lift layer ~~two~~B is a combination of the following horizons where present: AC, Bw, and Bt if the ~~p~~PH of those horizons was greater than 8.0 and Bk, Btk, and C horizons. The volumes are shown for a) the full thickness reported from the soil survey and also b) 80% or 90% of the thicknesses from the soil survey, depending upon wether the soils are prime or not. For prime soils, a 90% recovery is used. For non-prime soils, an 80% recovery is used. This reduction is, in most cases, realistic, since the soil survey points do not show

some rocky areas that exist between sample points, thickness variations that cannot be fully stripped in the field, and other constraints that occur with large equipment.

Table 2.04.9-4 represents the acreage by map unit and the weighted average volume (cubic yards) of soil salvage material by lift layer available in the 1998 soil survey area and which lies in the ~~proposed future area of~~ disturbance area. Soil map unit 98B and 98H and all soil units north of BB Road and west of and including the mine pit are combined into one lift layer for all horizons as ~~sited~~cited in 2.05.4(2)(d).

=

Table 2.04.9-3: Soil Sample Sites and Lift Depth With Average PH

by Map Unit

(from 1998 Amendment Area Study) This table assumes a 93% salvage in 98A and 98E soils which are prime and 80% salvage in all others.

Map Unit	Sample Site	Lift ~~1~~A (in.)	Lift ~~2~~B (in.)	LifA Avg.PH	Lift ~~1~~B Avg. ~~pH Lift 2 Avg. p~~PH
98A	98051-Begay	9	63	7.8	8
	98052-Begay*	31	41	7.7	7.8
	98068-Begay	22	50	7.7	8
	98069-Begay*	28	44	7.7	8
	98071-Begay	31	41	7.7	8.2
	98072-Incl.	22	50	7.9	7.6
	Weight Average @100% in-place	**2~~4~~3.8**	**48.2**	7.8	7.9
	Weight~~ed~~ Average @93%Salvage	**2~~4~~1**	**4~~8~~3**		
98B	98055-Monierco	6	12	7.8	8
	98078-Valleycity	1	11	7.8	8.2
	98079-Valleycity	4	13	7.6	8.1
	98080-Valleycity	3	11	7.6	8.1
	Weight Average @100% in-place	**~~4~~3.5**	**1~~2~~1.8**	7.7	8.1
	Weight~~ed~~ Average @80%Salvage	**~~4~~ 3**	**10**		
98C	98027-Monierco	9	10	7.7	8.2
	98035-Monierco	7	12	8	8.4
	98048-Monierco	13	6	7.7	8.2
	98049-Monierco*	13	6	7.9	8.2
	98050-Monierco	9	10	7.8	8.2
	98053-Monierco	4	16	7.8	8.2
	98056-Monierco	2	15	7.2	7.8
	98057-Monierco	6	17	7.8	8
	98058-Monierco*	5	14	7.8	8
	98063-Monierco	10	8	7.6	8.2
	98067-Monierco	2	12	7.8	8.2
	98075-Travasilla	3	9	7.6	8.2
	Weight Average @100% in-place	**~~7~~6.9**	**11.3**	7.7	8.2
	Weight~~ed~~ Average @80%Salvage	**~~7~~ 6**	**~~11~~9**		

Map Unit	Sample Site	Lift A (in.)	Lift B (in.)	LifA Avg.PH	Lift B Avg. PH
98D	98001-Bowbac	11	28	7.8	8.1
	98002-Bowdish	10	23	7.8	8.3
	98025-Progresso	6	20	7.6	8
	98026-Bowdish	9	13	7.7	8.3
	98033-Bowbac	17	9	7.6	8
	98037-Bowdish	5	24	7.6	8.2
	98038-Bowbac	16	10	7.7	8.2
	98039-Incl.	11	7	7.7	8.2
	98041-Bowbac	20	8	7.7	8.2
	98043-Bowdish	12	23	7.6	8.2
	98044-Bowbac	12	16	7.7	8.4
	98046-Bowbac*	12	12		
	98054-Bowdish	9	13	7.8	8
	~~TABLE 2.04.9-3: SOIL SAMPLE SITES AND LIFT DEPTH WITH AVERAGE pH (con't.)~~**~~Map Unit~~**~~Sample Site~~~~Lift 1 (in.)~~~~Lift 2 (in.)~~~~Lift 1 Avg. pH~~~~Lift 2 Avg. pH~~~~98D (con't)~~98060-Bowbac	12	19	7.7	8
	98061-Bowbac	9	22	7.8	8.1
	98064-Bowbac	10	21	8.1	8.2
	98066-Bowbac	25	12	7.7	8.2
	98077-Bowbac	23	23	7.6	8
	~~**Average13177.7 8.1**~~Weighted Average @100% in-place	~~**2**~~**12.7**	**16.8**	7.7	8.1
	Weight Average @80% Salvage	**10**	**13**		
98E	98003-Barx	22	20	7.7	8.1
	98004-Barx	19	20	7.8	8.2
	98005-Darvey*	12	46	7.6	8.2
	98006-Darvey	13	27	7.8	8.2
	98007-Darvey	12	27	7.8	8.2
	98008-Darvey	18	32	7.9	8.2

	98009-Darvey*	26	34	7.8	8
	98010-Barx	24	48	7.7	8.3
	98011-Darvey	16	26	7.9	8.3
	98012-Darvey	29	31	7.8	8.2
	98013-Darvey	32	32	7.9	8.4
	98014-Darvey	10	58	7.8	8.2
	98015-Darvey*	28	39	7.7	8
	98018-Barx	23	46	7.6	8
	98019-Darvey	9	44	7.6	8
	98020-Darvey	9	39	7.8	7.9
	98023-Darvey	9	36	7.8	8.1
	98024-Darvey	9	53	7.4	8.2
	98028-Barx	7	35	7.4	8.2
	98029-Barx	13	29	7.7	8.2
	98030-Darvey*	17	31	7.7	8.1
	98042-Barx	25	21	7.7	8.2
	98076-Barx	18	54	7.7	8.1
~~17367.78~~ ~~.2~~	Weight~~ed~~ Average @100% in-place =	**17.4**	**36**		

~~TABLE 2.04.9-3: SOIL SAMPLE SITES AND LIFT DEPTH WITH AVERAGE pH (con't.)~~Map Unit	**Sample Site**	**Lift ~~1~~A (in.)**	**Lift ~~2~~B (in.)**	**LifA Avg.PH**	**Lift ~~1~~B Avg. ~~p~~PH**
	~~**Lift 2 Avg. pH**~~ **Weight Average @93% Salvage**	**16**	**32**		
98F	98016-Haplargid	20	52	7.1	7.4
	98017-Haplargid	28	44	7.5	8.1
	98021-Endoaq				
	98022-Haplargid	21	0	7.2	
	98034-Haplargid*	29	8	7.3	7.7
	98036-Haplargid	26	46	7.3	7.7
	98040-Haplargid	23	13	7.7	8
	98045-Endoaq	5	28	7.8	7.8
	98047-Endoaq*	10	29	7.6	7.8
	98059-Haplargid	12	12	7.7	8
	98062-Endoaq*	13	59	7.2	7.4
	98065-Endoaq	6	22	7	7.8
	Weight Average @100%in-place	**1~~8~~7.5**	**28.5**	7.4	8

	Weighted Average @80% Salvage	**164**	**2523**		
98G	98031-Bowbac*	8	16	7.6	8.2
	98032-Bowbac	14	42	7.6	8.1
	98073-Bowdish	12	12	7.7	8.4
	98074-Progresso	16	10	7.7	8
	Weight Average @100% in-place	1312.5	20	7.7	8.2
	Weighted Average @80% Salvage	**120**	**186**		
98H	98070-Wahweap	3	14	7.8	8.2
	98081-Wahweap	3	15	7.8	8
	Weight Average @100% in-place	**3**	**114.5**	7.8	8.1
	Weighted Average @80% Salvage	**32**	**1512**		

* Lab Samples

Table 2.04.9-4:

1998 Soil Survey – Map Unit Acreage and Soil Salvage Volumes (Based on 1998 Survey and 80% or 93% salvage thicknesses in Table 2.04.9-3-3)

Note: The listed acreage and volumes are approximations and should be treated as such when dealing with topsoil balances calculations.

MAP UNIT	ACREAGE	ACRES (disturbed)	VOLUME OF MEAN SALVAGE THICKNESS OF TOPSOIL	MEAN SALVAGE THICKNESS OF TOPSOIL	VOLUME OF SALVAGE	VOLUME OF SALVAGE
	MATERIAL LIFT 1 (CU.YARDS) MATERIAL LIFT 2 (CU.YARDS)		Lift 1 (inch)	Lift 2 (Inch)	Material Lift 1 (cu.yards)	Material Lift 2 (cu.yards)
98A	4Begay fine sandy loam, 1 to 3 percent slopes (2)	5.87	21	43	16573	1290625813121403
98B	Valleycity - Rock outcrop complex, 30 to 60 percent slopes	013.66	3	10	2484555510	4033
98C	77Monierco fine sandy loam, 0 to 10 percent slopes (3)	80.06	6	9	64582	7453611180447260
98D	118Bowbac – Bowdish complex, 0 to 3 pecent slopes (2)	190373123.07	10	13	253831165461	17478
98E	77Darvey – Barx complex, 0 to 3 percent slopes (2)	175987109.19	16	37268032	234880	68836
98F	35Haplargids – Endoaquepts association, 0 to 3 percent slopes (4)	37.23	14	23	70075	752801176384329 1
98G	Bowdish – Bowbac complex, 3 to 15 percent slopes (2)	2420023.51	10	3630016	31608	21511
98H	17Wahweap fine sandy loam,10 to 30 percent slopes (1)	25.37	2	12	6822	3227
C	Coal	.57	0	41139C 10	0	0
NST	No Suitable Topsoil	10.33	0	0	0	0
P	2Ponds1.42	1.82	0	0	0	0
R	Roads	5.26	0	0	0	0
RO	1Rock Outcrop	0	0	0	0	0
				Totals3765532909840 50		

~~LITERATURE CITED~~

TOTALS	**435.94**	**595511**	**287039**

It is noted that the 1998 Soil Survey did not cover the entire permit amendment area, therefore, acreages do not accurately represent the actual area of disturbance.

16. Topsoil Stripping Procedures

Prior to February 2008, the 1998/1999 expansion area was stripped in one mixed lift which was basically the A and B lifts combined. For the Benson West and Lloyd properties, the average mixed lift stripping thickness was 18 inches. The mixed lift is confirmed by the data in the 1998 study, which shows that Lift A on the Benson West and Lloyd properties is only 8-11 inches thick (at 80% recovery). Therefore, Lift B was taken in its entirety using an average of 18" stripped. In addition, the Bench 1 material was stripped and placed as subsoil to a depth of approximately 30 inches.

For the eastern portion of the Morgan property, the average mixed lift stripping thickness was 22 inches. The mixed lift is confirmed by the data in the 1998/1999 study, which shows that Lift A on the east portion of the Morgan property is only 17 inches thick. In addition, the Bench 1 material was stripped and placed as suitable subsoil to a depth of approximately 34 inches.

The areas backfilled as of February 2008 are shown on Map 2.04.9-2. All topsoil backfilled thicknesses are shown on the Map for the entire permit area.

Topsoil was salvaged from all significant disturbance areas including sediment ponds (includes pond area, embankment, and spillway), mining activities, spoil stockpiles, haul roads, access roads, mining area (includes box cut spoil and highwall reduction area) shop area, and diversion ditches. Topsoil was removed from all cut and fill slopes. No topsoil was salvaged from the light use roads utilized for environmental monitoring or power line corridors, except where cut and fills are required. Prior to topsoil removal, vegetation which is too large for incorporation into the topsoil was scraped away and combined with the overburden. The remaining vegetation was incorporated into the topsoil to help increase soil organic matter levels. To prevent unnecessary contamination, adequate extent of topsoil was salvaged from the edge of a road, embankment, ditch, cut slope, and toe of fill.

For the original permit area, a two-lift topsoil operation was utilized for the two primary pre-mine irrigated pastureland soil types (30C and D70B), whereby the "A" and upper "B" horizons (Lift A)

are salvaged separately from the lower "B" and "C" soil horizons (Lift B) (1988 - 1996 disturbance area).

Specific Soil Map Units (1E, 1EW, and 808) at New Horizon 2 (1988 - 1996 disturbance area) was more suited for mixed one-lift topsoil salvage because they are very shallow to shallow, have little profile development, and/or are excessively stratified. The salvageable topsoil from these units was primarily utilized, whenever feasible, in postmine dry pastureland area. One-lift topsoil was isolated from the two-lift topsoil during all soil handling operations.

For the portions of the 1999 expansion area that were disturbed prior to February 2008, the A, Bt, Bw, Bk and C horizons were combined for salvage in a mixed lift and suitable subsoil (Bench 1 material) was salvaged and placed in Lift B. Map 2.05.4-4 shows the thicknesses of both materials that were placed in these areas as part of the reclamation.

Appropriate adjustments will be made to the recovery rate as dictated by actual field conditions and initial topsoil balance reports. The actual amount of topsoil salvaged has been less than the amount estimated in the soil survey. As of July 1994, WFC has experienced an overall recovery of 80 percent compared to the volumes shown in the soil surveys. Table 2.04.9-6 reflects estimated salvage quantities for the 1995 study area and Table 2.04.9-7 reflects estimated salvage quantities for the 1999 disturbance area.

16.1 Topsoil Salvage Depths - 1988 Study Area

This study addresses the approximate original permitted area of 274 acres or 235 disturbed acres, as shown on Map 2.04.9-1. The salvageable depths of topsoil material presented in this section are based on laboratory data and extensive field observations, and represent only the most suitable sources of topsoil material. No unsuitable sources of topsoil will be salvaged and used during reclamation activities. Table 2.04.9-5 summarizes topsoil salvage depths and characteristics by map unit for the New Horizon 2 Mine disturbance area. It should be noted that the topsoil depths and volumes listed in Table 2.04.9-5 are only estimates derived from field sample pits. WFC live handled the majority of the topsoil with trucks and the mine shovel or large front end loaders in front of the active pit to the final graded backfill. WFC is committed to salvaging and redistributing all

available topsoil. As of June 2010, the only areas from the original permit that still requires topsoil replacement are the haul road, the overburden stockpile and some other minor areas. These areas cannot be re-topsoiled until the mine is in final reclamation.

16.2 Topsoil Salvage Depths - 1995 Study Area

This study addresses the additional permit area immediately east of 2700 Road and south of BB Road, which is an area of 105.8 acres. See Map 2.04.9-1 for the boundary of this area. At the conclusion of Pase 6 topsoil removal campaign (12-20-95), WFC conducted a topsoil balance study for the approved permit boundary. The study included the entire New Horizon 2 mining area. The remaining undisturbed acreage that topsoil will be salvaged from plus the topsoil that was placed in topsoil stockpiles at the beginning of mining was taken into account. All disturbed acreages were taken into account. The conclusion of this study can be seen in Table 2.04.9-6.

The study shows that New Horizon 2 will be topsoil deficient in Lift A of the two lift irrigated pasture reclamation portion. This Lift A has typically come from the first lift of the 30C soil group. To correct this shortage, WFC will substitute excess soil type 808 from the major drainage directly north of Pond 007 for Lift A. During Phase 6 topsoil campaign, 2.4 feet of 808 soil was removed from the drainage area and used for mixed topsoil replacement. The soil map shows the 808 depth being 2.4 feet in the drainage area. There is more 808 to be salvaged. The 808 soil looks good and should make great Lift A material. WFC will test the remaining 808 to verify its quality. This was done in the Annual Reports submitted to the Division, which showed that this material was suitable as subsoil. As of February 2008, these areas have been fully reclaimed to the topsoil depths shown on Map 2.05.4-4.

Initially, it was reported that an area of approximately 6.73 acres immediately east of Mount Nucla (box cut overburden stockpile) was only covered with 0.8 feet of topsoil. This was incorrect. The postmine topsoil replacement map, Map 2.05.4-4 shows the actual replacement, which is 18" of Lift A and 27" of Lift B.

16.3 Topsoil Salvage Depths - 1998/1999 Study Area

In 1998 WFC conducted a detailed soil survey and topsoil survey (Map 2.04.9-1) for the proposed 1998/1999 mine permit expansion area. This included land to the north of BB Road and west of 2700 Road. The conclusions of this study are in Table 2.04.9-3 and 4. These tables are based on the volumes for each soil type. Table 2.04.9-7 shows the actual thicknesses that were stripped in the areas that have already been disturbed and the stripping depths that are planned for the remainder of the undisturbed area west of 2700 Road as of February 2008.

Table 2.04.9-5
Topsoil Quantities And Characteristics By Soil Type
New Horizon Mine 1988 (Original Permit Area)

DESIGNATION (SYMBOL)	NAME	AFFECTED AREA (ACRES)	MEAN SALVAGE THICKNESS OF TOPSOIL (INCH)) (Lift A)	MEAN SALVAGE THICKNESS OF TOPSOIL (INCH) (Lift B)	MEAN SALVAGE THICKNESS OF TOPSOIL (INCH) (MIXED)	MEAN SALVAGE VOLUME OF TOPSOIL (CU-YD) (Lift A)	MEAN SALVAGE VOLUME OF TOPSOIL (CU-YD) (Lift B)	MEAN SALVAGE VOLUME OF TOPSOIL (CU-YD) (MIXED)	TOPSOIL SALVAGE LIMITATIONS
1E	Travessilla-Pinon Channery Sandy Loams Complex	50.82	0	0	10	0	0	0	Very shallow to shallow bedrock, coarse fragment content
1EW	Lithic Haplaquoll	14.88	0	0	14	0	0	0	Very shallow to shallow sandstone bedrock,, very shallow ground water.
30C	Progresso-Bond Complex	88.31	10	16	0	118728	189965	0	Shallow sandstone bedrock and high carbonate content.
D70B	Barx Sandy Loam -Barx Scalped Barx Buried Complex	20.9	10	42	0	28099	118015	0	High calcium carbonate content and moderately to strongly alkaline PH at varied depths, moderate EC.
808	Lithic Typic Haplaquolls	34.5	0	29	29	0	134512	0	Very shallow to deep sandstone bedrock, very shallow ground water.
810	Typic Haplaquolls, Deep	24.55	0	0	0	0	0	0	High calcium carbonate levels, very shallow ground water.
DL	Disturbed Land	.95	0	0	0	0	0	0	Roads, ponds, residences, and farmyards
TOTAL		234.91				146827	442492	0	

(1) These soils will not be segregated by individual soil horizons. These soil resources will primarily be utilized, whenever feasible in postming dry pastureland areas, (one foot replacement depth).

(2) These soil resources will primarily be utilized in postmine prime farmland hayland areas (first lift =15 acre-feet, one foot replacement depth and second lift = 3- acre-feet, 2-foot replacement depth) and irrigated pasture areas (143.9 acre-feet, 1.5 feet combined replacement depth).
(3) Actual topsoil recovery as of 6/94.
(4) Actual yardage. All D70B has been redistributed (1995) onto 7.63 acres.

Table 2.04.9-6
for 1995 Additional Lands Soil Study
Topsoil Quantities And Characteristics By Soil Type

NEW HORIZON #2 MINE 1995 Expansion Area
Note: The listed acreages and volumes are approximations

MAPPING UNIT DESIGNATION (SYMBOL)	MAP UNIT NAME	AFFECTED AREA (ACRES)	MEAN SALVAGE THICKNESS OF LIFT A TOPSOIL (inch)	MEAN SALVAGE THICKNESS Lift B (INCHES)	MEAN SALVAGE THICKNESS OF MIXED (INCHES)	MEAN SALVAGE VOLUME OF LIFT A TOPSOIL (CY)	MEAN SALVAGE VOLUME Lift B (CY)	MEAN SALVAGE VOLUME MIXED (CY)
1E-A	Pinion- rock outcrop complex, 3 to 30 percent slopes	12.26	7	0	0	11538	0	0
30C-A	Progresso - Bond complex, 2 to 8 percent slopes	34.78	10	17	0	46760	79492	0
30C1-A	Progresso sandy loam, 2 to 4 percent slopes	39.95	11	26	0	59082	139647	0
30C2-A	Progresso sandy loam, 5 to 15 percent slpes	7.31	13	34	0	12776	33415	0
808-A	Haplaustalfs - Haplaquolls association, 1 to 3 percent slopes.	6.11	12	35	0	9857	28751	0
PONDS		.72	0	0	0	0	0	0
FARM		4.91	0	0	0	0	0	0
TOTAL		106.04				140013	281305	0

Note: The listed acreages and volumes are approximations and should be treated as such when dealing with topsoil balances calculations.

Table 2.04.9-7A: 1998 Soil Survey – Map Unit Acreage and Soil Salvage Volumes (Based on 1998 Survey and 80% or 93% salvage thicknesses in Table 2.04.9-3)-(WEST OF 27 RD & SOUTH OF BB RD -PRIME FARMLAND

Note: The listed acreage and volumes are approximations and should be treated as such when dealing with topsoil balances calculations.

MAP UNIT		ACRES (disturbed)	MEAN SALVAGE THICKNESS OF TOPSOIL	MEAN SALVAGE THICKNESS OF TOPSOIL	VOLUME OF SALVAGE	VOLUME OF SALVAGE
			Lift 1 (inch)	Lift 2 (Inch)	Material Lift 1 (cu.yards)	Material Lift 2 (cu.yards)
98A	Begay fine sandy loam, 1 to 3 percent slopes [2]	0	21	43	0	121403
98A	Disturbed feb 2008 with Pond 013- 1.68 ac worth	0	21	43	0	121403
98B	Valleycity - Rock outcrop complex, 30 to 60 percent slopes	0	3	10	0	4033
98B	Disturbed Feb 2008 with Pond 013 .38 ac worth	0	3	10	0	4033
98C	Monierco fine sandy loam, 0 to 10 percent slopes [3]	0	6	9	0	7260
					0	0
98D	Bowbac – Bowdish complex, 0 to 3 pecent slopes [2]	9.49	10	13	12759	17478
98E	Darvey – Barx complex, 0 to 3 percent slopes [2]	85.9	16	32	184780	68836
98F	Haplargids – Endoaquepts association, 0 to 3 percent slopes [4]	11.73	14	23	22078	43291
98G	Bowdish – Bowbac complex, 3 to 15 percent slopes [2]	0	10	16	0	21511
98H	Wahweap fine sandy loam,10 to 30 percent slopes [1]	0	2	12	0	3227
C	Coal		0	0	0	0
NST	No Suitable Topsoil	1.59	0	0	0	0
P	Ponds	.4	0	0	0	0
R	Roads	0	0	0	0	0
RO	Rock Outcrop	0	0	0	0	0
TOTALS		**109.11**			**219617**	**412475**

(1) These soil resources will not be segregated by individual soil horizons.
(2) These soil resources will primarily be utilized in postmine irrigated pasture or cropland areas.
(3) This soil resource will be used primarily in postmine dryland pasture.
(4) This soil resource will be salvaged with adjacent soil map units.

It is noted that the 1998 Soil Survey did not cover the entire permit amendment area, therefore, acreages do not accurately represent the actual area of disturbance.

Table 2.04.9-7B: 1998 Soil Survey – Map Unit Acreage and Soil Salvage Volumes (Based on 1998 Survey and 80% or 93% salvage thicknesses in Table 2.04.9-3-4 (EAST & WEST OF 27 RD AND NORTH OF BB RD)

Note: The listed acreage and volumes are approximations and should be treated as such when dealing with topsoil balances calculations.

MAP UNIT		ACRES (disturbed)	MEAN SALVAGE THICKNESS OF TOPSOIL	MEAN SALVAGE THICKNESS OF TOPSOIL	VOLUME OF SALVAGE
			Lift 1 mix (inch)	Lift 2 mix (inch)	MIXED total cubic yards
98A	Begay fine sandy loam, 1 to 3 percent slopes (2)	5.87	21	43	50508
98A	Disturbed feb 2008 with Pond 013 1.68ac worth	1.68	0	0	0
98B	Valleycity - Rock outcrop complex, 30 to 60 percent slopes (1)	13.66	3	10	23875
98B	Disturbed Feb 2008 with Pond 013- .38 ac worth	0.38	0	0	0
					0
98C	Monierco fine sandy loam, 0 to 10 percent slopes (3)	80.06	6	9	161454
98D	Bowbac – Bowdish complex, 0 to 3 pecent slopes (2)	113.58	10	13	351215
98E	Darvey – Barx complex, 0 to 3 percent slopes (2)	23.29	16	32	150298
98F	Haplargids – Endoaquepts association, 0 to 3 percent slopes (4)	25.5	14	23	126848
98G	Bowdish – Bowbac complex, 3 to 15 percent slopes (2)	23.51	10	16	82181
98H	Wahweap fine sandy loam,10 to 30 percent slopes (1)	25.37	2	12	47752
C	Coal	.57	0	0	0
NST	No Suitable Topsoil	8.74	0	0	0
P	Ponds	1.42	0	0	0
R	Roads	5.26	0	0	0
RO	Rock Outcrop	0	0	0	0
TOTALS		**326.83**			**994131**

(1) These soil resources will not be segregated by individual soil horizons.
(2) These soil resources will primarily be utilized in postmine irrigated pasture or cropland areas.
(3) This soil resource will be used primarily in postmine dryland pasture.
(4) This soil resource will be salvaged with adjacent soil map units.

It is noted that the 1998 Soil Survey did not cover the entire permit amendment area, therefore, acreages do not accurately represent the actual area of disturbance.

16.4 Prime Farmland Soils Stripping After February 2008

The prime farmland designation for the 98A and the 98E soils was identified by the NRCS in February of 2008. This resulted in numerous consultations with the DRMS and the NRCS about how to immediately modify the topsoil handling plan to ensure that all prime farmland soils for reclaimed prime farmlands were handled properly. This was done in TR 57, which was approved in 2008. At that time the initial far eastern portion of the Morgan property was already covered with subsoil using the Bench 1 subsoil material (min. 26 inches). This area was approximately 51.6 acres. WFC immediately embarked on a testing program to demonstrate that this subsoil met all the criteria for Lift B as stipulated by the NRCS for prime farmland soil, as shown in Table 2.05.4(2)(d)-1. All this subsoil and the topsoil (Lift A) placed above it came from the Morgan property. The total thickness of the Lift A and Lift B placed on this area exceeds the 48 inches required by the NRCS and approved in TR-57 in 2008. For this reason, WFC believes it has done everything possible to ensure that the Morgan topsoil and subsoil has been replaced adequately for those areas that were subsoiled prior to February 2008.

Lift A is a combination of the following horizons where present: A, Ap, Ag, AB, AC, Bw, and Bt if the PH of those horizons was less than 8.0. Lift layer B is a combination of the following horizons where present: AC, Bw, and Bt if the PH of those horizons was greater than 8.0 and Bk, Btk, and C horizons. Since the vast majority of the Bench 1 material has been tested to meet the suitability criteria and since some of this material will be needed to provide a total minimum depth in all reclaimed areas of 48 inches, some Bench 1 material may be included to achieve this goal. This is generally standard practice to place the suitable Bench 1 above the overburden spoil, followed by either the mixed topsoil (in the case of the non-prime farmlands) and Lift B followed by Lift A in the case of the prime farmlands.

It was agreed with the NRCS in February of 2008, and in a followup phone call among Dan Mathews, Greg Lewicki and the NRCS that the remaining topsoil stripping for the Morgan property (prime farmland soils after 15Feb08) will be as follows: Lift A - strip to color change, where the color change is defined as from dark brown, which is the normal color of the topsoil, to light pink, which is the distinct color of the subsoil. This color change is consistent and has been used by the

operators with no confusion. It is anticipated that the in-place stripping thickness for Lift A will be between 6 inches and 24 inches. Table 2.04.9-8A shows 17.5 inches in place Lift A (soil 98E) in place inches over the entire Morgan field and Table 2.04.9-8B shows 17.80 inches in place inches (soil 98E) for the undisturbed portion. This data for the average thickness for Lift A and B is seen in Table 2.04.9-8A through C. Due to the fact that there are a limited number of samples in the field and this average is based on the samples only, WFC needs some flexibility in case areas are encountered with less soil thicknesses that do not show up in the samples. For this reason, WFC commits to salvaging an average of 14-18 inches for Lift A. For volume calculation purposes, it is anticipated that the average stripping thickness of the remaining (post 15Feb08) Lift A is 16.0 inches, which is approximately 93% of the original average from the samples.

Table 2.04.9-8 is also split into 3 parts: the 1st is the entire Morgan property, the 2nd is the part of the Morgan property that is still undisturbed (as of February 2008) and the 3rd is the non prime farmland fields to the north of BB Road and west of 2700 Road. Lift B stripping thickness will be between 20 inches to 60 inches, depending on the location and suitability. It is anticipated that the average stripping thickness for Lift B will be 35.7 in place inches (Table 2.04.9-8A; 100% recovery 98E), although there is variability due to rock cobbles and color change to near white due to caliche present in the subsoil. For volume calculation purposes, it is anticipated that the average stripping thickness of Lift B (Prime Farmland soil left on Morgans land after Feb 2008 and 93% recovery) is 36.7 inches. The shift foreman will review the soils map showing the soil sample thickness in the area to be stripped. The foreman will check with the equipment operators to make sure the proper thicknesses are being followed. The operators will be trained on the stripping of Lift B, and will know to stop the removal when the color change occurs from light pink to light tan, which indicates the zone change from the Lift B subsoil to the Bench 1 material. Also, the operators will be trained to evaluate the change where coarse fragments rise from less than 10% volume in Lift B to material that has significantly higher coarse fragments (20-25% which is Bench 1). This was the cause of the cutoff of the Lift B material in the 1998 soil survey. The Lift B average thickness is greater than the average 32" for Lift B in Table 2.04.9-3 for the 98E soil at 90% recovery, however, this additional average of 4 inches (32" vs. 36") is due to the fact that some lower quality soils have also been included in the prime farmland field. See Map 2.04.9-1. In addition, the area

of the field has changed slightly, giving more area to the southwest corner, which has higher thicknesses.

The NRCS has stated that it is desired to maintain a total thickness of approximately 4.0 feet in the replaced soil for the prime farmland soil fields. The policies outlined above will provide approximately 16 inches of Lift A and 36 inches of Lift B, which is a total of 52 inches, which is more than the 48 inches desired by the NRCS. Also, some extra material stripped in the undisturbed area will be used in the previously stripped area on the Morgan property. All of this Lift A and Lift B soil will be stockpiled separately or immediately placed on the Morgan backfilled area. The stripped prime farmland soil will only be used for reclaiming prime farmland soil on the Morgan property.

In addition to the commitments outlined above, all Bench 1 material excavated on the Morgan property after February 2008 will be salvaged and replaced only on the Morgan property. Section 2.05.3(5) addresses the topsoil balance for the entire Morgan property, which is prime farmland.

For the 4.76 acres of prime farmland 98A soil in the northwest corner of the WFC property, all of this topsoil was already stripped (prior to the determination of prime farmlands in February 2008) to create a sediment pond for the mine at this location. It is located at the low point of the permit in this area. The topsoil was stripped in a mixed A and B lift from this area to a depth of 40 inches. This material has been placed in Stockpiles 3 and 4. This material will only be used to reclaim this small area of prime farmland. The salvage volumes for these 2 stockpiles are shown in Table 2.04.9-9.

16.5 Non Prime Farmlands Soil Stripping Procedures after February 2008

This area basically covers the Benson West property, the Lloyd property and the WFC property north of BB Road and west of 2700 Road.

The non prime farmland topsoil stripping procedures for this area is as follows: Since Lift A thicknesses are from 6-13 inches and Lift B thicknesses are also relatively shallow (8" to 22"), Lift

A and B will be combined into one lift of mixed topsoil because it is very difficult to strip thicknesses of approximately 6-8 inches with such large mining equipment. The Survcadd thickness averages for the non prime farmland fields west of the pit in February 2008 show 7.1 inches for the average of Lift A and 17.4 inches of Lift B. See Table 2.04.9-8C. Using 80% of the soil sample average to obtain a stripping average for the area, this results in 5.7 inches for Lift A and 13.9 inches for Lift B. Therefore, the total average stripping thickness for the combined Mixed Topsoil (Lift A and Lift B) is 19.6 inches. The expected range is from 8 inches to 38 inches. The mine foremen and operators will be trained on the stripping of the mixed Lift A & B, and will know to stop the removal when coarse fragments have a rise from less than 10% volume in Lift B to material that has significantly higher coarse fragments (20-25%). In some cases, bedrock will be encountered at the end of Lift B in the non prime farmland areas.

An additional amount of suitable subsoil, which is basically the Bench 1 overburden material, will be stripped and placed as shown on Map 2.05.4-4. The Benson West property basically has already been backfilled with a minimum of 30 inches of this material. The Lloyd property will receive a minimum of 30" of this material and the WFC property will receive a minimum thickness of 24" of this Bench 1 material. For the purposes of the volume calculations, the suitable subsoil material on the Benson West is assumed to be 30" in thickness, and Lloyd property is 30" and the WFC property will be 24" in thickness. These amounts allow a minimum of 48" total suitable medium on the Benson and Lloyd properties and 44" on the WFC property.

From the 1998 soil survey, the Bench 1 suitable material is differentiated from the bottom of Lift B (which is the C soil horizon) by greater percentage of coarse fragments. The C horizon (at the bottom of the combined Lift A & B) generally has less than 10% coarse fragments and the Bench 1 material has from approximately 15% to 30%. Lower material with higher coarse fragment amounts is considered overburden and will be placed below the suitable subsoil material. The mine foreman and the equipment operators will be trained to differentiate these levels of coarse fragments.

16.6 Stripping Frozen Topsoil

The scanned Table 2.05.4.9-10 shows the average monthly temperatures from 1961-1990 for Uravan ,Colorado area, which is near Nucla, from the Natural Resources Conservation Service-Soil Survey of San Miguel Area, Colorado, pg 197. It can be seen that the average daily temperatures are above freezing from February through November. The average daily temperature for December and January are only two-four (2-4) degrees F below freezing so it is believed that the frost line below the ground surface would be minimal and will not penetrate through the Prime Farmland Soil Lift A horizon. The only concern one would ever have is the operational possibility of pulling up chunks of frozen Lift A and B topsoil together with equipment because of the frost. One wouldn't want to dilute topsoil Lift A with big chunks of topsoil Lift B. For a single lift topsoil removal or a mixed topsoil stripping situation, then that concern goes away. It should be noted that New Horizon stacks Lift A, Lift B and Mixed topsoil into separate but large piles with a dozer. The larger the topsoil pile, the more dirt insulation there is protecting the interface to Lift B directly under the pile. The conclusion is, that stripping (dozing, load, haul, dump, and regrading) topsoil in freezing conditions is perfectly acceptable at the New Horizon Mine. By the rare chance there is a micro occurrence of an extremely sub freezing period of time, for many weeks, the actual rip, doze and stacking of any Lift A will be curtailed but stacking of Lift B or Mixed topsoil could continue. Finally, there would be a high probability the dozer(s) wouldn't be able to start or operate under those extreme freezing conditions anyway.

16.7 Stripping Saturated Topsoil

The scanned Table 2.05.4(2)(d)-10 from the Natural Resources Conservation Service-Soil Survey of San Miguel Area, Colorado, pg 197 shows the average monthly precipitation from 1961-1990 for Uravan ,Colorado area, which is near Nucla. The monthly average ranges from 0.62"-1.53" per month. The yearly average is only 12.60" of precipitation per year. WFC just doesn't see a problem with the ground getting saturated beyond a couple inches by rainfall, at any one time. The average snowfall per month as seen in Table 2.05.4(2)(d)-10 is also insignificant for the Nucla area. As mentioned above, Lift A, Lift B and Mixed topsoil will be piled up using a dozer. So after the dozer gets past the first couple of inches, if that, of rain soaked topsoil, he will be in the dry. No

significant problem as far as precipitation soaked soils. The likely hood of a dozer working during a severe thunderstorm stacking topsoil is remote. Operationally, that dozer would be pulled out of that work duty to assist the other mining operations such as clearing roads so coal haulage out of the pit could continue. As far as loading, hauling and spreading the topsoil after it has been stacked by the dozer is nothing to be concerned about either. The outer 2-3" of the pile may be damp but not the interior. Again, no worries or chances of any significant mixing of Lift A with Lift B because after Lift A is stockpiled on Lift B, then the interface is basically covered by several feet of Lift A and the working area is good.

WFC does recognize that removing topsoil through saturated irrigation tailwater runoff ditches and the sort could cause some intermixing of the different topsoil horizon(s) or subsoil layers. All that can be done is to minimize the impact to the topsoil is by attempting to divert any runoff water away and then strip it. If that is not possible, then the topsoil removal operation will just have to do the best they can with what they have.

17. Soil Volume Availability, February 2008

This subsection is left intact for PR 06 since the topsoil volumes are based on the time frame when the prime farmland soils were first identified, and the volume calculations changed since the stripping procedures changed. An updated soil volume table is included in Section 2.05.4(2)(d) which addresses the status of the soil salvage, stockpiling and replacement based on the conditions as of June 2010.

As of February, 2008, the active pit was approximately 2100 feet west of 2700 Road. All areas east of 2700 Road and east of the active pit have been fully reclaimed with topsoil and suitable subsoil. Map 2.04.9-2 shows the status of the stockpiles, active pit, undisturbed areas, areas fully topsoiled and areas where subsoil has been placed. Section 2.05.4(2)(d) discusses the stockpile areas in detail. The area north of BB Road and west of 2700 Road was not prime farmland except for a small area in the northwest corner of the permit. It was agreed that the Morgan property would receive the same topsoil and subsoil that was present on the their property prior to mining. The eastern portion of the Morgan property that has had subsoil placement has been tested to ensure

that this subsoil meets the criteria for prime farmland. This data is discussed in Section 2.05.4(2)(d) Topsoil Redistribution and Attachment 2.05.4(2)(d)-1.

Available topsoil that has not been stripped as of February 2008 was determined. These soils were characterized during the Order 1 Soil Survey (IRI, 1998). Table 2.04.9-8C shows a summary of the results from those soil pits from the 1998 survey that are in unstripped soil as of February 2008.

The topsoil and subsoil salvage calculations for the area west of 2700 Road are given below in Table 2.04.9-9. This Table includes all areas that have been topsoiled west of 2700 Road, all stockpile inventories and all topsoil and subsoil available from undisturbed areas. It is estimated that for non prime soils, 80% of the thickness value from the 1998 survey will be salvaged for Lift A and Lift B and combined together as a Mixed Topsoil. It is estimated that for prime soils, 93% of the thickness value from the 1998 survey will be salvaged for Lift A and Lift B. It is demonstrated in Section 2.05.4(2)(d) Topsoil Redistribution that the soil volumes available are adequate for the reclamation in all current and future disturbed areas.

Table 2.04.9-8A: Soil Thickness from 1998 Soil Survey Sample Points (February 2008)

Prime Farmland Field - Entire Morgan Property

Sample #	Map Unit-Property	Sample Site	Lift A (in.)	Lift B (in.)	Lift A Avg. PH	Lift B Avg. PH
1	98D-	98001-Bowbac	11	28	7.8	8.1
2	98D-	98002-Bowdish	10	23	7.8	8.3
3	98E-Barx	98003-Barx	22	20	7.7	8.1
4	98E-Barx	98004-Barx	19	20	7.8	8.2
5	98E-Darvey	98005-Darvey	12	46	7.6	8.2
6	98E-Darvey	98006-Darvey	13	27	7.8	8.2
7	98E-Darvey	98007-Darvey	12	27	7.8	8.2
8	98E-Darvey	98008-Darvey	18	32	7.9	8.2
9	98E-Darvey	98009-Darvey*	26	34	7.8	8
10	98E-Barx	98010-Barx	24	48	7.7	8.3
11	98E-Darvey	98011-Darvey	16	26	7.9	8.3
12	98E-Darvey	98012-Darvey	29	31	7.8	8.2
13	98E-Darvey	98013-Darvey	32	32	7.9	8.4
14	98E-Darvey	98014-Darvey	10	58	7.8	8.2
15	98E-Darvey	98015-Darvey*	28	39	7.7	8
16	98F-	98016-Haplargid	20	52	7.1	7.4
17	98F-	98017-Haplargid	28	44	7.5	8.1
18	98F-Barx	98018-Barx	23	46	7.6	8
19	98F-Darvey	98019-Darvey	9	44	7.6	8
20	98E-Darvey	98020-Darvey	9	39	7.8	7.9
21**	98F-	98021-Endoaq	9	52	7.6	8.05
22	98F-	98022-Haplargid	21	0	7.2	
23	98E-Darvey	98023-Darvey	9	36	7.8	8.1
24	98E-Darvey	98024-Darvey	9	53	7.4	8.2
Weighted Averages @ 100% recovery			**17.5**	**35.7**	**7.70**	**8.10**
Weighted Averages @ 93% recovery			**16.3**	**33.2**		

Note: Only prime farmland soils have Lift A and Lift B stripped separately.

**Sample 21 values calculated from total measured depth and averages of Samples 20 & 24

Table 2.04.9-8B: Soil Thickness from 1998 Soil Survey Sample Points West of Mine Face February 2008. Prime Farmland Field - Not yet disturbed Morgan Property

Sample #	Map Unit-Property	Sample Site	Lift A (in.)	Lift B (in.)	Lift A Avg. PH	Lift B Avg. PH
10	98E-Barx	98010-Barx	24	48	7.7	8.3
12	98E-Darvey	98012-Darvey	29	31	7.8	8.2
13	98E-Darvey	98013-Darvey	32	32	7.9	8.4
14	98E-Darvey	98014-Darvey	10	58	7.8	8.2
15	98E-Darvey	98015-Darvey*	28	39	7.7	8
16	98F-Haplargid	98016-Haplargid	20	52	7.1	7.4
18	98F-Barx	98018-Barx	23	46	7.6	8
19	98F-Darvey	98019-Darvey	9	44	7.6	8
20	98E-Darvey	98020-Darvey	9	39	7.8	7.9
21**	98F-Endbaq	98021-Endoaq	9	52	7.6	8.05
22	98F-Haplargid	98022-Haplargid	21	0	7.2	
23	98E-Darvey	98023-Darvey	9	36	7.8	8.1
24	98E-Darvey	98024-Darvey	9	53	7.4	8.2
Weighted Averages @ 100% recovery			**17.8**	**40.8**	**7.60**	**8.10**
Weighted Averages @ 93% recovery			**16.6**	**37.9**		

Note: Only prime farmland soils have Lift A and Lift B stripped separately.

**Sample 21 values calculated from total measured depth and averages of Samples 20 & 24.

Table 2.04.9-8C: Soil Thickness from 1998 Soil Survey Sample Points West of Mine Face

February 2008 - Non-Prime Farmland Soils

Sample #	Map Unit- Property	Sample Site	Lift A (in.)	Lift B (in.)	Lift A Avg. PH	Lift B Avg. PH
50	98C-Monierco	98050-Monierco	9	10	7.8	8.2
53	98C-Monierco	98053-Monierco	4	16	7.8	8.2
54	98D-Bowdish	98054-Bowdish	9	13	7.8	8
55	98B-Monierco	98055-Monierco	6	12	7.8	8
56	98C-Monierco	98056-Monierco	2	15	7.2	7.8
57	98C-Monierco	98057-Monierco	6	17	7.8	8
58	98C-Monierco	98058-Monierco	5	14	7.8	8
59	98F-Haplargid	98059-Haplargid	12	12	7.7	8
60	98D-Bowbac	98060-Bowbac	12	19	7.7	8
61	98D-Bowbac	98061-Bowbac	9	22	7.8	8.1
62	98F-Endoaq	98062-Endoaq	13	59	7.2	7.4
63	98C-Monierco	98063-Monierco	10	8	7.6	8.2
64	98D-Bowbac	98064-Bowbac	10	21	8.1	8.2
65	98F-Endoaq	98065-Endoaq	6	22	7	7.8
67	98C-Monierco	98067-Monierco	2	12	7.8	8.2
78	98B-Valleycity	98078-Valleycity	1	11	7.8	8.2
79	98B-Valleycity	98079-Valleycity	4	13	7.6	8.1
		Weighted Averages @ 100%	**7.1**	**17.4**	**7.66**	**8.02**
		Weighted Averages @ 80%	**5.7**	**13.9**		

Note: Only prime farmland soils have Lift A and Lift B stripped separately.

Table 2.04.9-9: Topsoil And Subsoil Availability (Salvage) West of 2700 Road By Property. See Map 2.04.9-2. Thicknesses based on NRCS agreement and 1998 Soil Survey (Feb 08).

AREA (AC)	DESCRIPTION	THICKNESS TOPSOIL Top Lift (IN)	THICKNESS TOPSOIL Bottom Lift (IN)	VOLUME TOPSOIL Top Lift (CY)	VOLUME TOPSOIL Bottom Lift (CY)	COMMENTS
56.34	MORGAN UNDISTURBED	15 Lift A only	34 Lift B only	113,619	257,536	PRIME FARMLAND SOIL (Bench 1 suitable subsoil not included here but will also be placed to min. 3' thick)
16.09	MORGAN ACTIVE PIT	0	24 Suitable Subsoil	0	51,917	PRIME FARMLAND SOIL Bottom Lift is Bench 1 material.
27.90	MORGAN AREA SUBSOILED	0	34 Suitable Subsoil	0	127,534	PRIME FARMLAND SOIL Bottom Lift is Bench 1 material.
7.63	MORGAN TOPSOILED	22	34 Suitable Subsoil	22,568	34,878	PRIME FARMLAND SOIL Bottom Lift is Bench 1 material.
	TOPSOIL STOCKPILES #5,6,7,8			159,985		(Lift A & B Mixed) Stripped before February 2008
107.96	**TOTAL MORGAN**			**296,172**	**471,865**	
55.93	BENSON TOPSOILED	18 Lift A & B	30 Suitable Subsoil	135,351	225,584	NON PRIME Bottom Lift is Bench 1 material.
9.86	BENSON BACKFILLED AND SUBSOILED	0	30 Suitable Subsoil	0	39,769	NON PRIME Bottom Lift is Bench 1 material.
	BENSON BACKFILLED					

AREA (AC)	DESCRIPTION	THICKNESS TOPSOIL Top Lift (IN)	THICKNESS TOPSOIL Bottom Lift (IN)	VOLUME TOPSOIL Top Lift (CY)	VOLUME TOPSOIL Bottom Lift (CY)	COMMENTS
	TOPSOIL STOCKPILES #1, 2, 9	0	0	19,932	0	NON PRIME (Lift A & B Mixed)
65.79	**TOTAL BENSON**			**155,283**	**265,353**	
31.94	LLOYD BACKFILLED	0	36 Suitable Subsoil	0	154,590	NON PRIME
22.86	LLOYD ACTIVE PIT	0	0	0	0	NON PRIME
16.67	LLOYD UNDISTURBED	18.3 Lift A & B	36 Suitable Subsoil	41,014	80,683	NON PRIME
	TOPSOIL STOCKPILES #10	0	0	3,350	0	NON PRIME (Lift A & B Mixed)
71.47	**TOTAL LLOYD**			**44,364**	**235,272**	
87.76	WFC UNDISTURBED	18.3 Lift A & B	38.9 Suitable Subsoil	215,919	458,975	NON PRIME
3.96	WFC DISTURBED (FOR POND)	0	0	0	0	PRIME FARMLAND SOIL
	TOPSOIL STOCKPILES #3,4	0	0	14,731	0	PRIME FARMLAND SOIL to reclaim pond disturbance
91.72	**TOTAL WFC**			**230,650**	**458,975**	
336.94	**GRAND TOTAL**			**726,468**	**1,431,465**	

In Table 2.04.9-9 above, for undisturbed areas, the top lift is Lift A topsoil in the case of prime farmland and a mixed Lift A and B in the case of all other areas. The bottom lift is Lift B in the case of prime farmland and suitable Bench 1 subsoil in the case of all other areas. The eastern portion of the prime farmland has Bench 1 subsoil as the lower lift material.

Section 2.05.4(2)(d) Topsoil Redistribution contains information regarding the topsoil stockpiling, replacement and volume balance for all soils including the prime farmland by property.

Table 2.04.9-10

Nucla Regional Climatic Data for Precipitation and Temperatures

Table 1.--Temperature and precipitation

(Recorded in the period 1961-90 at Uravan, CO)

Month	Temperature						Precipitation				
				2 years in 10 will have--				2 years in 10 will have--			
	Average daily maximum	Average daily minimum	Average	Maximum temperature higher than--	Minimum temperature lower than--	Average number of growing degree days*	Average	Less than--	More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	41.1	14.3	27.7	57	-10	3	0.89	0.33	1.42	3	4.5
February----	49.4	21.7	35.6	67	1	28	0.62	0.25	1.01	2	0.6
March-------	57.9	28.8	43.4	77	14	145	1.00	0.36	1.59	3	0.4
April-------	67.7	35.5	51.6	85	19	349	1.01	0.39	1.53	3	0.3
May---------	78.2	44.2	61.2	94	30	641	1.00	0.35	1.59	3	0.0
June--------	89.2	52.0	70.6	103	38	885	0.45	0.13	0.80	1	0.0
July--------	94.9	59.0	77.0	105	48	1118	1.35	0.58	2.01	4	0.0
August------	92.0	57.7	74.8	103	46	1062	1.42	0.56	2.14	4	0.0
September---	83.5	48.0	65.7	98	33	754	1.30	0.39	2.04	3	0.0
October-----	71.7	36.8	54.2	88	23	432	1.53	0.45	2.41	3	0.2
November----	54.8	26.9	40.9	72	10	97	1.09	0.63	1.56	3	0.8
December----	42.7	17.9	30.3	59	-4	6	0.95	0.32	1.46	3	3.7
Yearly:											
Average---	68.6	36.9	52.7	---	---	---	---	---	---	---	---
Extreme---	110	-23	---	105	-12	---	---	---	---	---	---
Total-----	---	---	---	---	---	5521	12.60	9.91	14.93	35	10.3

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minumum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40 degrees F)

Literature Cited

Brady, N.C. 1974. The nature and properties of soils, eighth edition. The Macmillan Co., New York. 653 p.

Cater, F. W. 1970. Geology of the Salt Anticline Region in Southwestern Colorado. U.S. Geological Survey Professional Paper 637. U.S. Government Printing Office. Washington D.C. 75 p.

Fosberg, M.A. and A.L. Falen. 1983. Guide for preparing soil pedon descriptions (abbreviations, descriptions, and classifications), USDA-SCS and Univ. of Idaho - Dept. of Plant and Soil Sciences. 107 p.

Guthrie, R.L. and J.E. Witty. March-April, 1982. New designations for soil horizons and layers and the new Soil Survey Manual. Comments and Letters to the Editor. Soil Sci. Soc. Am. J. Vol. 46, No. 2. p. 443-444.

Hawn, William. May 27, 1987. Party leader, SCS San Migel Area Soil Survey. Personal Communication.

Klute, A. ed., 1986. Methods of Soil Analysis, No. 9, Part I, 2nd ed., American Society of Agronomy, Madison, WI. 1188 p.

Intermountain Resource Inventories, Inc. (IRI). 1998. Order 1 Soil Survey for New Horizon Mine, Western Fuels - Colorado LLC. March 1998.

Levesque, M. and E.D. Vendett. 1971. Selenium determination in soil and plant material. Canadian Journal of Soil Science. Vol. 51, p. 85-93.

Natural Resource Conservation Service.1984. Colorado Important Farmland Inventory. NRCS Colorado.

Natural Resource Conservation Service. 1996. National Soil Survey Handbook, Chapter 657.5, Identification of Important Farmlands. Washington DC.

Natural Resource Conservation Service. Unpublished. Soil Survey of San Miguel Area, Colorado, Parts of Dolores, Montrose and San Miguel Counties.

Nettleton, W.D., R.E. Nelson, B.R. Brasher, and P.S. Derr. 1982. Gypsiferous soils in the western United States. Chapter 9, in Acid Sulfate Weathering. Soil Science Society of America. p. 147-68.

Page, A. L., ed. 1982. Methods of Soil Analysis, No. 9. Part II, 2nd ed., American Society of Agronomy, Madison, WI. 1159 p.

Rosenfeld, I. and O.A. Beath. 1964. Selenium: Geobotany, Biochemistry, Toxicity, and Nutrition. Academic Press, N.Y. 411 p.

Sandoval, F.M. and J.F. Power. 1977. Laboratory methods for chemical analysis of mined-land spoils and overburden in western United States. USDA Agricultural Handbook 525. 31 p.

Schuman, G.E., and J.F. Power. March - April 1981. Topsoil management on mined lands. Journal of Soil and Water Conservation. p. 77-78.

Severson, R.C. and L.P. Gough. January - March 1983. Boron in mine soils and rehabilitation plant species at selected surface coal mines in western united States. Journal of Environmental Quality. Vol. 12, No. 1. p. 142-146.

Soil Conservation Service. 1975. Soil Taxonomy. Agriculture Handbook No. 436, U.S. Department of Agriculture, Washington, D.C. 754 p.

Soil Conservation Service. 1980. Soil Survey Manual, 430-V-SSM, Chapter 5, Map Units. 25 p.

Soil Conservation Service. 1981. Soil Survey Manual, 430-V-SSM, Chapter 4, Examination and Description of Soils in the Field. 107 p.

Soil Conservation Service. May 1981. 430-SOILS-Investigations-Preliminary Characterization Data for the LaPlata, Montezuma, Montrose, and San Miguel Counties, Colorado (CP80C0-255). 70 p.

Soil Conservation Service. 1982. Procedures for Collecting Soil Samples and Methods of Analysis for Soil Survey, Soil Survey Investigations Report No. 1, U.S. Department of Agriculture, Washington, D.C. 97 p.

Soil Conservation Service. October 1982. Important Farmland Inventory-Colorado. 68 p.

Soil Conservation Service and Colorado State University Agricultural Experiment Station. 1980. Important Farmlands of Colorado-State Summary and Map. 12 p.

Soil Conservation Service, May 1985. Classification and Correlation of the Soils of San Juan County, Utah, Central Part. 65 p.

Soil Conservation Service. No Date. Soil Survey of San Miguel Area, Colorado. Unpublished.

U.S. Department of Agriculture and Agency for International Development. 1985. Keys to Soil Taxonomy, Technical Monograph No. 6, prepared by Cornell University, Ithaca, New York, for Soil Management Support Services. 244 p.

USDA - NRCS. 1999. Soil Taxonomy. Agricultural Handbook 436, Second Edition. Soil Survey Staff

USDA-SCS. June 1961. Transect methods for determination of the composition of soil mapping units. William M. Johnson, Principal Soil Correlator, Berkeley, California. Soil Survey Technical Notes. 8 p.

USDA-SCS. 1971. Handbook of Soil Survey Investigation Field Procedures. 88 p.

USDA-SCS. April 1974. West Technical Service Center. Definitions and abbreviations for soil descriptions. 14 p.

USDA-SCS. Revised April, 1978. Land Resource Regions and Land Resource Areas of the United States. 72 p.

USDA-SCS. 1979. West Technical Service Center. Definitions and abbreviations for soil descriptions. Revision for Utah. 16 p.

USDA-SCS. May 1981. Wyoming Soil Interpretation Procedure Guide - Procedure for Developing SCS-Soils-5 Forms. SCS State Office, Casper, WY. 79 p.

USDA-SCS. April 1985. Soil series of the United States, Puerto Rico, and the Virgin Islands: Their taxonomic classification. in two sections. U.S. Gov't Printing Office, Washington D.C. On microfiche.

USDA-SCS/Wyoming. April 16-19, 1984. Updated information concerning new designations for soil horizons and layers. (material passed out at SCS Workshop, Casper, Wyoming by P.S. Derr, State Soil Correlator). 7 p.

U.S. Salinity Laboratory Staff. 1954. Diagnosis and improvement of saline and alkali soils. USDA Agricultural Handbook No. 60. Washington, D.C. 160 p.

Walsh Environmental, LLC. 2008. Subsoil Suitability Study, New Horizon Mine, Western Fuels, LLC. March, 2008.

Attachment 2.04.9-1

Soil Identification

Legend

Soil Identification Legend

Map Unit	Map Unit Name
1E	Travessilla - Pinon channery sandy loam complex, 3 to 30 percent slopes
1E-A	Travessilla - Pinon channery sandy loam complex, 3 to 30 percent slopes
1EW	Lithic Haplaquolls, 1 to 6 percent slopes
20C	owdish - Lazear complex, 3 to 15 percent slopes
20C-A	Bowdish - Lazear complex, 3 to 15 percent slopes
30C	Progresso - Bond complex, 2 to 15 percent slopes
30C-A	Progresso - Bond complex, 2 to 8 percent slopes
30C-A	Progresso sandy loam, 2 to 4 percent slopes
30C-A-1	Progresso sandy loam, 4 to 15 percent slopes
70B-A-2	Barx sandy loam, 1 to 4 percent slopes
D70B	Barx - Barx, scalped - Barx, buried complex, 1 to 4 percent slopes
808	Lithic - Typic Haplaquolls, shallow to deep, 1 to 3 percent slopes
808-A	Lithic - Typic Haplaquolls, shallow to deep, 1 to 3 percent slopes
810	Typic Haplaquolls, deep, 1 to 3 percent slopes
98A	Begay fine sandy loam, 1 to 3 percent slopes (prime farmland)
98B	Valleycity - Rock outcrop complex, 30 to 60 percent slopes
98C	Monierco fine sandy loam, 0 to 10 percent slopes
98D	Bowbac – Bowdish complex, 0 to 3 pecent slopes
98E	Darvey – Barx complex, 0 to 3 percent slopes (prime farmland)
98F	Haplargids – Endoaquepts association, 0 to 3 percent slopes
98G	Bowdish – Bowbac complex, 3 to 15 percent slopes
98H	Wahweap fine sandy loam,10 to 30 percent slopes
C	Coal
NST	No Suitable Topsoil
P	Ponds
R	Roads
RO	Rock Outcrop

Attachment 2.04.9-2

Soil Classification

Legend

Soil Classification Legend

Soil	Classification
Barx	Fine-loamy, mixed, superactive, mesic Ustic Calciargids (prime farmland)
Begay	Coarse-loamy, mixed, superactive, mesic Ustic Haplocambids (prime farmland)
Bond	Loamy, mixed, superactive, mesic Lithic Ustic Haplargids
Bowbac	Fine-loamy, mixed, mesic Ustic Haplargids
Bowdish	Fine-loamy, mixed, superactive, mesic Ustic Haplocalcids
Darvey	Fine-loamy, mixed, superactive, mesic Ustic Haplocalcids (prime farmland)
Endoaquepts	Endoaquepts
Haplargids	Haplargids
Lazear	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Monierco	Loamy, mixed, mesic, shallow Typic Haplargids
Pinon	Loamy, mixed, mesic Lithic Ustollic Calciorthids
Progresso	Fine-loamy, mixed, superactive, mesic Ustic Calciargids
Travessilla	Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents
Valleycity	Loamy-skeletal, mixed, mesic Lithic Haplargids
Wahweap	Loamy-skeletal, mixed, superactive, mesic, shallow Typic Haplocalcids

Attachment 2.04.9-3

Taxonomic Unit Descriptions

BARX SERIES

LOCATION BARX UT+AZ, CO

Established Series

Rev. DTH/JWH/WWJ

6/97

The Barx series consists of very deep, well drained soils that formed in alluvium and reworked eolian material derived from sandstone. Barx soils are on alluvial fans, terraces, hills, and mesas. Slopes range from 0 to 15 percent. Mean annual precipitation is about 11 inches and the mean annual temperature is about 49 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Calciargids

TYPICAL PEDON: Barx very fine sandy loam, on rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 3 inches; reddish brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; weak medium platy structure; soft, friable; common very fine and fine roots; few very fine tubular pores; moderately alkaline (pPH 8.0); clear smooth boundary. (2 to 4 inches thick)

AB--3 to 9 inches; reddish brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine, few medium roots; common very fine and fine tubular pores; moderately alkaline (pPH 8.0); clear smooth boundary. (0 to 7 inches thick)

Bt1-9 to 15 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate coarse subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common very fine and fine, and few medium roots; common very fine and fine, and few medium tubular pores; common distinct clay films on faces of peds; moderately alkaline (pPH 8.0); clear smooth boundary. (6 to l6 inches thick)

Bt2--15 to 23 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate coarse subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common very fine and fine roots; few medium tubular pores; many distinct clay films on faces of peds; moderately alkaline (pPH 8.0); clear smooth boundary. (6 to 12 inches thick)

Btk--23 to 36 inches; reddish yellowish (5YR 6/6) sandy clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; common very fine and fine roots; common very fine and fine tubular pores; few distinct clay films on faces of peds; strongly effervescent; carbonates segregated in filaments; moderately alkaline (~~p~~PH 8.2); abrupt wavy boundary. (0 to 14 inches thick)

Bk1--36 to 47 inches; pink (5YR 7/4) sandy clay loam, yellowish red (5YR 5/6) moist; massive; hard, friable, moderately sticky and moderately plastic; few very fine and fine roots; common very fine and fine tubular pores; violently effervescent; carbonates in veins; strongly alkaline (~~p~~PH 8.6); clear wavy boundary. (10 to 36 inches thick)

Bk2--47 to 55 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 4/6) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine roots; common very fine and fine tubular pores; strongly effervescent; carbonates are disseminated throughout; strongly alkaline (~~p~~PH 8.4); clear wavy boundary. (6 to 10 inches thick)

Bk3--55 to 60 inches; pink (5YR 7/4) sandy clay loam, yellowish red (5YR 5/6) moist; massive; hard, friable, slightly sticky and slightly plastic; common fine pores; violently effervescent; carbonates are in veins; ~~st**TYPE**~~st

TYPE LOCATION: San Juan County, Utah; about 2 miles southeast of the intersection of highway 95 and highway 261; located about 1,700 feet south and 1,600 feet west of the northeast corner of sec. 19, T. 37 S., R. 19 E.

~~RANGE IN CHARACTERISTICS~~Range in Characteristics:

Soil moisture regime: aridic bordering on ustic

Soil temperature regime: mesic

Mean annual soil temperature: 48 to 54 degrees F

Particle-size control section: 18 to 35 percent clay

Depth to calcic horizon: 12 to 39 inches

Depth to secondary calcium carbonate: 6 to 30 inches

A horizon:

Hue: 2.5YR to 10YR

Value: 4 to 6 (3 to 5 moist)

Chroma: 2 to 6
Texture: very fine sandy loam, fine sandy loam, or loam
Rock fragments: 0 to 25 percent gravel
Reaction: neutral to moderately alkaline

Bt and Btk horizon:
Hue: 2.5YR to 7.5YR
Value: 4 to 7 (3 to 7 moist)
Chroma: 3 to 6
Texture: sandy clay loam, clay loam, or loam
Rock fragments: 0 to 15 percent
Calcium carbonate equivalent: 0 to 5 percent
Reaction: neutral to moderately alkaline

Bk horizon:
Hue: 2.5YR to 7.5YR
Value: 5 to 8 dry (4 to 8 moist)
Chroma: 2 to 6
Texture: very fine sandy loam, fine sandy loam, sandy clay loam, loam, sandy loam, clay loam, or silt loam
Rock fragments: 0 to 35 percent gravel and cobbles
Calcium carbonate equivalent: 15 to 45 percent
Reaction: moderately to very strongly alkaline

COMPETING SERIES: These are the Hiland and Solirec series. Hiland soils have less than 15 percent carbonates in the calcic horizon. Solirec soils are in MLRA 34 and receive maximum precipitation in spring and fall. Similar soils and previously competing series are (Ustic Haplargids) Bowback, Cambria, Cushman, Decolney, Forkwood, Fort, Maysdorf, Pugsley, Teckla, Yenlo and (Ustollic Haplargids) Balon, Buckle, Cerrillos, Clovis, Fattig, Fernando, Flaco, Gaddes, Gapbutte, Hagerman, Harboard, Los Alamos, Millett, Oelop, Olney, Palacid, Penistaja, Pokemen, Potts, Progresso, Quagwa, Redpen, Scholle, Selpats, Spangler, Spenlo, Sundance, Tapia, Threetop, Toluca, and Tuweep. Only Cerrillos,

Clovis, Fernando, Millett, Scholle, Tapia, Toluca, and Tuweep soils are reclassified to Calciargids under the 7th Edition. Cerrillos soils are dryest from October to May. Clovis soils receive more than half of their precipitation between the months of July and October. Fernando soils contain 50 to 80 percent silt in the solum and are in MLRA 51. Millett soils contain 25 to 75 percent gravel and cobbles in the lower part of the solum. Scholle soils contain 15 to 35 percent gravel in the control section. Tapia soils contain caliche fragments in the Bt and Bk horizons. Toluca soils are in MLRA 58A and are yellower than 5YR throughout. Tuweep soils are yellower than 5YR and formed in alluvium from pyroclastics and basalt.

GEOGRAPHIC SETTING:

Parent material: reworked eolian material and alluvium derived from sandstone

Landform: alluvial fans, terraces, hills, and mesas

Slopes: 0 to 15 percent

Elevation: 4,400 to 7,800 feet

Mean annual temperature: 46 to 55 degrees F

Mean annual precipitation: 9 to 14 inches

Precipitation is fairly evenly distributed throughout the year with July and August being slightly wetter and June being slightly dryer.

Frost-free period: 100 to 175 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Abra, Begay, Mivida, Rizno, Sazi, Strych, and Windwhistle soils. Abra soils lack an horizon of clay accumulation. Begay and Mivida soils have coarse-loamy particle size control sections. Sazi and Windwhistle soils have bedrock at a depth of 20 to 40 inches deep. Strych soils have more than 35 percent rock fragments in the particle size control section.

DRAINAGE AND PERMEABILITY: well drained, negligible to high runoff, moderate or moderately slow permeability

USE AND VEGETATION: These soils are used mainly for rangeland. The potential vegetation is Indian ricegrass, galleta, Wyoming big sagebrush, and winterfat.

DISTRIBUTION AND EXTENT: Southeast Utah and southwest Colorado. LRR D, MLRA 34, 35, 39. This series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: Utah-Central Part, Grand County, Utah 1985. The name comes from the Bar X wash.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

ochric epipedon: The zone from 0 to 3 inches. (A)

argillic horizon: The zone from 9 to 36 inches. (Bt1, Bt2, and Btk)

calcic horizon: The zone from 36 to 60 inches. (Bk1, Bk2, Bk3)

Particle size control section: The zone from 9 to 29 inches. (Bt1, Bt2, Btk)

Taxonomy version, 7th edition 1996

ADDITIONAL DATA: Lab sampled S93CO083003.

National Cooperative Soil Survey

U.S.A.

BEGAY SERIES

LOCATION BEGAY UT+AZ, CO
Established Series
Rev. RLM/GWL/RLB
4/98

The Begay series consists of very deep, well drained, moderately rapidly permeable soils that formed in eolian deposits, derived mainly from sandstone. Begay soils are on structural benches and broad mesas and have slopes of 0 to 30 percent. The average annual precipitation is about 12 inches, and the mean annual temperature is about 48 degrees F.

AXONOMIC CLASS: Coarse-loamy, mixed, superactive, mesic Ustic Haplocambids

TYPICAL PEDON: Begay loamy fine sand, rangeland. (Colors are for air-dry soil unless otherwise noted.)

A--0 to 3 inches; yellowish red (5YR 5/6) loamy fine sand, yellowish red (5YR 4/6) moist; single grained; loose; very slightly effervescent, carbonates are disseminated; moderately alkaline (~~p~~PH 7.9); clear smooth boundary. (2 to 5 inches thick)

Bw--3 to 16 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; soft, friable; common fine roots; few fine pores; slightly alkaline (~~p~~PH 7.8); clear wavy boundary. (11 to 17 inches thick)

Bk1--16 to 28 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, firm; few fine roots; common fine pores; very slightly effervescent, carbonates are disseminated; moderatelt alkaline (~~ph~~PH 7.9); gradual wavy boundary. (10 to 14 inches thick).

Bk2--28 to 42 inches; yellowish red (5YR 5/6) very fine sandy loam, yellowish red (5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, firm; few fine roots;common fine pores; very slightly effervescent; carbonate strongly effervescent, moderately alkaline (~~p~~PH 8.0); gradual wavy boundary. (12 to 16 inches thick)

C--42 to 60 inches; yellowish red (5YR 5/8) very fine sandy loam, yellowish red (5YR 4/8) moist; massive; soft, very friable; few fine pores; very slightly effervescent, carbonates are disseminated; strongly alkaline (pPH 8.1).

TYPE LOCATION: San Juan County, Utah; 7 miles east and 5 miles north of Navajo Mountain School; SW 1/4, SE 1/4 sec. 31, T. 42 S., R. 17 E.

RANGE IN CHARACTERISTICS: The mean annual soil temperature ranges from 47 to 57 degrees F. The mean summer soil temperature at a depth of 20 inches ranges from 61 to 65 degrees F. In 7 out of 10 years the soils are dry in all parts of the moisture control section for 50 to 75 percent of the time (cumulative) that the soil temperature at depth of 20 inches is above 41 degrees F. The soils are moist in some part of the moisture control section for 30 to 40 days during the summer and are dry in some part of the moisture control section for 60 to 90 consecutive days during winter and early spring and are moist in some parts between July and October.

The combined thickness of the A and B horizons is 35 to 50 inches. The depth to secondary carbonates ranges from 12 to 22 inches. The series particle-size control section ranges from 15 to 40 percent fine sand or coarser and 0 to 15 percent rock fragments.

The A horizon has hue of 2.5YR through 10YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 3 through 6. Reaction is slightly alkaline or moderately alkaline. Carbonate content ranges from 0 to 3 percent.

The Bw horizon has hue of 2.5YR to 7.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 4 through 8. This horizon ranges from very fine sandy loam, loamy very fine sand, fine sandy loam, sandy loam and is mildly alkaline to strongly alkaline. Carbonate content ranges from 0 to 3 percent.

The Bk and C horizons have hue of 2.5YR through 7.5YR, value of 5 through 8 dry, and 4 through 8 moist, and chroma of 4 through 6. This horizon ranges from very fine sandy loam, fine sandy loam, or sandy loam, and thin strata of gravelly fine sandy loam, or loamy fine sand, below a depth of 40 inches. Reaction ranges from slightly alkaline to strongly alkaline. Carbonate content ranges from 0 to 5 percent.

COMPETING SERIES: These are the Ignacio (NM), Parida (NM), Remmit (CO), Sandspring (T AZ), and Turnback (WY) series. Ignacio and Turnback soils have bedrock at depths of 20 to 40 inches.

Parida soils have more than 15 percent rock fragments in the particle-size control section. Remmit and Sandspring soils have hue yellower than 7.5YR.

GEOGRAPHIC SETTING: Begay soils occur on fan remnants, structural benches and broad mesa tops at elevations of 4,700 to 7,400 feet. Slopes are 0 to 30 percent. These soils formed in deep eolian deposits and alluvium from sedimentary rocks. The climate is semiarid and the average annual precipitation ranges from 8 to 14 inches. The mean annual temperature is 44 to 55 degrees F. The mean summer temperature is 59 to 63 degrees F. and the freeze-free period ranges from 110 to 175 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the the competing Moepitz soils. Anasazi soils have a calcic horizon and have a lithic contact at depths of 20 to 40 inches. Aneth soils do not have cambic horizons and have a sandy particle size control section. Sogzie soils have calcic horizons.

DRAINAGE AND PERMEABILITY: Well drained; very slow to medium runoff; moderately rapid permeability.

USE AND VEGETATION: Used only as rangeland. Potential vegetation is needleandthread, big sagebrush, blue grama, Indian ricegrass.

DISTRIBUTION AND EXTENT: Southeastern Utah and northwestern Colorado. Begay soils are moderately extensive. MLRA 34, 35 and 48A.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona
SERIES ESTABLISHED: San Juan County, Utah, 1976.

REMARKS: These soils have been correlated to semidesert range sites in Utah.
Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - from 0 to 3 inches (A horizon).
Cambic horizon - from 3 to 16 inches (Bw horizon).

The Bk horizon is assumed to have too little carbonate to be a calcic horizon.

In December 1994 the classification was changed from Ustollic Camborthids to Ustic Haplocambids.

BOND SERIES

LOCATION BOND NM+AZ CO UT
Established Series
Rev. TLP/CDL/LWH/WWJ
11/97

The Bond series consists of very shallow and shallow, well drained, moderately permeable soils that formed in alluvium and eolian deposits derived from sandstone on cuestas, mesas, hills and ridges. Slopes range from 0 to 50 percent. The mean annual precipitation is about 11 inches and mean annual temperature is about 51 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, mesic Lithic Ustic Haplargids

TYPICAL PEDON: Bond sandy loam - on dipslopes; northeast aspect of cuesta with 4 percent slopes - rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 3 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few medium, fine and very fine roots; few very fine irregular pores; neutral; clear smooth boundary. (2 to 4 inches thick)

BA--3 to 7 inches; brown (7.5YR 5/4) sandy loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; few very fine and fine roots; common very fine irregular pores; neutral; abrupt smooth boundary. (0 to 4 inches thick)

Bt--7 to 13 inches; reddish brown (5YR 4/4) sandy clay loam, reddish brown (5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, sticky and slightly plastic; common moderately thick clay films on faces of peds and lining pores; common very fine and few fine roots; common very fine and fine tubular pores; neutral; abrupt smooth boundary. (5 to 12 inches thick)

C--13 to 16 inches; light brown (7.5YR 6/4) sandy clay loam; brown (7.5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common very fine irregular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary. (0 to 4 inches thick)

2R--16 inches; sandstone.

TYPE LOCATION: Cibola County, New Mexico; about 7 miles north of Milan; 300 feet south and 2,600 feet east of the northwest corner, sec. 8, T. 12 N., R. 10 W.

RANGE IN CHARACTERISTICS:

Soil Moisture: Usually dry, dry in all parts of the soil moisture control section in late spring and early summer, but moist intermittently in some part of the soil moisture control section from July to October.
Soil Temperature: 51 to 55 degrees F.
Depth to lithic contact: 6 to 20 inches
Rock fragments in the profile: 0 to 35 inches
Clay content in the particle-size control section: 20 to 35 percent

A horizon
Hue: 5YR, 7.5YR or 10YR
Value: 4 to 6 dry, 3 through 5 moist
Chroma: 2 to 4
Texture: loamy fine sand, sandy loam or fine sandy loam

BA horizon (where present)
Hue: 5YR or 7.5YR
Value: 4 to 6 dry, 4 or 5 moist
Chroma: 3 or 4
Texture: sandy loam, sandy clay loam or fine sandy loam

Bt horizon
Hue: 5YR or 7.5YR
Value: 4 or 6 dry, 3 to 6 moist
Chroma: 3 to 6
Texture: sandy clay loam, loam, sandy loam or clay loam

C horizon
Hue: 5YR or 7.5YR
Value: 5 to 8 dry, 5 or 6 moist

Chroma: 4 through 6 dry and moist
Fine earth fraction: sandy clay loam, loam, sandy loam or clay loam

COMPETING SERIES: There are no competitors in the present classification. Former competitors in the previous classification (Lithic Ustollic) are the Berto, Bondman, Frontier, and Kech series. Berto soils have calcic horizons. Bondman soils have soil temperatures ranging from 47 to 50 degrees F, and receive more winter moisture. Frontier and Kech soils have horizons with segregated secondary carbonates. In addition, Frontier soils have hue yellower than 7.5YR in the argillic horizon.

GEOGRAPHIC SETTING: Bond soils are on cuestas, mesas, hills, and ridges with slopes ranging from 0 to 50 percent. They formed in alluvial and eolian deposits from sandstone. Elevations are 5,600 to 7,000 feet. Typically, the average annual precipitation is 10 to 13 inches, but ranges to 15 inches in some areas; mean annual temperature is 49 to 54 degrees F. The frost-free period is 110 to 160 days. In Colorado, the temperature ranges as low as 43 degrees F. In Arizona elevations are as low as 4500 feet, temperatures as high 55 degrees and frost free as long as 165 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Aparejo, Hagerman, Penistaja and Skyvillage soils. Aparejo and Penistaja soils are deep. Hagerman soils have lithic contact between 20 and 40 inches. Skyvillage soils do not have argillic horizons.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff; moderately permeable.

USE AND VEGETATION: The major use of this soil is for livestock grazing. The present vegetation is blue grama, sideoats grama, New Mexico feathergrass, Indian ricegrass, scattered oneseed juniper, and winterfat.

DISTRIBUTION AND EXTENT: West-central New Mexico, Northern Arizona, southwestern Colorado and southern Utah. MLRA 36. The series is moderately extensive.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: McKinley County, New Mexico; Zuni Mountains Area, New Mexico, 1964.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric Horizon - The zone from 0 to 3 inches (A horizon).
Argillic Horizon - The zone from about 7 to 13 inches (Bt horizon).
Lithic contact - the boundary with sandstone at 16 inches
The type location of the Bond series was moved from McKinley to Cibola County in 1984 to better reflect the present concepts of the Bond series.

National Cooperative Soil Survey
U.S.A.

BOWBAC SERIES

LOCATION BOWBAC WY+MT
Established Series
Rev. JWW/MCS
10/94

The Bowbac series consists of moderately deep, well drained soils formed in alluvium, eolian deposits or residuum derived primarily from argillaceous sandstone. They occupy dissected fan remnants, fan piedmonts, hillslopes, pediments, ridges and buttes. Slopes are 0 to 15 percent and both simple and complex. The mean annual precipitation is about 13 inches, and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, mesic Ustic Haplargids

TYPICAL PEDON: Bowbac sandy loam-on a northeast facing slope of 1 percent under native vegetation. (Colors are for dry soil unless otherwise stated.)

~~**A--0 to 3 inches; bro**~~wn (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak fine and very fine granular structure; soft, very friable, nonsticky nonplastic; many fine and very fine roots; neutral (~~p~~PH 6.8); abrupt wavy boundary. (2 to 7 inches thick)

Bt1~~**--3 to 25 inches; y**~~ellowish brown (10YR 5/4) sandy clay loam, brown (10YR 4/3) moist; moderate coarse and medium prismatic structure parting to moderate medium and coarse angular blocky; hard, friable, slightly sticky and plastic; common fine and very fine, few medium and coarse roots; many distinct clay films on faces of peds; neutral (~~p~~PH 7.2); clear wavy boundary. (8 to 24 inches thick)

Bt2--~~25 to 31 inche~~s; yellowish brown (10YR 5/4) sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium fine and very fine roots; common distinct clay films on faces of peds; mildly alkaline (~~p~~PH 7.6); clear wavy boundary. (4 to 8 inches thick)

~~Bk--31 to 39 inches~~; very pale brown (10YR 7/3) sandy loam, brown (10YR 5/3) moist; massive; soft, friable, slightly plastic; few medium, fine and very fine roots; slight effervescence, calcium carbonate as few fine and medium soft masses; moderately alkaline (~~p~~PH 8.0); abrupt smooth boundary. (6 to 18 inches thick)

Cr--39 inches; slightly hard, slightly effervescent, argillaceous sandstone.

TYPE LOCATION: Campbell County, Wyoming; 1250 feet north and 1350 feet west of the southeast corner of sec. 23, T. 42 N., R. 72 W. 43 degrees 35 minutes 45 seconds north latitude and 105 degrees 28 minutes 5 seconds west longitude.

RANGE IN CHARACTERISTICS: Depth to soft sandstone ranges from 20 to 40 inches. Depth to continuous carbonate accumulation ranges from 10 to 35 inches, and depth to the base of the argillic horizon ranges from 10 to 35 inches. Coarse fragments range from 0 to 15 percent and are soft sandstone channers or semirounded pebbles. The soil is dry in the moisture control section more than half the time cumulative that the soil temperature at a depth of 20 inches is 41 degrees F. and is never moist in some or all parts for as long as 60 consecutive days when the soil temperature at a depth of 20 inches is 41 degrees F., which occurs about April 21-27, but is dry in all parts of the moisture control section for at least 60 consecutive days from July 15 to October 25 and for at least 90 cumulative days during this period. The mean annual soil temperature is 47 to 53 degrees F., and the soil temperature at a depth of 20 inches is 41 degrees F. or more for 175 to 192 days. EC ranges from 0 to 2 mmhos throughout the profile.

The A horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. Textures are typically sandy loam but may be sandy clay loam, fine sandy loam, very fine sandy loam, or loam. Reaction is typically neutral or mildly alkaline but ranges to moderately alkaline in some pedons.

The Bt horizon has hue of 2.5Y through 7.5YR, value of 4 through 6 dry, 3 through 5 moist, and chroma of 2 through 4. In pedons where mollic colors are present in this horizon, the layer is too thin to meet the requirements for a mollic epipedon. Texture is sandy clay loam with more than 35 percent fine sand or coarser. Clay ranges from 20 to 35 percent. Reaction is typically mildly alkaline but may range from neutral to moderately alkaline.

The Bk horizon has hue of 2.5Y through 7.5YR, value of 5 through 7 dry, 4 through 6 moist, and chroma of 2 through 6. Texture is typically sandy loam or sandy clay loam but may be fine sandy loam or very fine sandy loam. Carbonates range from 6 to 14 percent. This horizon does not meet the requirements of a diagnostic calcic. Discontinuous horizons with greater than 15 percent carbonates occur in some pedons. Reaction is moderately or strongly alkaline with less than 15 percent ESP.

The Cr is a paralithic contact to calcareous, argillaceous sandstone. This material is weakly consolidated and does restrict the movement of water and, therefore, roots. Interbedded shales may be present in some areas and may form the contact.

COMPETING SERIES: These are the Balon, Barx, Buckle, Cambria, Cerrillos, Clovis, Cushman, Decolney, Fattig, Fernando, Flaco, Forkwood, Gaddes, Gapbutte(T), Hagerman, Harbord, Hiland, Los Alamos, Maysdorf, Millett, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Progresso, Pugsley, Quagwa, Redpen(T), Scholle, Spangler, Spenlo, Sundance, Tapia, Teckla(T), Threetop, Toluca, Tuweep, and Yenlo, series in the same family. Balcon, Barx, Buckle, Cambria, Cerrillos, Clovis, Decolney, Fernando, Forkwood, Harbord, Hiland, Los Alamos, Maysdorf, Millet, Oelop, Olney, Palacid, Penistaja, Potts, Quagwa, Redpen, Scholle, Spenlo, Sundance, Tapia, Teckla, Toluca, Tuweep, and Yenlo soils lack bedrock above 40 inches. Cushman soils have less than 35 percent fine sand or coarser in the Bt horizon. Fattig, Flaco, Gaddes, Gapbutte, Hagerman, Progresso, and Threetop soils have a lithic contact at 20 to 40 inches. Pokeman soils have alabaster at 20 to 40 inches and hues redder than 7.5YR throughout. Pugsley and Spangler soils are noncalcareous throughout.

GEOGRAPHIC SETTING: Bowbac soils are on dissected fan remnants, fan piedmonts, hillslopes, pediments, ridges and buttes. Slopes are 0 to 15 percent. Elevations are 3,500 to 6,500 feet. The average annual precipitation is 13 inches with over half of the annual precipitation falling in April, May, and June and less than one inch falling in each month of July, August, September, and October. Precipitation ranges from 10 to 14 inches. The mean annual temperature ranges from 43 to 51 degrees F. The frost-free season is about 110 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Cushman, Hiland, and Cambria soils and the Parmleed soils. Parmleed soils have over 35 percent clay in the Bt horizon.

DRAINAGE AND PERMEABILITY: Well drained; runoff is medium or low; moderate permeability.

SE AND VEGETATION: These soils are used primarily for grazing. Native vegetation is needleandthread grass, blue grama, western wheatgrass, and big sagebrush.

DISTRIBUTION AND EXTENT: Central and northern Wyoming. The soil is extensive.

MLRA OFFICE RESPONSIBLE: Bozeman, Montana

SERIES ESTABLISHED: Carbon County, Montana; 1971.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - 0 to 3 inches (A)
Argillic horizon - 3 to 31 inches (Bt1,Bt2)
Paralithic contact - 39 inches (Cr)

SIR - WY1133

BOWDISH SERIES

LOCATION BOWDISH CO+UT

Established Series

Rev. WSH-GB

08/97

The Bowdish series consists of moderately deep, well drained soils that are formed in residuum derived dominantly from sandstone and interbedded shale. Bowdish soils are on mesas, benches, ridges, and escarpments and have slopes of 1 to 30 percent. The mean annual precipitation is about 13 inches and the mean annual temperature is about 47 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplocalcids

TYPICAL PEDON: Bowdish loam - pinon-Juniper woodland. (Colors are for air dry soil unless otherwise noted.)

A--0 to 5 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and slightly plastic; strongly effervescent; moderately alkaline (pH 8.0); clear smooth boundary. (4 to 8 inches thick)

Bw--5 to 12 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; moderate medium subangular blocky structure; hard, friable, nonsticky and nonplastic; lime disseminated throughout; violently effervescent; moderately alkaline (pH 8.0); clear smooth boundary. (6 to 12 inches thick)

Bk--12 to 23 inches; pinkish white (7.5YR 8/2) gravelly loam, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; hard, friable, nonsticky and slightly plastic; 15 percent pebbles; lime disseminated throughout; violently effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary. (10 to 20 inches thick)

R--23 inches; hard sandstone.

TYPE LOCATION: Montrose County, Colorado, about 2.5 miles west and 3.5 miles north of Uravan, 150 feet east and 700 feet south of the northwest corner, sec. 18, T. 48 N., R. 17 W.

RANGE IN CHARACTERISTICS: Depth to the calcic horizon ranges from 5 to 20 inches. Depth to the lithic contact ranges from 20 to 40 inches.

The A and Bw horizons have hue of 7.5YR or 5YR, 4 to 6, 4 or 5 moist and chroma of 2 to 4. The rock

fragment content ranges from 0 to 30 percent, and is predominantly pebble and cobble sized. Reaction is mildly alkaline or moderately alkaline. The Bk horizon has hue of 10YR through 2.5YR hue, 5 to 8, 3 to 6 moist, and chroma of 3 to 6. The texture is loam, sandy clay loam, clay loam, or thin layers of sandy loam. The clay content is 18 to 35 percent. The rock fragment content is 0 to 30 percent, and is predominantly pebble size. Reaction is moderately alkaline or strongly alkaline. The calcium carbonate equivalent ranges from 15 to 40 percent. COMPETING SERIES: These are the Abra, Bighams, Cibeque, Copeman, Creel, Darvey, Harvey, Hernandez, Honlu, Numa, and Pultney series. Abra, Cibeque, Darvey, Harvey, Hernandez, Honlu, and Numa soils are deep. Pultney soils have 10YR and yellower hues and have 10 to 15 percent exchangeable sodium in the Cky horizon. Bighams soils have a paralithic contact at 20 to 40 inches. Creel soils have soil temperatures of 54 to 59 degrees F. Copeman soils have horizons of secondary gypsum accumulation.

GEOGRAPHIC SETTING: Bowdish soils are on mesas, benches, and escarpments. Slopes range from 1 to 30 percent. The soil formed in residuum derived dominantly from interbedded sandstone and shale. Elevation ranges from 5,000 to 7,300 feet. The mean annual precipitation ranges from 9 to 15 inches. Mean annual temperature ranges from 46 to 50 degrees F. The frost-free season is about 110 to 150 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Pinon, Clovis, and Progresso soils. Pinon soils have bedrock at less than 20 inches. Clovis soils are deep and have an argillic horizon. Progresso soils have an argillic horizon.

DRAINAGE AND PERMEABILITY: Well drained; medium to very rapid runoff; moderate permeability.

USE AND VEGETATION: They are used for limited livestock grazing and wildlife habitat. The native vegetation is pinon pine and Utah juniper with an understory of big sagebrush, galleta grass, Indian ricegrass, and salina wildrye.

DISTRIBUTION AND EXTENT: Southwestern Colorado. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: Wayne County, (Henry Mountains Area Soil Survey), Utah, 1982.

National Cooperative Soil ~~SurveyU~~Survey U.S.A.

DARVEY SERIES

LOCATION NM
Established Series
ev. CRL-RCP-RJA-ACT
11/97

The Darvey series consists of very deep, well drained, moderately permeable soils that formed in alluvium from calcareous sandstone, shale and limestone. These soils are on hills, fan terraces, and valley fill. Slope ranges from 0 to 5 percent. Mean annual precipitation is about 12 inches and mean annual air temperature is about 55 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Haplocalcids

TYPICAL PEDON: Darvey loam - rangeland. (Colors are for dry soil unless otherwise noted.)

--0 to 6 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable, sticky and slightly plastic; many fine and few very fine roots; many fine interstitial pores; strongly effervescent; moderately alkaline (pPH 8.2); clear smooth boundary. (3 to 10 inches thick)

Bw1--6 to 20 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; strong medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; moderately alkaline (pPH 8.2); gradual smooth boundary.

Bw2--20 to 31 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; common fine tubular pores; strongly effervescent; moderately alkaline (pPH 8.2); clear irregular boundary. (Combined thickness of Bw horizons is 7 to 30 inches)

Bk1-31 to 38 inches; pink (7.5YR 7/4) loam, light brown (7.5YR 6/4) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; common fine tubular pores; strongly effervescent; many calcium carbonate accumulations; moderately alkaline (pPH 8.2); gradual irregular boundary. (6 to 15 inches thick)

Bk2--38 to 60 inches; light brown (7.5YR 6/4) loam, brown (7.5YR 5/4) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and plastic; strongly effervescent; many calcium carbonate accumulations; moderately alkaline (pPH 8.2).

TYPE LOCATION: Lincoln County, New Mexico; about 1.4 miles southeast of the old Owens Ranch headquarters on dirt road; 20 feet south of road; in the northeast quarter, sec. 29, T. 5 S., R. 17 E.

RANGE IN CHARACTERISTICS:

Soil Moisture: Intermittently moist in the soil moisture control section from May through October and December through February. The soil moisture control section is moist for longer periods of time during the summer than the winter.Soil Temperature: 48 to 59 degrees F. Depth to calcic horizon: 24 to 35 inches.

A horizon:
Hue: 10YR or 7.5YR
Value: 3 to 5 dry, 3 or 4 moist
Chroma: 2 to 4
Texture: loam or clay loam

Bw horizon:
Hue: 5YR, 7.5YR, or 10YR
Value: 4 to 6 dry, 3 to 5 moist
Chroma: 3 to 6
Texture: loam or clay loam
Bk horizon:
Hue: 5YR, 7.5YR, or 10YR
Value: 5 to 8 dry, 4 to 7 moist
Chroma: 3 to 5
Texture: loam, silty clay loam, clay loam, or sandy clay loam
Calcium carbonate: 15 to 50 percent with more than 5 percent visible carbonates.

COMPETING SERIES: These are the Abra (AZ), Bighams (AZ), Bowdish (CO), Copeman (WY), Creel

(NM), Harvey (NM), Hernandez (NM), Honlu (UT), Numa (CO) and Pultney (CO) series. Abra soils do not have a cambic horizon and have a calcic horizon at a depth of less than 20 inches. Bighams, Bowdish, Creel, and Pultney soils have a lithic or paralithic contact at 20 to 40 inches. Copeman, Harvey, and Honlu soils have a calcic horizon at a depth of less than 24 inches. Hernandez soils are 9 to 12 inches deep to the calcic horizon. Numa soils do not have a cambic horizon and in addition are moist for longer periods in the spring.GEOGRAPHIC SETTING: Darvey soils are on hills, fan terraces and valley fills. Slope is 0 to 5 percent. The soils formed in alluvium derived from calcareous sandstone and shale and limestone. The elevation is 4,500 to 6,500 feet. The mean annual precipitation is 10 to 13 inches, but has ranged to 17 inches in the past. The mean annual soil temperature ranges from 48 to 59 degrees F. The frost-free period is about 150 to 190 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Asparas, Deama, La Fonda, Pastura, and the competing Harvey soils. Asparas soils have an argillic horizon. Deama soils are shallow to limestone. La Fonda soils lack calcic horizons. Pastura soils have petrocalcic horizons.

DRAINAGE AND PERMEABILITY: Well drained; slow runoff; moderate permeability.

USE AND VEGETATION: Used mainly for rangeland. The vegetation is sideoats grama, black grama, blue grama, soapweed, and sacahuista.

DISTRIBUTION AND EXTENT: Southeastern and south-central New Mexico. The soils are of moderate extent.

LRA OFFICE RESPONSIBLE: Temple, Texas

SERIES ESTABLISHED: Chaves County (North Part), New Mexico, 1981.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon: The zone from 0 to 6 inches. (A horizon).

Cambic horizon: The zone from 6 to 31 inches. (Bw horizons).

Calcic horizon: The zone from 31 to 60 inches. (Bk horizons).

ADDITIONAL DATA: NMSU Sample No. S79NM-5-1

National Cooperative Soil Survey
U.S.A.

LAZEAR SERIES

LOCATION LAZEAR CO+UT WY
Established Series
Rev. GB/JWH/WWJ
6/97

The Lazear series consists of shallow, well drained soils that formed in residuum derived from interbedded shales, loamstone, and sandstone. Lazear soils are on hills, mesas, and ridges. Slopes range from 0 to 65 percent. Mean annual precipitation is about 12 inches and the mean annual temperature is about 53 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents

TYPICAL PEDON: Lazear gravelly loam in grassland. (Colors are for dry soil unless otherwise noted.)
A--0 to 4 inches; light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/2) moist; moderate fine granular structure; soft, very friable; 15 percent sandstone gravel; strongly effervescent; moderately alkaline (pH 8.2); clear smooth boundary. (3 to 5 inches thick)
C--4 to 14 inches; light brown (7.5YR 6/3) gravelly loam, brown (7.5YR 4/3) moist; massive; slightly hard, very friable; 20 percent sandstone gravel; strongly effervescent; moderately alkaline (pH 8.2); abrupt wavy boundary. (7 to 17 inches thick)
R--14 inches; hard calcareous sandstone bedrock.

TYPE LOCATION: Delta County, Colorado; SW 1/4 of the NW 1/4 of sec. 29, T. 4 S., R. 3 E.; USGS quad; lat. 38 degrees 43 minutes 50 seconds N. and long. 108 degrees 17 minutes 20 seconds W., NAD

RANGE IN CHARACTERISTICS:
Soil moisture regime: aridic bordering on ustic
Soil temperature regime: mesic
Mean annual soil temperature: 47 to 58 degrees F
Mean summer soil temperature: 60 to 78 degrees F
Particle-size control section: 18 to 35 percent clay

Depth to lithic contact: 10 to 20 inches to hard calcareous sandstone

A horizon:
Hue: 7.5YR or 10YR
Value: 5 to 7 (3 to 5 moist)
Chroma: 2 to 4
Rock fragments: 0 to 35 percent
EC (mmhos/cm): 0 to 1
Reaction: slightly to strongly alkaline

C horizon:
Hue: 7.5YR to 2.5Y
Value: 5 to 8 (4 to 6 moist)
Chroma: 2 to 4
Texture: loam or clay loam
Rock fragments: 0 to 35 percent
Calcium carbonate equivalent: 1 to 6 percent
EC (mmhos/cm): 0 to 1
Reaction: slightly to strongly alkaline

COMPETING SERIES: These are the Farview, Redspear, Rizno, Rizozo, Skyvillage, and Travessilla, Travson, and Zukan soils. Farview soils are less than 10 inches to hard bedrock. Redspear soils have a mean annual soil temperature of less than 50 degrees F. Rizno soils have less than 18 percent clay in the particle size control section. Rizozo soils have hues of 5YR or redder. Travessilla and Skyvillage soils have particle size control sections with less than 18 percent clay. Zukan soils are over limestone bedrock and have an horizon of carbonate accumulation. Travson soils contain less than 18 percent clay in the control section. Similar soils and previously competing series are Gladel. The Gladel soil was reclassified to an Ustochrept.

GEOGRAPHIC SETTING:
Parent material: residuum derived from interbedded shales, loamstone, and sandstone
Landform: hills, mesas, and ridges
Slopes: 0 to 65 percent

Elevation: 4,800 to 6,200 feet
Mean annual temperature: 47 to 56 degrees F
Mean annual precipitation: 10 to 13 to inches
Frost-free period: 120 to 140 days

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Shavano soils and the competing Travessilla soils. Shavano soils have a lithic contact at depths greater than 20 inches and Travessilla soils contain less than 18 percent clay in the particle size control section.

DRAINAGE AND PERMEABILITY: well drained, negligible to high runoff, moderate permeability

USE AND VEGETATION: These soils are used principally as native pastureland. Native vegetation is galleta grass, cactus, greasewood, and snakeweed.

DISTRIBUTION AND EXTENT: The foothill areas of western and southwest Colorado and adjacent parts of Wyoming. LRR D, MLRA 34B. This series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: Delta County, (Paonia Area) Colorado. 1970.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
ochric epipedon: The zone from 0 to 4 inches. (A)
lithic contact: The zone at 14 inches. (R).
Taxonomy version, 7th Edition 1996
Secondary carbonates usually coat the surface of the bedrock.
Particle size control section: The zone from 0 to 14 inches. (A, C)

National Cooperative Soil Survey
U.S.A

MONIERCO SERIES

LOCATION NM+AZ
Established Series
Rev.CWK/LWH
10/90

The Monierco series consists of shallow, well drained moderately slowly permeable soils that formed from alluvium and eolian material derived dominantly from interbedded siltstone and shale. Monierco soils are on knolls and ridges on plateaus and mesas. Slopes range from 0 to 8 percent. The mean annual precipitation is about 8 inches and the mean annual temperature is about 53 degrees F.

TAXONOMIC CLASS: Loamy, mixed, mesic, shallow Typic Haplargids

TYPICAL PEDON: Monierco fine sandy loam rangeland.
(colors are for dry soil unless otherwise noted.)

A--0 to 3 inches; light yellowish brown (10YR 6/4) fine sandy loam, brown (10YR 4/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few fine pores; mildly alkaline (pPH 7.8); clear smooth boundary. (2 to 3 inches thick)

Bw--3 to 5 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; few fine pores; mildly alkaline (pPH 7.8); clear smooth boundary. (2 to 4 inches thick)

Bt--5 to 10 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate fine subangular blocky structure; hard, friable, sticky and plastic; thin continuous clay films on faces of peds; common fine and very fine roots; few fine and medium pores; moderately alkaline (pPH 7.8); clear wavy boundary. (4 to 6 inches thick)

Bk--10 to 16 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak fine

subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; few fine continuous pores; strongly effervescent with disseminated calcium carbonate; strongly alkaline (~~p~~PH 8.9); clear smooth boundary. (2 to 7 inches thick)

2 Cr--16 inches; siltstone and shale.

TYPE LOCATION: San Juan County, New Mexico; 400 feet east, 160 feet south of the northwest corner of sec. 24, T. 27., R. 12 W.; 108 degrees 34 minutes 12 seconds west longitude, 36 degrees 34 minutes 04 seconds north latitude.

RANGE IN CHARACTERISTICS:

Soil Moisture: Intermittently moist in some part of the soil moisture control section December through March and July through September. The soil is driest during May and June.

Soil Temperature: 52 to 56 degrees F.

Depth to paralithic contact: 10 to 20 inches.

Reaction: Mildly alkaline to strongly alkaline.

Percent clay in the control section: 18 to 35 percent.

A horizon - Hue: 10YR or 7.5YR and 5YR and 2.5YR in Arizona.
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 2 through 4
Texture: sandy loam, fine sandy loam, sandy clay loam or clay loam

Bw horizon - Hue: 10YR or 7.5YR and 5YR and 2.5YR in Arizona. Value: 5 or 6 day, 4 or 5 moist
Chroma: 3 or 4
Texture: sandy loam, fine sandy loam or clay loam

Bt horizon - Hue: 7.5YR or 5YR and 2.5YR in Arizona.

Value: 5 or 6 dry
Chroma: 3 or 4
Texture: sandy clay loam, loam or gravelly loam

Bk horizon - Hue: 7.5YR or 5YR and 2.5YR in Arizona.
Value: 5 or 6 dry
Chroma: 2 or 3
Texture: sandy clay loam, clay loam, loam or gravelly loam.

COMPETING SERIES: This is the Advokay series (Nv). Advokay soils contain more than 15 percent rock fragments and are effervescent in the argillic horizon.

GEOGRAPHIC SETTING: Monierco soils are on plateaus, knolls and ridges. Slopes range from 0 to 8 percent, Elevations range from 4800 to 6400 feet. The mean annual precipitation is 6 to l10 inches. The mean annual temperature is 48 to 55 degrees F. The average frost-free period is 120 to 160 days. In Arizona the temperature is as high as 57 degrees F.; frost free days as long as 180 days; precipitation as
much as 12 inches; and slopes to 15 percent.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Mayqueen, Sheppard and Shiprock soils. Mayqueen and Shiprock soil have less than 18 percent clay in the particle-size control section and are deep. Sheppard soils are sandy and deep.

DRAINAGE AND PERMEABILITY: Well drained; medium runoff and moderately slow permeaility.

USE AND VEGETATION: These soils are used for livestock grazing. Native vegetation is galleta, Mormon tea, blue grama, Indian ricegrass, big sagebrush, broom snakeweed and winterfat.

DISTRIBUTION AND EXTENT: The Monierco soils are of small
extent in northwestern New Mexico and northeastern Arizona.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: San Juan County, New Mexico Eastern Park, 1977.

REMARKS: Diagnostic horizon and features recognized in this pedon are:

Ochric Epipedon: the zone from the surface to a depth of 3 inches.

Argillic horizon: the zone from 5 to 10 inches. (Bt horizon)

National Cooperative Soil Survey
U.S.A.

PINON SERIES

LOCATION PINON NM+UT
Established Series
RD: BDS/CDL/RJA
5/86

The Pinon series consists of shallow, well drained, moderately slowly permeable soils that formed in alluvium and residuum derived from limestone. These soils are on knolls, ridges, mesas and hillslopes with slopes ranging from 1 to 30 percent. Mean annual precipitation is about 13 inches; mean annual temperature is about 53 degrees F.

TAXONOMIC CLASS: Loamy, mixed, mesic Lithic Ustollic Calciorthids

TYPICAL PEDON: Pinon channery loam - rangeland. (Colors are for dry soil unless otherwise noted.)
A--0 to 7 inches; brown (7.5YR 5/3) channery loam, dark brown (7.5YR 4/3) moist; moderate very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and fine roots; about 4 percent limestone fragments; strongly effervescent; disseminated calcium carbonate; moderately alkaline; clear smooth boundary. (3 to 10 inches thick)
Bk1--7 to 10 inches; light brown (7.5YR 6/3) channery loam, brown (7.5YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; strongly effervescent with common large concretions, few thin seams and streaks of calcium carbonate; moderately alkaline; clear smooth boundary. (2 to 4 inches thick)
Bk2--10 to 16 inches; pinkish white (7.5YR 8/2) channery loam, pinkish gray (7.5YR 6/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; violently effervescent with many soft segregations of calcium carbonate; moderately alkaline; abrupt smooth boundary. (5 to 10 inches thick)
R--16 inches; fractured limestone with many lime coatings on rock fragments.

TYPE LOCATION: Torrance County, New Mexico; 2,340 feet east of the NW corner sec. 15, T. 2 N., R. 7 E.

RANGE IN CHARACTERISTICS:

Depth to bedrock: 10 to 20 inches
Rock fragments: 5 to 35 percent
Soil temperature: 52 to 57 degrees F.
Reaction: mildly to moderately alkaline
A horizon: Hue - 7.5YR or 10YR
Value: 4 through 6 dry, 2 through 5 moist
Chroma: 2 through 4
Bk horizon: Hue - 5YR through 10YR
Value: 5 through 8 dry, 4 through 7 moist
Chroma: 2 through 4
Texture: loam, sandy clay loam, or clay loam (averages 18 to 30 percent clay).
Calcium carbonate equivalent: 15 to 40 percent

COMPETING SERIES: These are the Bisodi (T), Shalaco (T), and Wayneco (T) series. Bisodi, Shalaco and Wayneco soils have less than 18 percent clay.

GEOGRAPHIC SETTING: Pinon soils are on knolls, ridges, mesas and hillslopes at elevations of 5,500 to 6,700 feet. Slope gradients range from 1 to 30 percent. These soils formed in alluvium and residuum derived from limestone. Pinon soils are in a warm climate having mean annual temperature ranging from 49 to 56 degrees F., and a mean summer temperature of 64 degrees F. Mean annual precipitation ranges from 10 to 15 inches. The frost-free period is 130 to 170 days. In Colorado these soils have air temperatures ranging from 45 to 48 degrees F. and have a frost-free period of 90 to 130 days with elevations up to 7,400 feet.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dean and Deama soils and the competing Harvey soils. Dean soils have 40 percent or more carbonate in the control section and they lack a lithic contact within a depth of 20 inches. Deama soils have more than 35 percent rock fragments in the particle-size control section.

DRAINAGE AND PERMEABILITY: Well drained; slow surface runoff; moderately slow permeability.

USE AND VEGETATION: These soils are used primarily for livestock grazing. Native vegetation is pinyon, juniper, grama grass and shrubs.

DISTRIBUTION AND EXTENT: Central New Mexico and southern Colorado. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Temple, Texas

SERIES ESTABLISHED: Valencia County (East Valencia Area), New Mexico, 1970.

REMARKS: DIAGNOSTIC HORIZONS AND FEATURES RECOGNIZED IN THIS PEDON ARE:
Ochric epipedon - from the soil surface to a depth of about 7 inches. (A horizon)
Calcic horizons - the zone between 7 and 16 inches. (Bk1, Bk2 horizons)
Lithic contact - the occurrence of limestone at 16 inches.
National Cooperative Soil Survey, U.S.A.

PROGRESSO SERIES

LOCATION PROGRESSO CO+AZ NM
Established Series
Rev. BDS/GB/RLB
8/97

The Progresso series consists of moderately deep, well drained soils formed in alluvium derived from sandstone or limestone. Progresso soils are on old terraces, benches, mesas, and upland hills and ridges. Slopes range from 0 to 15 percent. The mean annual precipitation is about 14 inches and the mean annual temperature is about 46 degrees F.

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, mesic Ustic Calciargids

TYPICAL PEDON: Progresso loam - rangeland. (Colors are for dry soil unless otherwise noted.)
A--0 to 7 inches; reddish brown (5YR 5/4) loam, dark reddish brown (5YR 3/4) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and plastic; slightly alkaline; clear smooth boundary. (4 to 8 inches thick)

Bt--7 to 14 inches; reddish brown (5YR 5/4) clay loam; reddish brown (5YR 4/4) moist; weak medium subangular structure; hard, friable, slightly sticky and plastic; slightly alkaline; clear smooth boundary. (4 to 10 inches thick)

Btk--14 to 24 inches; reddish brown (5YR 5/4) clay loam, yellowish red (5YR 4/6) moist; moderate medium subangular blocky; hard, friable, slightly sticky and plastic; lime segregated in common fine irregularly shaped soft masses; violently effervescent; moderately alkaline; gradual wavy boundary. (6 to 10 inches thick)

Bk--24 to 36 inches; white (5YR 8/1) loam, pink (5YR 7/4) moist; massive; hard, very friable, slightly sticky and plastic; 10 percent pebbles; lime disseminated throughout and on pebbles as thick pendants; calcareous; moderately alkaline; abrupt wavy boundary. (6 to 12 inches thick)

R--36 inches; hard sandstone.

TYPE LOCATION: Montrose County, Colorado; about 100 feet east and 2,300 feet north of the southwest corner of Sec. 16, T. 48 N., R. 17 W.

RANGE IN CHARACTERISTICS:

Mean annual soil temperature ranges from 47 to 52 degrees F. Depth to bedrock ranges from 20 to 40 inches. Depth to calcareous material ranges from 8 to 24 inches. The moisture control section is moist in some part less than one-half the time the soil temperature is above 41 degrees F., and is dry in all parts for 15 consecutive days from May 15 to June 15. Coarse fragments range from 0 to 15 percent and are dominantly pebble-sized.

A horizon has hue of 2.5Y through 5YR, value of 4 through 6 dry, 3 or 4 moist, and chroma of 2 through 6. Soil reaction is neutral or slightly alkaline.

Bt horizon has hue of 2.5Y through 5YR, value of 4 through 6 dry, 4 or 5 moist, and chroma of 3 through 6. It is typically clay loam or sandy clay loam and has 18 to 35 percent clay. Soil reaction is neutral through moderately alkaline.

Bk horizon has hue of 2.5Y through 5YR, value of 5 through 8, 4 through 7 moist, and chroma of 1 through 6. It has common, medium to coarse, soft to hard, lime bodies and lime pendants on pebbles as well as disseminated lime. Texture is loam or sandy clay loam. Calcium carbonate equivalent ranges from 15 to 35 percent. Some pedons have a thin paralithic layer above the bedrock.

COMPETING SERIES: These are the Balon, Barx, Bowbac, Buckle, Cambria, Cerrillos, Clovis, Cushman, Fattig, Fernando, Decolney, Flaco, Forkwood, Fort Collins, Gaddes, Gapbutte(T), Hagerman,

Harbord, Hiland, Los Alamos, Maysdorf, Millet, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, pugsley, Scholle, Spangler, Spenlo, Stoneham, Sundance, Tapia, Threetop, Toluca, Tuweep, and Yenlo series. Balon, Barx, Bowbac, Buckle, Cambria, Cerrillos, Clovis, Decolney, Fernando, Forkwood, Fort Collins, Gaddes, Harbord, Hiland, Los Alamos, Maysdorf, Millett, Oelop, Olney, Palacid, Penistaja, Pokeman, Potts, Pugsley, Scholle, Spenlo, Stoneham, Tapia, Toluca, Tuweep, and Yenlo soils lack lithic contacts within depths of 40 inches. Cushman and Hagerman soils lack a calcic horizon below the argillic horizon. Fattig soils have chroma of 1 in the Bt horizon. Flaco soils have mean annual soil temperatures greater than 52 degrees F. Gapbutte soils have less than 15 percent calcium carbonate equivalent. Spangler soils have a paralithic contact above depths of 40 inches. Sundance soils have lithologic discontinuities. Threetop soils have soil moisture control sections that are moist in some or all parts in May and June.

GEOGRAPHIC SETTING: Progresso soils are on old terraces, benches, mesas, and upland hills and ridges. The soil formed in alluvium derived from sandstone or limestone. Slopes range from 0 to 15 percent. Elevation ranges from 5,300 to 6,800 feet. The mean annual precipitation ranges from 12 to 15 inches. Mean annual air temperature ranges from 45 to 49 degrees F. In Arizona mean annual air temperatures reach 57 degrees F., mean annual precipitation is as low as 10 inches, and the frost-free period extends to 165 days. The average frost-free period ranges from 90 to 130 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Barx soils and the Pinon soils. Pinon soils have hard bedrock at depths above 20 inches.

DRAINAGE AND PERMEABILITY: Well drained; slow to medium runoff; moderate permeability.

USE AND VEGETATION: This soil is used mainly for rangeland. A few areas are irrigated and produce corn for silage, small grains, alfalfa, and grass hay. Native vegetation consists mainly of galleta, Indian ricegrass, needleandthread, and Wyoming big sage.

DISTRIBUTION AND EXTENT: Western Colorado, northern Arizona and adjacent parts of New Mexico. The series is of moderate extent.

SERIES ESTABLISHED: Reconnaissance Upper Rio Puerco, New Mexico, Soil Conservation Service, 1940.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - the zone from 0 to 7 inches
Argillic horizon - the zone from 7 to 24 inches.
Lithic contact - the boundary with sandstone at 36 inches.
Ustic feature - soil moisture regime and organic carbon content meets the requirements for Ustic intergrades.

National Cooperative Soil Survey
U.S.A.

TRAVESSILLA SERIES

LOCATION TRAVESSILLA NM+AZ CO KS MT OK SD UT WY
Established Series
Rev. VGL-AJC-RJA
11/97

The Travessilla series consists of shallow, well drained soils that formed in calcareous eolian sediments and material weathered from sandstone. These soils are on hills, cuestas, and mesas with slopes ranging from 0 to 75 percent. Mean annual precipitation is about 11 inches. The mean annual temperature is above 53 degrees F.

TAXONOMIC CLASS: Loamy, mixed, superactive, calcareous, mesic Lithic Ustic Torriorthents

TYPICAL PEDON: Travessilla stony sandy loam - rangeland. (Colors are for dry soil unless otherwise noted.)

A--0 to 4 inches; light brownish gray (10YR 6/2) stony sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; common fine pores; 15 percent stones; slightly effervescent; mildly alkaline; clear smooth boundary. (2 to 6 inches thick)

C--4 to 8 inches; pale brown (10YR 6/3) channery loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; common fine pores; 20 percent channers; slightly effervescent; moderately alkaline; abrupt smooth boundary. ((2 to 14 inches thick)

2R--8 inches; hard sandstone with some fractures.

TYPE LOCATION: Union County, New Mexico; approximately 1,560 feet north and 4,200 feet west of the southeast corner, sec. 24, T. 31 N., R. 36 E.

RANGE IN CHARACTERISTICS:

Soil Moisture - Typically, moist intermittently from April 30 through October in some part of the soil moisture control section and dry in all parts periodically from November 1 to April 30.

Soil Temperature - 50 to 58 degrees F.

Depth to bedrock - 4 to 20 inches.

Reaction - Mildly or moderately alkaline calcareous throughout.

Particle-size Control Section - Rock Fragments: 0 to 10 percent stones, 0 to 10 percent cobbles and 0 to 25 percent pebbles but weighted average is less than 35 percent.

Fine Earth Fraction: Sandy loam, fine sandy loam, loam or very fine sandy loam.

Clay Content: 5 to 18 percent.

Silt Content: 5 to 50 percent.

Sand Content: 40 to 90 percent with more than 25 percent fine sand or coarser.

A and C horizons -

Hue: 2.5Y through 7.5YR

Value: 5 to 7 dry, 3 to 5 moist Chroma: 2 to 4

COMPETING SERIES: These are the Gladel, Lazear, Redspear, Rizno, Rizozo, Skyvillage, and Travson series. Gladel soils have continuous genetic subhorizons of secondary calcium carbonate and/or sulfate. Lazear soils have more than 18 percent clay. Redspear, Rizno and Rizozo soils have hues of 5YR or redder. Skyvillage soils are dry in all parts of the soil moisture control section periodically from February 15 to June 30. Travson soils are dry in the soil moisture control section July through September.

GEOGRAPHIC SETTING: The Travessilla soils are on hills, cuestas, and mesas with slopes ranging from 0 to 75 percent. Elevation ranges from about 4,700 to 8,000 feet. They formed from calcareous eolian sediments and material weathered from sandstone and shale. Outcrops of sandstone with a minor amount of shale are common on steep slopes. Typically, the average annual precipitation ranges from about 10 to 13 inches, but has ranged higher in the past. The average annual temperature ranges from about 47 to 57 degrees F. Frost-free period is typically 115 to 170 days. Utah has a frost-free period as low as 70 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bernal, Carnero, Hagerman, Quay and Pajarito soils. Bernal and Hagerman soils have argillic horizons. Carnero soils lack bedrock at depths of less than 20 inches. Quay and Pajarito soils lack bedrock within a depth of 40 inches and Quay soils have more than 18 percent clay in the control section and have a prominent zone of lime accumulation.

DRAINAGE AND PERMEABILITY: Well drained; medium to rapid runoff; moderate or moderately rapid permeability.

USE AND VEGETATION: Rangeland. Juniper, squawbush, oakbrush, blue grama, sideoats grama and snakeweed are the principal plants.

DISTRIBUTION AND EXTENT: Northern New Mexico, Arizona, Colorado, Montana, western Oklahoma, Utah and Wyoming. The series is extensive.

MLRA OFFICE RESPONSIBLE: Temple, Texas

SERIES ESTABLISHED: Eastern New Mexico Reconnaissance, Harding County, New Mexico, 1937.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric Epipedon - The zone from the surface of the soil to a depth of 4 inches (A horizon).
Lithic Contact - The occurrence of hard sandstone at about 8 inches (2R horizon).
Particle-size Control Section - The zone from the surface of the soil to about 8 inches (A, C horizons).

National Cooperative Soil Survey U.S.A.

VALLEYCITY SERIES

LOCATION VALLEYCITY UT
Established Series
REV: VKH/DTH/RLM
11/82

The Valleycity series consists of shallow, well drained, moderately permeable soils formed in colluvium and residuum from calcareous sandstone and shale. These soils occur on backslopes, ridges, and hogbacks with slopes of 8 to 25 percent. Average annual precipitation is 5 to 8 inches and mean annual temperature is about 53 degrees F.
TAXONOMIC CLASS: Loamy-skeletal, mixed, mesic Lithic Haplargids

TYPICAL PEDON: Valleycity very stony fine sandy loam, rangeland. (Colors are for air-dry soil unless noted.)

A--0 to 3 inches; light brown (7.5YR 6/4) very stony fine sandy loam, brown (7.5YR 5/4) moist; weak medium platy structure parting to weak fine and very fine subangular blocky; soft, very friable; few fine and very fine roots; many fine and very fine interstitial pores; 10 percent stones, 20 percent cobbles, and 30 percent pebbles on the surface, 15 percent cobbles and 15 percent pebbles; moderately calcareous; moderately alkaline (pPH 8.4); clear wavy boundary. (2 to 5 inches thick)
Bt--3 to 8 inches; brown (7.5YR 5/4) extremely stony sandy clay loam, dark brown (7.5YR 4/4) moist; moderate medium and fine subangular blocky structure; slightly hard, friable, sticky and plastic; many medium, fine and very fine roots; many medium, fine and very fine tubular pores; few thin patchy clay films in pores and as bridging between sand grains; 20 percent stones, 30 percent cobbles, 20 percent pebbles; moderately calcareous; moderately alkaline (pPH 8.2); clear wavy boundary. (4 to 6 inches thick)
BCk--8 to 12 inches; pink (7.5YR 7/4) extremely stony sandy loam, light brown (7.5YR 6/4) moist; weak fine subangular blocky structure; hard; friable; slightly sticky and slightly plastic; common medium, fine and very fine roots; many fine, very fine and common medium pores; 30 percent stones, 20 percent cobbles, 20 percent pebbles; very strongly calcareous; strongly alkaline (pPH 8.8); abrupt irregular boundary. (1 to 5 inches thick)

--12 inches; fractured calcareous sandstone.

TYPE LOCATION: Grand County, Utah. About 4.5 miles south of Cresent Junction on U. S. Highway 160; East of railroad tracks; SE 1/4, SW 1/4, sec. 22, T. 22 S., R. 19 E.

RANGE IN CHARACTERISTICS: Depth to bedrock ranges from 10 to 20 inches. The particle-size control section ranges in texture from very stony sandy clay loam, or very stony clay loam. Clay content ranges from 18 to 35 percent. Rock fragment content is 35 to 70 percent in the particle-size control section and consists of mainly of stones and cobbles, but some pebble size fragments are present. The mean annual soil temperature is 54 to 59 degrees F.

The A horizon has hue of 7.5YR, value 5 or 6 dry, 4 or 5 moist, and chroma of 3 or 4.

The Bt horizon has hue of 7.5YR, value 5 or 6, dry, 4 or 5 moist, and chroma of 4. Texture is very gravelly clay loam, very stony sandy clay loam, or very stony clay loam.

The BCk horizon has hue of 10YR or 7.5YR, value of 6, 7, or 8 dry, 4, 5, or 6 moist, and chroma of 3 or 4. It is strongly calcareous or very strongly calcareous. Texture is very stony sandy clay loam, very gravelly clay loam, or very stony clay loam. In some pedons, gravelly sandy loam, very stony clay loam, clay loam, very gravelly loam, very stony clay loam, and very stony loam strata are present.

COMPETING SERIES: These are the Hoot, Mirkwood (T), Theon (T), and Waucaba series. All these soils receive most of their annual precipitation during the winter months and receive little or no precipitation after the summer solstice. Hoot soils have loam, silt loam, clay loam, or silty clay loam textures in the particle-size control section. They are neutral to mildly alkaline in the argillic horizon. Theon soils are dominated by pebble sized fragments in the subsoil and are formed in granitic parent material. They have a paralithic contact above the lithic contact. Waucaba soils are dominated by pebble and cobble sized fragments in the argillic horizon and lack a BCk horizon.

GEOGRAPHIC SETTING: Valleycity soils occur on the marginal hogbacks and ridges of the Salt Valley anticline, Burro Canyon Formation. Slopes are medium and long in length and range from 8 to 25 percent. The soils are formed in colluvium and residuum and mostly from calcareous sandstones and shale. Mean annual temperature is 52 to 57 degrees F and average annual precipitation is 5 to 8 inches. The freeze-free period is 150 to 170 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Farb, Monue, and Chipeta soils. Farb soils have a loamy particle-size control section and lack a B horizon. Monue soils lack bedrock above a depth of 40 inches. Chipeta soils are less than 20 inches to paralithic contact.

DRAINAGE AND PEREMABILITY: Valleycity soils are well drained, medium runoff; and moderate permeability.

USE AND VEGETATION: These soils are used for rangeland; wildlife habitat and for recreation. Potential vegetation includes galleta, shadscale, Indian ricegrass, blackbrush, rabbitbrush, and pricklypear. DISTRIBUTION AND EXTENT: Southeastern Utah. The soils of this series are small in extent, 2,500 acres and are confined principally to the marginal hogbacks of the Salt Valley anticline.
MLRA OFFICE RESPONSIBLE: Lakewood, Colorado
SERIES ESTABLISHED: Grand County Utah, 1982.
REMARKS: Named for a ghost town near the north end of Salt Valley. National Cooperative Soil Survey U.S.A.

WAHWEAP SERIES

LOCATION WAHWEAP AZ
Established Series
Rev. WJ/RCH/PDC
06/97

The Wahweap series consists of shallow, somewhat excessively drained soils formed in eolian sands and sandstone alluvium on rolling plateaus. Slopes are 0 to 16 percent. Mean annual precipitation is about 7 inches and the mean annual air temperature is about 56 degrees F.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, mesic, shallow Typic Haplocalcids

TYPICAL PEDON: Wahweap fine sand - rangeland. (Colors are for dry soil unless otherwise noted.)
A--0 to 1 inch; yellowish red (5YR 5/8) fine sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; many very fine roots; many very fine interstitial pores; 5 percent gravel; moderately alkaline (pPH 8.0); abrupt smooth boundary. (1 to 3 inches thick)
Bk1--1 to 12 inches; yellowish red (5YR 5/8) gravelly loamy fine sand, yellowish red (5YR 4/6) moist; massive; slightly hard, very friable; common very fine roots; common very fine tubular pores; 30 percent gravel with thicker lime coatings on the bottom than on the top; slightly effervescent, 10 percent calcium carbonate equivalent; moderately alkaline (pPH 8.2); clear wavy boundary. (6 to 11 inches thick)
Bk2--12 to 19 inches; yellowish red (5YR 5/6) extremely gravelly fine sandy loam, yellowish red (5YR 5/6) moist; moderate fine subangular blocky structure; slightly hard, very friable; common very fine roots; common very fine tubular pores; 60 percent gravel with thicker lime coatings on the bottom than on the top; violently effervescent, 10 percent calcium carbonate equivalent; moderately alkaline (pPH 8.2); clear wavy boundary. (5 to 9 inches thick)
2Cr--19 inches; pinkish white (5YR 8/2) partially weathered sandstone; lime coatings in joints.

TYPE LOCATION: Coconino County, Arizona; about 7 miles northwest of Page; 1200 feet north and 500 feet east of the southwest corner of section 7, T. 41 N., R.8 E.

RANGE IN CHARACTERISTICS:
Soil moisture - Intermittently moist in some part of the soil moisture control section during July-

September and December-February. Driest during May and June. Typic aridic soil moisture regime.
Soil temperature - 57 to 59 degrees F.
Rock fragments - 35 to 60 percent gravel in the control section
Organic matter content - Less than 1 percent
Depth to paralithic contact - 10 to 20 inches
Depth to calcic - 1 to 13 inches

A and B horizons
Hue: 7.5YR, 5YR
Value: 5 or 6 dry, 4 or 5 moist
Chroma: 6 or 8 dry Texture: Fine sand, loamy fine sand, fine sandy loam, averaging finer than loamy fine
sand

COMPETING SERIES: There are no competing series.

GEOGRAPHIC SETTING: Wahweap soils are on rolling plateaus. These soils formed in eolian sands and sandstone alluvium. Slopes range from 0 to 16 percent. Elevations range from 3600 to 4400 feet. Mean annual precipitation is 6 to 10 inches. Mean annual air temperature is 55 to 57 degrees F. Frost-free period is 160 to 180 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Pagina and Sheppard series. Pagina soils are moderately deep. Sheppard soils are very deep.

DRAINAGE AND PERMEABILITY: Somewhat excessively drained; slow runoff; moderately rapid permeability.

USE AND VEGETATION: Used mainly for livestock grazing. Vegetation is mainly blackbrush, Mormon-tea, broom snakeweed, Indian ricegrass, and annuals.

DISTRIBUTION AND EXTENT: Northern Arizona. The Wahweap series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Phoenix, Arizona

SERIES ESTABLISHED: Coconino County; Soil survey of Coconino County Area, Arizona, North Kaibab Part; 1985.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - the zone from 0 to 1 inch (A horizon)
Calcic horizon - the zone from 1 to 19 inches (Bk1, Bk2 horizons)
Paralithic contact - the boundary at 19 inches (2Cr horizon)
National Cooperative Soil Survey
U.S.A.

657.5 Identification of important farmlands.

(a) Prime farmlands.

(1) General. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban or built-up land or water areas). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner when treated and managed, including water, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable levels of acidity or alkalinity, an acceptable content of salt and sodium, and few or no rocks. They have soils that are permeable to water and air. Prime farmland is not excessively erodible or saturated with water for a long period of time, and it either does not flood frequently or is protected from flooding. Examples of soils that qualify as prime farmland are Palouse silt loam, O to 7 percent slopes; Brookston silty clay loam, drained; and Tama silty clay loam, O to 5 percent slopes.

(2) Specific criteria. Terms used in this section are defined in USDA publications: "Soil Taxonomy, Agriculture Handbook 436;" "Soil Survey Manual, Agriculture Handbook 18;" "Rainfall-Erosion Losses from Cropland, Agriculture Handbook 282;" "Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346;" and "Saline and Alkali Soils, Agriculture Handbook 60." Prime farmlands meet all the following criteria:

(i) The soils have:

(a) Aquic, udic, ustic, or xeric moisture regimes and a sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone (the root zone is the part of the soil that is penetrated or can

be penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugar beet, sugarcane, vegetable, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; or

(b) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; or,

(c) Aridic or torric moisture regimes, and the area has a developed irrigation water supply that is dependable and of adequate quality.

(ii) The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These soils have, at a depth of 20 inches (50 cm), a mean annual temperature higher than 32o F (Oo C). In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47o F (8o C); it is higher than 59o F (15o C) in soils that have no O horizon.

(iii) The soils have a ~~p~~PH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep.

(iv) The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown.

(v) The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.

(vi) The soils are not flooded frequently during the growing season (less than once in 2 years).

(vii) The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soils erodibility) x C (climatic factor) does not exceed 60.

(viii) The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm), and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59o F (15o C). The permeability rate is not a limiting factor if the mean annual soil temperature is 59o F (15o C) or higher.

(ix) Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm) in diameter.

Attachment 2.04.9-4

National Soil Survey Handbook

Chapter 657.5

657.5 Identification of important farmlands.

(a) Prime farmlands.

(1) General. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land but not urban or built-up land or water areas). It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner when treated and managed, including water, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable levels of acidity or alkalinity, an acceptable content of salt and sodium, and few or no rocks. They have soils that are permeable to water and air. Prime farmland is not excessively erodible or saturated with water for a long period of time, and it either does not flood frequently or is protected from flooding. Examples of soils that qualify as prime farmland are Palouse silt loam, O to 7 percent slopes; Brookston silty clay loam, drained; and Tama silty clay loam, O to 5 percent slopes.

(2) Specific criteria. Terms used in this section are defined in USDA publications: "Soil Taxonomy, Agriculture Handbook 436;" "Soil Survey Manual, Agriculture Handbook 18;" "Rainfall-Erosion Losses from Cropland, Agriculture Handbook 282;" "Wind Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346;" and "Saline and Alkali Soils, Agriculture Handbook 60." Prime farmlands meet all the following criteria:

(i) The soils have:

(a) Aquic, udic, ustic, or xeric moisture regimes and a sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone (the root zone is the part of the soil that is penetrated or can be penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugar beet, sugarcane, vegetable, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10; or

(b) Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water

is available for irrigation in 8 out of 10 years for the crops commonly grown) and of adequate quality; or,

(c) Aridic or torric moisture regimes, and the area has a developed irrigation water supply that is dependable and of adequate quality.

(ii) The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These soils have, at a depth of 20 inches (50 cm), a mean annual temperature higher than 32o F (Oo C). In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47o F (8o C); it is higher than 59o F (15o C) in soils that have no O horizon.

(iii) The soils have a ~~p~~PH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep.

(iv) The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown.

(v) The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep, during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15.(vi) The soils are not flooded frequently during the growing season (less than once in 2 years).

(vii) The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soils erodibility) x C (climatic factor) does not exceed 60.

(viii) The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm), and the mean annual soil temperature at a depth of 20 inches (50 cm) is less than 59o F (15o C). The permeability rate is not a limiting factor if the mean annual soil temperature is 59o F (15o C) or higher.(ix) Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm) in diameter.

(430-VI-NSSH, 1996)

Attachment 2.04.9 - 59-5

Important Farmland Inventory

Natural Resource Conservation Service

United States Department of Agriculture

Denver, Colorado

October, 1982

Specific criteria. Prime farmlands meet all the following criteria: Terms used in this section are defined in USDA publications: "Soil Taxonomy, Agriculture Handbook 436"; "Soil Survey Manual, Agriculture Handbook 18"; "Rainfall-Erosion Losses from Cropland, Agriculture Handbook 282"; Land Erosion Forces in the United States and Their Use in Predicting Soil Loss, Agriculture Handbook 346" and "Saline and Alkali Soils,. Agriculture Handbook 60."

1. The soils have:

a. Aquic, udic, ustic, or xeric moisture regimes and sufficient available water capacity within a depth of 40 inches (1 meter), or in the root zone (root zone is the part of the soil that is penetrated or can be penetrated by plant roots) if the root zone is less than 40 inches deep, to produce the commonly grown cultivated crops (cultivated crops include, but are not limited to, grain, forage, fiber, oilseed, sugar beets, sugarcane, vegetables, tobacco, orchard, vineyard, and bush fruit crops) adapted to the region in 7 or more years out of 10: o

rb. Xeric or ustic moisture regimes in which the available water capacity is limited, but the area has a developed irrigation water supply that is dependable (a dependable water supply is one in which enough water is available for irrigation in 8 cut of 10 years for the crops commonly grown) and of adequate quality; or, (the term, adequate supply of water as used in the text of this report is synonymous with dependable water supply).

c. Aridic or torric moisture regimes and the area has a developed irrigation water supply that is dependable and of adequate quality; and,

2. The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50 cm), have a mean annual temperature higher than 32 deg F (O deg C). in addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47 deg F (80 deg C); in soils that have no O horizon, the man summer temperature is higher than 59 deg F (15 deg C); and,

3. The soils have a ~~p~~PH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep; and

4. The soils either have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops cam n to the area to be grown; and,

5. The soils can be managed so that, in all horizons within a depth of 40 inches (1 meter) or in the root zone if the root zone is less than 40 inches deep), during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage (ESP) is less than 15; and,

6. The soils are not flooded frequently during the growing season (less often than once in 2 years) ; and,

7. The product of K (erodibility factor) x percent slope is less than 2.0, and the product of I (soils erodibility) x C (climatic factor) does not exceed 60; and,

8. The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50 cm) and the mean annual 0 soil temperature at a depth of 20 inches (50 cm) is less than 59 F (150C) the permeability rate 18 not a limiting factor if the mean annual soil temperature is 59 0 F (15 C)'or higher; and,

9. Less than 10 percent of the surface layer (upper 6 inches) in these soils consists of rock fragments coarser than 3 inches (7.6 cm).

The following modifications and/or interpretations of the National Criteria for Prime Farmlands were used in Colorado.

The soil must have:

1. A developed irrigation water supply that is dependable and adequate to meet moisture requirements 8 out of 10 years and have 4 inches or more available water capacity within a depth of 40 inches (1 meter), or within the root Zone if the root zone is less than 40 inches;2. A growing season of 90 days or more;

3. No water table or the water table is below a depth of 1.5 feet and drainage is possible;

4. A conductivity of 8 mmhos/cm or less in the upper 40 inches and permeability is greater than .2 inches/hr. (moderately slow or greater) if the slope is less than 2 percent. These soils are considered capable of being managed so that all horizons within a depth of 40 inches (1 meter) or in the root zone if it is less than 40 inches will have a conductivity of the saturated extract of less than 4 mmhos/cm and

the exchangeable sodium percentage (ESP) is less than 15; irrigated soils with bedrock within 40 inches of the surface and soil horizons that have a ~~p~~PH higher than 7.4 are considered as having high conductivity and therefore not prime;5. slope of irrigated prime farmland will not exceed 6 percent.

Unique ~~FarmlandUnique~~Farmland

Unique Farmland is land other than Prime Farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yield of a specific crop, when treated and managed according to acceptable farming methods. Two areas in Colorado are considered Unique Farmlands of National Importance -- the fruit orchards in the Grand Valley and the Delta-Montrose areas, and the seed potato and fruit and vegetable producing areas of the San Luis Valley.

Attachment 2.04.9-6

NRCS Prime Farmland ~~Determination Letter~~

~~October 14, 1992~~

Evaluation Letters

The NRCS letter on the following page stating that there is no prime farmland in the permit area was written in 1992 by Dean Stindt and applied to the permit area that was under evaluation at that time. This permit area was a portion of the current permit area that is east of 2700 Road and south of BB Road. See the included Map on the page immediately after the letter. The letter refers to only XXXX ___ acres of the permit, which was the initial permit area. It does not include large portions of the current permit area (2010) nor any property west of 2700 Road.

Attachment 2.04.9-7

Soil Laboratory Data

~~Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC~~ ~~Colorado State University~~

~~P 0 Box 628 27646 West 5th~~ ~~Soil, Water and Plant Testing Laboratory~~

~~Nucla CO 81424~~ ~~Natural & Environmental Sciences Bldg - A319~~

~~Fort Collins, CO 80523~~

~~DATE RECEIVED: 03-25-98(970) 491-5061 FAX: 491-2930~~

~~DATE REPORTED: 04-17-98~~

~~BILLING:~~

~~RESEARCH SOIL ANALYSIS~~

~~"Pre-mine Soil Survey~~

~~Lab #PasteAB-DTPA Extract~~

~~ppm Sample IDPHEC mmhos/cm Lime Estimate%~~

~~OmN03-NPKZnFeMnCuF457 a - Darvey: 0-12"~~

~~98005 AP7.61.9Medium2A157.213720.516.91.978.06Lab #PasteAD-DTPA Extract~~

~~ppm Sample ID~~

~~PHEC mmhos/cm Lime Estimate%~~

~~OmN03-NPKZnFeMnCuF493 kk - Darvey: 12-26"98005~~

~~BW7.93.8High0.520.11096.101.00106F458 b - Darvey: 26-46"~~

~~98005 Bk18.10.9High0.523.632.90.223.640.481.51F459 c - Darvey: 46-58"~~

~~98005 Bk28.20.7High0.235.444.50.684.050.581.11F460 d - Darvey: 0-10"~~

~~98009 AP7.90.9High1.491.71816.1711.32.244.51F461 e - Darvey: 10-26"~~

~~98009 BW7.81.3High0.640.81330.756.431.452.73F462 f - Darvey: 26-60"~~

~~98009 C7.91.6High0.435.254.90~~

Enclosed on the subsequent pages are the field data sheets from the baseline soil testing, as well as the laboratory analyses. The sample points are shown on Map 2.04.9-1. The Table enclosed on the following page was that used in the 1998 Soil suitability evaluation. This table has since been revised, and the revised version (due to more strict selenium standards) is enclosed in the main text of Section 2.04.9.~~244.150.451.46F463 g - Darvey: 0-11"~~

~~98015 AP7.20.4Low2.0125.325713.113.55.796.16Lab #PasteAB-DTPA Extract~~

~~ppm Sample IDPHEC mmhos/cm Lime Estimate%~~

~~OmN03-NPK~~

TABLE 2.04.9-2

CRITERIA FOR EVALUATING SOIL SUITABILITY

PARAMETER - UNITS	THRESHOLD SUITABILITY LEVEL[1]
PH	<6.1->7.8
Conductivity (mmhos/cm)	4.0[2]
Saturation percentage (%)	>80% <25%
Sodium adsorption ratio[3]	>4
Calcium carbonate percentage	>15%
Selenium (ppm)	>2 ppm
Particle size[4]	All soil textures except: s, 1s, sc, sic, c
Coarse fragments (%)	15%[5]

[1] The threshold levels are to be used as a guide in evaluating the suitability of a soil material for reclamation. An evaluation should take into account the "total system". Interactive parameters may either nullify or verify the significance of a potential problem.

[2] The actual maximum acceptable salt level will depend on the plant species proposed in the revegetation plan and the potential for upward salt movement.

[3] Specific level depends upon clay mineralogy, soil texture, and saturation percentage according to Dollhopf et al., 1983.

[4] The specific percentage of clay or sand allowed will depend upon clay mineralogy, organic matter content, consistence, soil lift, spoil characteristics, and size of sand fraction.

[5] These values may vary depending upon the plant species proposed for revegetation in specific locations (e.g., a soil with a high coarse fragment content throughout its profile may be completely salvaged if used for rangeland versus cropland postmine land use).

INCL

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98072

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98A

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	7.5YR 4/3	fSL	15	60		2 m gr		0	—	8.0 es	CS
1	Bg	5-22	7.5YR 5/4 10YR 6/6 7.5YR 5/2	SCL	22	65		2c SBK		0	?	7.8 e	CS
2	Cg	22-[illegible]	7.5YR 5/2 10YR 4/1	fSL	12	75		M		0	—	7.6 e	—

Notes: H_2O TABLE 53 11

USTIC AQUICAMBIDS

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

INCL

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98068

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98A

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	7.5YR 4/3	L	15	40		1f gr		0	—	7.6 eo	CS
1	BT	5-22	7.5YR 4/4	SCL	24	60		2mc SBK		0	2n pf	7.8 es	CW
2	BTK	22-72	10YR 7/4	gr CL	28	35		2m SBK		2c 0 0	1n pf	8.0 ev	—

Notes: BARX

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Valleyfity

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98078
HAND DUG

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98B

Date: 3/17/98 **Surveyor: Jim Irvine, CPSS ARCPAC # 2404**

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
2	A	0-1	7.5YR 4/3	FSL	14	60		1 vf gr		5 5 0	—	7.8 cs	CS
2	~~BK~~	1-9	7.5YR 5/4	cb SL	18	60		1 m sbk		15 25 C	1n pf	8.2 ev	C-S
2	C	9-12	10YR 7/4	cbv SL	10	75		M		25 25 0	—	8.2 ev	gS
	R	12											

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Valley City

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

HAND DUG

98079

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98B

Date: 3/17/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	O-4	0-4	10YR 4/3	cb FSL	16	60		1 m gr		10 10 0	—	7.6 e	CS
2	EtK	4-10	7.5YR 5/4	cbv SCL	22	60		2m c SBK		15 25 0	2 FO	8.0 eV	gs
2	BK2	11-17	10YR 7/4	cbv SL	15	65		1mc SBK		15 30 0	—	8.2 eV	gw
	R	17		HARD		SS							

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Valleycity

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

HAND DUG

98080

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98B

Date: 3/17/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-3	10YR 4/3	cb L	18	35		2m gr		10 10 0	—	7.6	CS
2	BTK	3-9	10YR 5/4	grv SCL	24	60		2mc SBk		30 10 0	2n Pf	8.0	as
2	C	9-14	10YR 6/4	grv SL	16	70		M		35 15 0	—	8.2	gw
	R			HARD	SS			BED ROCK					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Ruled

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98055
SAMP.

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98B

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-6	10YR 4/3	FLV FSL	14	65		1 M SBK		20 20 0	—	7.8 e	CS
2	Bt	6-18	5Y 4/2	grv SiL	16	28		2mc SBK		5 30 0	2~ pf	8.0 ev	gw
	Cr	18		soft		wx		shale					

Notes: Cr IS COAL LIKE SHALE

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONIERCO

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98048

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98C

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-6	5YR 4/3	FSL	16			1M SBK		0	—	7.6	CS
1	BT	6-13	5YR 4/4	SCL	22			2M SBK		0	2% pf	7.8	CW
2	BK	13-19	10YR 5/6	gr SL	8	75		1C SBK		25 0 0	—	8.2	gW
	Cr	19	SOFT		WX			SS					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONTERCO

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98049
SAMPL

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 7/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98C

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-6	5YR 4/3	SL	16	60		2f gr		0		7.8 e	CS
1	B_{tk1}	6-13	5YR 4/4	SCL	(26) 24	(60) 65		2m SBK		0	2n pf	8.0 es	CS
2	B_{tk2}	13-19	7.5YR 7/4	SL	18	60		2m SBK		10 0 0	1n pf	8.2 ev	CS
	Cr	19											

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MCNIERCO

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98050
SAMP

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98C

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	5YR 4/3	FSL	12	65		1f gr		0 2 0	—	7.8 e	CS
1	BT	5-9	5YR 4/4	FSL	15	70		2m SBK		10 3 0	1n pf	7.8 e	gi
2	BK	9-19	5YR 4/4	gr LS	5	90		1m SBK		40 0 0		8.2 ev	gs
	Cr	19		SOFT	SS								

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONIER CO

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98056
SAMP.

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98C

Date: 2/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S	Cosist. M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-2	7.5YR 4/3	FSL	16	60		1f gr			0	—	7.2 e0	cs
2	BT	2-17	7.5YR 4/4	SCL	20	60		2m SBK			0	1n pf	7.8 e	gs
	Cr	17		soft	wx			ss						

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONIERCO

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98057

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98C

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-6	10YR 5/4	FSL	16	60		1fgr		0	—	7.8 e	CS
2	B+	6-17	10YR 6/4	SCL	22	65		2m SBK		10 0 0	1m pf	8.0 ev	gs
	Cr	17		SOFT		wx		SS					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONIERCK

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98067
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 Surveyor: Jim Irvine, CPSS ARCPAC # 2404 98C

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-2	5YR 3/3	SiL	22	25		2m gr		0	—	7.8 es	CS
1	BT	2-8	5YR 4/4	CL	28	40		2m SBK		0	2n pf	8.0 ev	CS
2	BTK	8-14	10YR 7/3	CL	30	35		1m SBK		5 0	1n pf	8.4 ev	gs
	Cr	14		soft			wx	SHALE					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

MONIERCO

NOT FT

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98053
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 4/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98C

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-4	10YR 4/3	FLV FSL	14	60		2m SBK		10 35 0	—	7.8 e	CS
2	Bt	4-20	10YR 5/4	grv SCL	22	60		2m SBK		30 10 0	2n pf	8.2 ev	gs
	Cr	20		SOFT		WX		SHALE					

Notes: 40% FLAGS ON SURFACE

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BOWBAC

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98060

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/22/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98D

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-3	10YR 4/3	SCL	20	60		2c gr		0	—	7.6 co	CS
1	Bt	3-12	10YR 5/4	SCL	28	60		2m SBK		0	2d pf	7.8 e	CW
2	BtK	12-31	10YR 6/4	CL	28	40		2fm SBK		10 0 0	1d pf	8.0 eV	gs
	Cr	31		SOFT			WX	SHALE					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BOW3AC

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98064

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 7/26 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98D

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-2	10YR 3/3	SCL	20	35		1m gr		0	—	8.2 eo	CS
1	Bt	2-10	10YR 5/4	SCL	24	20		2m SBK		0	2m pf	8.0 es	gs
2	BtK	10-31	10YR 7/4	grv SCL	20	65		1m SBK		50 0 0	1m pf	8.2 ev	gs
	Cr	31			SOFT		WX	SS					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

BIGHAM'
Similar to BONDIS.

98043

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98D

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-6	5YR 4/3	SL	18	60		2f gr		0	—	7.4 eo	cs
1	Bw	6-12	5YR 4/4	SCL	20	70		2mc SBK		0	1n pf	7.8 eo	cs
2	Bk	12-35	5YR 7/4	gr LS	5	90		1m SBK		40 0 0	—	8.2 ev	gi
	Cr	35											

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98020

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 7/24/96 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-9	5YR 5/3	fSL	14	60		2m gr		0	—	7.8 e	
2	BK1	9-25	5YR 6/4	fSL	15	60		2m SBK		0	1m pf	8.0 es 3md 5YR 7/3	
2	BK2	25-48	5YR 5/4	gr fSL	14	65		20m gBK		15 8	—	7.8 e 2mf 5YR 7/3	
	Cr	48		SOFT	WX	SS							

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

LEGACY

LAB

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98052

SAMPLED ( )

98A

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	7.5YR 4/3	(L) FSL	(20) 18	(48) 60		1C SBK		0	—	7.8 eo	cs
1	BW	5-31	7.5YR 5/4	FSL	(16) 18	(56) 60		2C SBK		0	—	7.6 eo	gs
2	BK	31-72	7.5YR 5/4	FSL	(12) 6	(68) 80		M		0	—	7.8 es	—

Notes: TYPIC HAPLOCAMBID

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98032
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98G

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-4	5YR 4/3	L	14	35		1fm gr		0 0	—	7.4 eo	cs
1	Bt	4-14	5YR 4/4	SCL	22	60		2mc SBK		5 0	2n pf	7.8 e	gs
2	BtK	14-32	5YR 5/4	fSL	16	60		2mc SBK		10 0	1n pf	8.0 es	gs
2	BK	32-56	5YR 4/4	SL	14	25		1M SBK		40 0	—	8.2 ev	gs
	Cr	56		SOFT WX				Sandstone					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

(Revised June 2010)

Attachment 2.04.9-7-24

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC
P O Box 628 27646 West 5th
Nucla CO 81424

FAXED 4-21-98 cw

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

MAY - 8 1998

DATE RECEIVED: 03-25-98
DATE REPORTED: 04-17-98

BILLING:

RESEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #	Sample ID #	paste pH	paste EC (mmhos/cm)	Lime Estimate	% OM	AB-DTPA Extract (ppm) NO_3-N	P	K	Zn	Fe	Mn	Cu
F457 a	98005 AP	7.6	1.9	Medium	2.4	15	7.2	137	20.5	16.9	1.97	8.06
F458 b	98005 C1	8.1	0.9	High	0.5	2	3.6	32.9	0.22	3.64	0.48	1.51
F459 c	98005 C2	8.2	0.7	High	0.2	3	5.4	44.5	0.68	4.05	0.58	1.11
F460 d	98009 AP	7.9	0.9	High	1.4	9	1.7	181	6.17	11.3	2.24	4.51
F461 e	98009 BW	7.8	1.3	High	0.6	4	0.8	133	0.75	6.43	1.45	2.73
F462 f	98009 C	7.9	1.6	High	0.4	3	5.2	54.9	0.24	4.15	0.45	1.46
F463 g	98015 AP	7.2	0.4	Low	2.0	12	5.3	257	13.1	13.5	5.79	6.16
F464 h	98015 BW2	7.9	1.6	High	0.1	2	0.1	96.5	0.37	5.25	0.79	1.85
F465 i	98015 BW1	7.7	0.4	Low	0.5	6	<0.1	111	0.36	4.83	0.92	1.99
F466 j	98030 BK	7.8	1.7	High	0.6	2	1.4	63.9	0.38	13.3	1.26	1.97
F467 k	98030 BTK	7.7	2.9	High	0.6	2	0.1	105	0.47	11.9	1.56	2.74
F468 l	98030 BT	7.8	0.9	Low	1.1	3	<0.1	117	9.98	18.7	1.54	5.27
F469 m	98031 AP	7.5	0.9	High	5.2	6	2.8	264	46.4	62.9	4.92	12.5
F470 n	98031 BK	8.0	0.6	High	0.6	2	0.7	41.9	0.14	4.63	0.67	0.62
F471 o	98031 BT	7.8	0.6	High	2.0	5	<0.1	210	7.16	45.1	2.57	5.08
F472 p	98034 ABT	6.6	0.6	Low	2.3	5	<0.1	216	48.3	71.2	3.93	19.9
F473 q	98034 BT	7.6	0.7	Low	0.5	2	0.2	173	0.68	22.5	2.06	1.75
F474 r	98034 BTK	7.9	0.7	High	0.5	2	<0.1	133	0.39	12.6	1.45	1.70
F475 s	98046 ABT	7.4	0.9	High	4.4	16	1.4	124	114	50.2	3.59	30.7
F476 t	98046 BK	7.8	0.4	High	0.9	3	0.6	55.0	5.24	23.3	2.22	4.80
F477 u	98046 BT	7.7	0.6	High	1.4	4	1.2	87.9	22.9	30.4	2.47	11.6
F478 v	98049 A	7.2	1.0	Low	3.2	2	1.4	215	24.7	46.4	2.34	12.0
F479 w	98045 BT	7.4	0.9	Low	0.9	2	0.2	112	6.16	28.4	1.64	5.64
F480 x	98052 A	7.6	1.3	Medium	1.5	10	1.5	208	5.52	39.8	2.66	5.23
F481 y	98052 BW	7.7	1.3	High	0.6	4	2.6	192	1.51	28.1	2.14	2.32

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC
P O Box 628 27646 West 5th
Nucla CO 81424

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

DATE RECEIVED: 03-25-98
DATE REPORTED: 04-17-98

BILLING:

RESEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #	Sample ID #	paste pH	paste EC mmhos/cm	Lime Estimate	% OM	AB-DTPA Extract ppm NO_3-N	P	K	Zn	Fe	Mn	Cu
F482 z	98052 C	7.9	1.2	High	0.3	2	2.2	107	0.40	25.9	1.20	1.82
F483 aa	98058 A	7.9	0.6	High	1.1	3	0.5	96.4	0.17	3.86	1.78	1.74
F484 bb	98058 Bt	7.3	0.6	Medium	3.1	6	10.2	315	0.99	7.58	4.06	1.47
F485 cc	98062 Ag	6.8	12.2	High	23.1 *	8	3.6	386	66.7	283	21.4	18.7
F486 dd	98062 Bg	7.8	1.6	High	0.7	2	8.1	152	1.99	143	10.3	3.95
F487 ee	98069 a	7.8	0.9	High	3.5	4	1.5	556	6.61	7.17	4.34	3.28
F488 ff	98069 Bt	7.9	7.7	High	0.7	1	2.0	227	0.56	4.05	1.73	1.11
F489 gg	98069 C	7.7	3.9	High	0.7	2	1.4	227	1.10	4.36	1.37	1.14
F490 hh	98047 Ag	7.6	1.7	Medium	2.3	7	1.1	131	8.38	94.1	4.94	7.20
F491 ii	98047 Bt	8.0	0.9	High	0.5	2	2.2	115	0.83	31.4	3.34	3.39
F492 jj	98049 BTK	7.8	0.9	High	0.3	2	0.3	73.8	0.45	30.3	2.30	2.43
F493 kk	98005 BW	7.9	3.8	High	0.5	2	0.1	109	0.41	6.10	1.00	2.06

*** Expressed as weight loss on ignition.**

(Revised June 2010)

Attachment 2.04.9-7-26

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC
P O Box 628 27646 West 5th
Nucla CO 81424

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

DATE RECEIVED: 03-25-98
DATE REPORTED: 04-17-98

BILLING:

RESEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #	Sample ID #	% Saturation	meq/L Ca	meq/L Mg	meq/L Na	meq/L K	SAR	% $CaCO_3$ Equivalent	Hot Water Extract Se mg/kg	% Gravel
F457 a	98005 AP	47.88	16.0	4.9	3.1	0.1	0.9	0.93	0.045	9.4
F458 b	98005 C1	45.66	5.5	4.4	1.1	<0.1	0.5	49.4	0.021	6.9
F459 c	98005 C2	36.58	4.5	3.5	1.1	<0.1	0.5	24.3	0.015	25.6
F460 d	98009 AP	36.86	6.5	2.2	1.3	0.1	0.6	2.48	0.027	2.0
F461 e	98009 BW	40.66	10.5	3.4	1.6	0.1	0.6	4.60	0.055	25.3
F462 f	98009 C	37.38	12.0	6.7	2.2	0.1	0.7	36.1	0.010	9.1
F463 g	98015 AP	38.60	3.8	1.0	0.7	0.2	0.4	0.15	0.022	18.2
F464 h	98015 BW2	35.48	14.5	3.0	1.2	<0.1	0.4	4.16	0.013	31.5
F465 i	98015 BW1	43.72	3.6	0.8	0.6	<0.1	0.4	<0.03	0.017	21.9
F466 j	98030 BK	42.14	16.0	5.9	1.8	<0.1	0.5	44.1	0.006	32.2
F467 k	98030 BTK	39.44	29.9	9.9	1.8	<0.1	0.4	4.16	0.016	45.7
F468 l	98030 BT	41.58	8.0	1.7	0.9	<0.1	0.4	0.59	0.015	25.4
F469 m	98031 AP	50.60	8.5	1.4	0.7	0.4	0.3	2.26	0.018	7.6
F470 n	98031 BK	40.08	4.6	1.1	0.6	<0.1	0.4	27.3	0.008	9.1
F471 o	98031 BT	59.70	4.8	0.8	0.5	0.2	0.3	5.94	0.010	19.2
F472 p	98034 ABT	45.46	4.0	1.1	0.6	0.3	0.4	<0.03	0.018	8.3
F473 q	98034 BT	36.44	5.5	1.2	0.9	0.1	0.5	0.26	0.017	20.8
F474 r	98034 BTK	40.58	4.5	1.6	1.1	<0.1	0.6	5.05	0.006	28.4
F475 s	98046 ABT	53.88	8.5	1.4	0.7	0.1	0.3	4.49	0.039	20.8
F476 t	98046 BK	53.10	4.3	0.6	0.5	<0.1	0.3	34.6	0.010	23.9
F477 u	98046 BT	44.62	4.7	0.7	0.6	<0.1	0.4	15.7	0.020	32.7
F478 v	98049 A	50.12	8.0	2.1	1.4	0.2	0.6	0.37	0.017	15.6
F479 w	98045 BT	49.52	8.0	1.6	1.0	<0.1	0.5	0.37	0.012	9.1
F480 x	98052 A	48.04	11.5	2.6	0.7	0.2	0.3	0.59	0.014	6.5
F481 y	98052 BW	33.56	13.0	3.0	1.0	0.2	0.4	2.37	0.011	7.4

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC
P O Box 628 27646 West 5th
Nucla CO 81424

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

DATE RECEIVED: 03-25-98
DATE REPORTED: 04-17-98

BILLING:

RESEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #	Sample ID #	% Saturation	meq/L Ca	meq/L Mg	meq/L Na	meq/L K	SAR	% $CaCO_3$ Equivalent	Hot Water Extract Se mg/kg	% Gravel
F482 z	98052 C	43.12	10.5	2.9	0.7	0.1	0.3	4.27	0.012	2.3
F483 aa	98058 A	48.54	4.1	1.2	0.8	<0.1	0.5	8.05	0.015	8.2
F484 bb	98058 Bt	53.44	4.2	1.9	0.4	0.5	0.2	0.15	0.031	1.8
F485 cc	98062 Ag	113.7	30.9	21.4	3.1	0.5	0.6	2.15	0.091	7.2
F486 dd	98062 Bg	36.64	9.5	5.4	1.7	0.4	0.6	4.71	0.019	24.1
F487 ee	98069 a	45.20	7.5	2.5	0.5	0.9	0.2	1.37	0.020	8.3
F488 ff	98069 Bt	35.54	31.9	80.6	24.2	0.5	3.2	4.38	0.021	23.8
F489 gg	98069 C	35.48	29.4	11.5	11.1	0.7	2.4	3.82	0.025	17.0
F490 hh	98047 Ag	48.32	15.0	5.3	1.4	0.1	0.4	1.04	0.026	16.7
F491 ii	98047 Bt	39.20	5.5	2.5	0.8	<0.1	0.4	4.16	0.018	22.5
F492 jj	98049 BTK	35.62	7.0	1.5	1.1	<0.1	0.5	13.6	<0.002	11.3
F493 kk	98005 BW	38.74	26.4	18.9	5.0	<0.1	1.0	3.26	<0.002	16.7

(Revised June 2010)

Attachment 2.04.9-7-28

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC
P O Box 628 27646 West 5th
Nucla CO 81424

Colorado State University
Soil, Water and Plant Testing Laboratory
Natural & Environmental Sciences Bldg - A319
Fort Collins, CO 80523

(970) 491-5061 FAX: 491-2930

DATE RECEIVED: 03-25-98
DATE REPORTED: 04-17-98

BILLING:

RESEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #	Sample ID #	Sand	Silt	Clay	Texture
F457 a	98005 AP	50	24	26	Sandy Clay Loam
F458 b	98005 C1	64	14	22	Sandy Clay Loam
F459 c	98005 C2	70	8	22	Sandy Clay Loam
F460 d	98009 AP	58	22	20	Sandy Clay Loam/Sandy Loam
F461 e	98009 BW	58	18	24	Sandy Clay Loam
F462 f	98009 C	58	8	34	Sandy Clay Loam
F463 g	98015 AP	60	22	18	Sandy Loam
F464 h	98015 BW2	64	20	16	Sandy Loam
F465 i	98015 BW1	68	18	14	Sandy Loam
F466 j	98030 BK	52	12	36	Sandy Clay
F467 k	98030 BTK	62	18	20	Sandy Clay Loam/Sandy Loam
F468 l	98030 BT	56	26	18	Sandy Loam
F469 m	98031 AP	62	24	14	Sandy Loam
F470 n	98031 BK	74	10	16	Sandy Loam
F471 o	98031 BT	64	14	22	Sandy Clay Loam
F472 p	98034 ABT	64	20	16	Sandy Loam
F473 q	98034 BT	66	10	24	Sandy Clay Loam
F474 r	98034 BTK	60	14	26	Sandy Clay Loam
F475 s	98046 ABT	48	34	18	Loam
F476 t	98046 BK	62	20	18	Sandy Loam
F477 u	98046 BT	56	26	18	Sandy Loam
F478 v	98049 A	60	24	16	Sandy Loam
F479 w	98045 BT	64	20	16	Sandy Loam
F480 x	98052 A	48	32	20	Loam
F481 y	98052 BW	58	26	16	Sandy Loam
F482 z	98052 C	68	20	12	Sandy Loam
F483 aa	98058 A	64	14	22	Sandy Clay Loam
F484 bb	98058 Bt	66	28	6	Sandy Loam
F485 cc	98062 Ag	32	40	28	Clay Loam
F486 dd	98062 Bg	70	14	16	Sandy Loam
F487 ee	98069 a	40	40	20	Loam
F488 ff	98069 Bt	50	32	18	Loam
F489 gg	98069 C	68	18	14	Sandy Loam
F490 hh	98047 Ag	48	28	24	Sandy Clay Loam/Loam
F491 ii	98047 Bt	52	22	26	Sandy Clay Loam
F492 jj	98049 BTK	60	14	26	Sandy Clay Loam
F493 kk	98005 BW	60	18	22	Sandy Clay Loam

BLGAY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98051
SAMPLED

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98A

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-9	7.5 YR 4/3	FSL	14	60		1C SBK		0	—	7.8 e	CS
2	BK	9-72	7.5YR 5/4	FSL	16	65		1C SBK		10 0 0	—	8.0 es	—

Notes: 36°F TYPIC HAPLOCAMBID

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BEGAY

LAB

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98069

SAMPLED ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98A

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	5YR 3/4	L	(20) 15	(40) 40		1m gr		O	—	7.6 CO	CS
1	EW	5-28	5YR 4/4	(L) SCL	(18) 24	(50) 60		2mc SBK		O	1a pf	7.8 e	GS
2	BK	28-72	5YR 4/6	gr LS (SL)	(14) 5	(68) 85		M		20 8	—	8.0 ev	—

Notes: TYPIC HAPLARGID

C-LAB SAMPLE CLAY HIGH DUE TO LIME

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARNEY

Intermountain
Resource
Inventories Inc.

182 County Road 24 • Ridgway, CO 81432

98023

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98E

Date: 7/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-9	5YR 4/3	vfSL	14	60		1m GR		0	—	7.8 e	CS
2	BK1	9-30	5YR 6/4	vfSL	14	60		2m SBK		0	—	8.2 ev	CS
2	BK2	30-45	5YR 5/4	fSCL	20	60		2mL SBK		0	1n pf	8.0 es	gi
	Cr	45			soft		wx		SS				

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98024

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 7/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S	Cosist. M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-9	5YR 4/3	fSL	16	65		1c SBK			0	—	lo 7.4	cs
2	Bk1	9-25	5YR 5/4	fSL	20	60		2c SBK			0	2n pf	es 8.0	ci
2	Bk2	25-48	5YR 6/4	fSL	14	70		2c SBK			0	—	ev 8.2	ci
2	C	48-62	5YR 7/4	fSL				M			0	—	ev 8.4	gs
	Cr	62			SOFT		WX	SS						

Notes: 36°F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARIEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98008

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-10	5YR 4/3	SCL	20	55		1CO SBK		0	—	7.8 e	CS
1	Bw	10-18	5YR 4/4	FSL	18	60		2M SBK		0	1a po	8.0 es	cs
2	BK1	18-34	7.5YR 7/4	6R SL	14	65		1M SBK		20 0 0	—	8.2 ev	gs
2	BK2	34-50	10YR 7/4	6R SL	10	70		M		25 0 0	—	8.2 ev	gs
	R	50	50FT		5	5		BEDROCK					

Notes: 36°F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98009

SAMPLED

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-10	5YR 4/3	FSL	(24) 16	(58) 60		1c SB		0	—	7.8 c	CS
1	BW	10-26	5YR 4/6	SL	(24) 18	(58) 60		2 fm SBK		0	1n Po pf	7.8 c	ci
2	BK	26-60	7.5YR 7/4	SL	(34) 12	(58) 65		M		5 0 0	—	8.2 ev	—

Notes: 38°F

BK lab sample has high clay may be lime
field sample more accurate

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98011

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-18	5YR 4/3	FSL	18	60		1 c SBK		0	—	7.8 e	cs
1	Bw	10-16	5YR 4/6	SL	18	60		2c SBK		0	1n pf	8.0 es	cs
2	Bk	16-36	7.5YR 7/4	gr SL	15	65		1 mc SBK		20 8	—	8.4 ev	gw
2	C	36-42	7.5YR 7/4	gr SL	10	70		m		25 8	—	8.2 ev	gw
	R	42		HARD			55	BEDROCK					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98030
SAMPLE ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98E

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-7	5YR 4/3	fSL	16	60		1f SBK		O	—	7.6 eo	CS
1	Bw	7-17	5YR 4/4	SCL	(18) 22	(56) 60		2c SBK		O	2d pf	7.8 e	gS
2	Btk	17-22	5YR 5/4	SCL	(20) 20	(64) 65		2mc SBK		O	1d pf	8.0 e 3md 5YR 7/4	CW
2	Bk	22-48	5YR 7/4	gr SL	(30) 15	(52) 65		M		20 0	—	8.2 ev	gS
	Cr	48	SOFT		wx	SS							

Notes: BK lab sample overestimates clay which is probably lime

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98012

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-10	5YR	FSL	18	60		1CO SBK		0	—	7.6 eo	cs
1	Bw	10-29	5YR 4/6	SCL	20	60		2mc SBK		0	1n pf	8.0 es	gi
2	Bk	29-60	7.5YR 7/4	SL	16	65		M		10 0 0	—	8.2 ev	gi
	Cr	60	SOFT WX			SS						—	—

Notes: 38°=

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98013

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S	Cosist. M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-9	5YR 4/3	FSL	18	60		2C SBK			0	-	7.8 e	CS
1	Bw	9-32	5YR 4/4	SCL	22	60		2C SBK			0	1m pf,fo	8.0 es	ci
2	Bk	32-64	10YR 7/4	SCL	20	65		M			5 0 0		8.4 ev	gw
	Cr	64		SOFT WX				SS						

Notes: 36? second picture

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

DARVEY

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98015

SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-11	5YR 4/3	FSL	(18) 16	60		2C SBK		0	—	7.8 e	CS
1	Bw	11-28	5YR 4/6	FSL	(14) 16	(64) 65		2MC SBK		0	—	7.6 e	GS
2	Bk	28-67	5YR 4/4	FSL	(16) 14	(68) 65		2MC SBK		0	—	8.0 ev	—
	Cr	67		SOFT WX			SS					3md 5YR 7/3	

Notes: 58°F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98003

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 7/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-10	5YR 5/3	VF SL	16	60		1m SBK	SHVFR SS NP	0	—	7.8 e	CS
1	B+1	10-22	5YR 4/4	SCL	25	65		2c SBK	VH FI SS SP	0	2d Pro pf	7.6 e	GS
2	B+K	22-36	5YR 5/4	SCL	22	65		2m SBK	H PR NS NP	0	1n Pro f	8.0 ev 3d 5YR 7/3	CW
2	BK	36-42	10YR 5/6	6R LS	4	90		M	M	20 0 0	—	8.2 ev 3fM 10YR 8/3	GS
	Cr	42		SOFT	WX		SS						
	R	50		HARD	SS								

Notes: 42°F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BAR X

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98004

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/23/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-8	5YR 4/3	SCL	20	60		1C SBK		0	—	7.8 CS	CS
1	Bt	8-19	5YR 5/6	SCL	24	65		2m SBK		0	2% pf	7.8 es	CS
2	BK	19-32	5YR 7/4	GR SL	12	75		2f SBK		0	—	8.2 ev	GS
2	C	32-41	7.5YR 7/3	GR SL	8	80		M		20 5 0	—	8.2 ev	GW
	Cr	41		SOFT		WX		SS					

Notes: 38°F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98010

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-10	5YR 3/3	FSL	15	60		1c SBK		0	—	7.6 e	CS
1	BT	10-24	5YR 4/4	SCL	22	60		2m SBK		0	2m Pf	7.8 e	gs
2	BK	24-48	5YR 6/4	gr SL	16	65		1m SBK		20 8	—	8.4 ev	gs
2	C	48-72	5YR 7/4	gr SL	10	75		M		25 0	—	8.2 ev	—

Notes: 38 °F

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98018

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98E

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-7	5YR 4/3	fsl	14	60		1c SBK		0	—	7.6 eo	cs
1	Bt	7-23	5YR 4/4	fsl	18	60		2mc SBK		0	2n pf	7.6 eo	cs
2	Bt	23-40	5YR 6/4	scl	22	65		2c SBK		0	2n pf	8.0 es	gs
2	C	40-69	5YR 5/6	sl	16	65		M		0		8.0 es	—
	Cr	69	soft wx ss										

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98029
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98E

Date: 7/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-6	5YR 4/3	FSL	14	60						7.6 eo	CS
1	BtK	6-13	5YR 4/4	SCL	22	60						7.8 e	CW
2	BK	13-42	5YR 7/3	grSL	14	70						8.2 ev	gw
	Cr	42	SOFT			WX		SS	BEDROCK				

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98042

SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98E

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-5	5YR 4/2	SiL	18	30		2C pl		O	—	7.6 co	cs
1	BT	5-25	5YR 4/4	SCL	26	65		2C SBK		O	2 pf	7.8 e	gs
2	BTK	25-46	5YR 6/4	SCL	20	65		1C SBK		O	1 pf	8.2 ev	gi
	Cr	46											

Notes: BTK OXIDATION CONC. 7.5YR 6/8
H_2O TABLE 46"

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98076
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98E

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-4	7.5YR 4/3	FSL	18	60		1f gr		0	—	7.6 eo	cs
1	BT	4-18	5YR 4/4	SCL	25	60		2m SBK		0	en pf	7.8 es	cs
2	BK	18-39	5YR 5/4	SCL	24	60		3mc SBK		500	in pf	8.2 ev	gs
2	C	39-72	5YR 4/4	FSL	12	70		M		500	—	8.0 ev	—

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BARX

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98028
SAMPLE
98E

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-7	5YR 4/3	SiL	14	25		1m gr		5 0 0	—	7.4 eo	CS
2	BTK	7-13	5YR 5/4	SCL	22	60		2MC SBK		10 0 0	2n pf	es 8.0	CS
2	BK	13-42	5YR 7/3	grv LFS	5	90		M		40 0 0	—	ev 8.4	aw
	R	42		FRACTURED			ss	BEDROCK					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

REGA

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98016

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A_P	0-11	5YR 4/3	FSL	14	60				0	—	7.2	
1	$2A_B$	11-20	5YR 4/2	FSL	12	60				0	—	7.0	
1	$2B_W$	20-38	5YR 4/4	FSL	10	65				0	—	7.2 2nd 7.5YR 6/8	OXIDATION
2	2C	38-72	5YR 6/4	FSL	12	60				0	—	7.6 e	

Notes: WATER TABLE AT 28"
BURIED HORIZON HAS BURNED SAGEBRUSH STEMS
SUBIRRIGATED

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

~~ZnFeMnCuF464 h - Darvey: 11-28"~~

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98017

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-9	5Y 4/3	fSL	16	60		1c SBK		0	—	7.4 ca	cs
1	Bw1	9-28	5YR 4/4	f	16	60		1mc SBK		0	—	7.6 e	cs
2	Bw2	28-45	5YR 6/4	vfSL	14	60		1m SBK		0	—	8.0 ca	gs
2	C	45-72	7.5YR 6/4	grSL	10	80		M		25000	—	8.2 ca 2nd 7.5YR 7/3	

Notes: H_2O TABLE 28"
36°F
SUBIRRIGATED

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

98015BW27.91.6High0.120.196.50.375.250.791.85F465 i - Darvey: 28-67"

98015BW17.70.4Low0.56<0. l1110.364.830.921.99

F467 k - Darvey: 7-17"

98030 BW7.72.9High0.620.11050.4711.91.562.74F468 l - Darvey : 17-22"

98030 BK17.80.9Low1.13<0. 11179.9818.71.545.27F466 j - Darvey: 22-48"98030

BK27.81.7High0.621.463.90.3813.31.261.97F469m — Bowbac: 0-2"

98031 AP7.50.9High5.262.826446.462.94.9212.5F471 o — Bowbac: 2-8"98031 BT7.80.6High2.05<0.

12107.1645.12.575.08Lab #PasteAB-DTPA Extract

ppm Sample IDPHEC mmhos/cm Lime Estimate%

OmN03-NPK ZnFeMnCuF470 n — Bowbac: 8-24"98031

BK8.00.6High0.620.741.90.144.630.670.62F472 p - Haplargids: 1-8"98034 ABT6.60.6Low2.35<0.

121648.371.23.9319.9F473 q - Haplargids: 8-29"

98034 BT7.60.7Low0.520.21730.6822.52.061.75F474 r - Haplargids: 29-37"

98034 BTK7.90.7High0.52<0. 11330.3912.61.451.70F475 s - Bowbac: 2-6"

98046 ABT7.40.9High4.4161.412411450.23.5930.7F477 u - Bowbac: 6-12"98046

BT7.70.6High1.441.287.922.930.42.4711.6F476 t - Bowbac: 12-24"

98046 BK7.80.4High0.930.655.05.2423.32.224.80Lab #PasteAB-DTPA Extract

ppm Sample IDPHEC mmhos/cm Lime Estimate%

OmN03-NPK ZnFeMnCuF478 v - Monierco: 0-6"

98049 A7.21.0Low3.221.421524.746.42.3412.0F479 w - Monierco: 6-13"

98045 BT7.40.9Low0.920.21126.1628.41.645.64F492 jj - Monierco: 13-1998049

BTK7.80.9High0.320.373.80.4530.32.30 2.43F480 x - Begay: 0-5"

98052 A7.61.3Medium1.5101.52085.5239.82.665.2 3F481 y - Begay: 5-31"

98052 BW7.71.3High0.642.61921.5128.12.142.32F482 z - Begay: 31-72"98052

C7.91.2High0.322.21070.4025.91.2082Lab #PasteAB-DTPA Extract

ppm Sample IDPHEC mmhos/cm Lime Estimate%

OmN03-NPK ZnFeMnCuF483 aa - Monierco: 0-5"98058

A7.90.6High1.130.596.40.173.861.781.74F484 bb - Monierco: 5-19"98058

Bt7.30.6Medium3.1610.23150.997.584.061.47F485 cc - Endoaquepts: 0-13"98062

Ag6.812.2High23.1*83.638666.728321.418.7F486 dd - Endoaquepts: 13-72"98062

Bg7.81.6High0.728.11521.9914310.33.95F487 ee - Begay: 0-5"98069

a7.80.9High3.541.55566.617.174.343.28F488 ff - Begay: 5-28"98069

Bt7.97.7High0.712.02270.564.051.731.11F489 gg - Begay: 28-72"98069

C7.73.9High0.721.42271.104.361.371.14Lab #PasteAB-DTPA Extract

~~ppm Sample IDPHEC mmhos/cm Lime Estimate%~~

~~OmN03-NPK ZnFeMnCuF490 hh - Endoaquepts: 0-1098047~~

~~Ag.7.61.7Medium2.371.11318.3894.14.947.20F491 ii - Endoaquepts: 10-39"98047~~

~~Bg8.00.9High0.522.21150.8331.43.343.39 * Expressed as weight loss on ignition.~~

Tod LeFevre, P.E.

New Horizon Mine/Western Fuels--Colorado LLC

Colorado State University

P 0 Box 628 27646 West 5 di

Soil, Water and Plant Testing Laboratory

Nucla CO 81424

Natural & Environmental Sciences Bldg - A319

Fort Collins, CO 80523

DATE RECEIVED: 03-25-98

(970) 491-5061 FAX: 491-2930

DATE REPORTED: 04-17-98

BILLING:

RE, SEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab # meq/LSample IDSaturationCaMgNaKSAR%

CaC03

EquivalentHot Water Extract Se mg/kg% GravelF457 a -Darvey: 0-12"98005 AP47.8816.04.93.10.10.90.930.0459.4Lab # meq/LSample IDSaturationCaMgNaKSAR%

CaC03

EquivalentHot Water Extract Se mg/kg% GravelF493 kk - Darvey: 12-26"98005 Bw38.7426.418.95.0<0.11.03.26<0.00216.7F458 b -Darvey 26-46"98005 Bk145.665.54.41.1<0. 10.549.40.0216.9F459 c -Darvey: 46-58"98005 Bk236.584.53.51.1<0. 10.524.30.01525.6F460 d - Darvey: 0-10"98009 AP36.866.52.21.30.10.62.480.0272.0F461 e -Darvey: 10-26"98009 BW40.6610.53.41.60.10.64.600.05525.3F462 f -Darvey: 26-60"98009 Bk37.3812.06.72.20.10.736.10.0109.1F463 g -Darvey: 0-11"98015 AP38.603.81.00.70.20.40.150.02218.2Lab # meq/LSample IDSaturationCaMgNaKSAR%

CaC03

EquivalentHot Water Extract Se mg/kg% GravelF464 h -Darvey: 11-28"98015 BW235.4814.53.01.2<0. 10.44.160,01331.5F465 i -Darvey: 28-61"98015 BW143.723.60.80.6<0. 10.4<0.030.01721.9F467 k -Darvey: 7-17"98030 Bw39.4429.99.91.8<0. 10.44.160.01645.7F468 l - Darvey: 17-22"98030 Bk141.588.01.70.9<0. 10.40.590.01525.4F466 j -Darvey: 22-48"98030 Bk242.1416.05.91.8<0. 10.544; 10.00632.2F469 m - Bowbac: 0-2"98031 AP50.608.51.40.70.40.32.260.0187.6F471 o - Bowbac: 2-8"98031 BT59.704.80.80.50.20.35.940.01019.2Lab # meq/LSample IDSaturationCaMgNaKSAR%

~~CaC03~~

~~EquivalentHot Water Extract Se~~ ~~mg/kg%~~ ~~GravelF470 n - Bowbac: 8-24"98031~~

~~BK40.084.61.10.6<0. 10.427.30.0089.1F472 p - Haplargids: 1-8"98034~~

~~A13T45.464.01.10.60.30.4<0.030.0188.3F473 q - Haplargids: 8-29"98034~~

~~BT36.445.51.20.90.10.50.260.01720.8F474 r - Haplargids: 29-37"98034 BTK40.584.51.61.1<0.~~

~~10.65.050.00628.4F475 s - Bowbac: 2-6"98046 ABT53.888.51.40.70.10.34.490.03920.8F477 u -~~

~~Bowbac: 6-12"98046 BT44.624.70.70.6<0. 10.415.70.02032.7F476 t - Bowbac: 12-24"98046~~

~~BK53.104.30.60.5<0. 10.334.623.9Lab # meq/LSample IDSaturationCaMgNaKSAR%~~

~~CaC03~~

~~EquivalentHot Water Extract Se~~ ~~mg/kg%~~ ~~GravelF478 v - Monierco: 0-6"98049~~

~~A50.128.02.11.40.20.60.370.01715.6F492 jj - Monierco: 13-19"98049 BTK35.627.01.51.1<0.~~

~~10.513.6<0.002F480 x - Begay: 0-5"98052 A48.0411.52.60.70.20.30.590.0146.5F481 y - Begay: 5-~~

~~31"98052 BW 33.5613.03.01.00.20.42.370.0117.4F482 z - Begay: 31-72:98052~~

~~C43.1210.52.90.70.10.34.270.0122.3F483 aa - Monierco: 0-5"98058 A48.544.11.20.8<0.~~

~~10.58.050.0158.2Lab # meq/LSample IDSaturationCaMgNaKSAR%~~

~~CaC03~~

~~EquivalentHot Water Extract Se~~ ~~mg/kgF484 bb - Monierco: 5-19"98058~~

~~Bt53.444.21.90.40.50.20.150.0311.8F485 cc - Endoaquepts: 0-13"98062~~

~~Ag113.730.921.43.10.50.62.150.0917F486 dd - Endoaquepts: 13-72"98062~~

~~Bg36.649.55.41.70.40.64.710.01924.1F487 ee - Begay: 0-5"98069~~

~~a45.207.52.50.50.90.21.370.0208.3F488 ff - Begay: 5-28"98069 Bt~~

~~35.5431.980.624.20.53.24.380.02123.8F489 gg - Begay: 28-72"98069~~

~~C35.4829.411.511.10.72.43.820.02517.0Lab # meq/LSample IDSaturationCaMgNaKSAR%~~

~~CaC03~~

~~EquivalentHot Water Extract Se~~ ~~mg/kgF490 hh - Endoaquepts: 0-10"98047 Ag~~

~~48.3215.05.31.40.10.41.040.02616.7F491 ii - Endoaquepts: 10-39"98047 Bg 39.205.52.50.8<0.~~

~~10.44.160.01822.5~~

Tod LeFevre, P.E. New Horizon Mine/Western Fuels--Colorado LLC Colorado State University

P 0 Box 628 27646 West 5di Soil, Water and Plant Testing Laboratory

Nucla CO 81424 Natural & Environmental Sciences Bldg - A319

Fort Collins, CO 80523

DATE RECEIVED: 03-25-98 (970) 491-5061 FAX: 491-2930

DATE REPORTED: 04-17-98

BILLING:

RE, SEARCH SOIL ANALYSIS

"Pre-mine Soil Survey"

Lab #Sample IDSandSiltClayTextureF457 a - Darvey: 0-12"8005 AP502426Sandy Clay Loam F493 kk - Darvey: 12-26"98005 Bk1601822Sandy Clay LoamF458 b - Darvey: 26-46"98005 Bk2641422Sandy Clay Loam F495 c - Darvey: 46-58"98005 Bk370822Sandy Clay LoamF461 d - Darvey: 0-10"98009 Ap582218Sandy Loam/Sandy Clay Loam F461 e - Darvey: 10-26"98009 BW581824Sandy Clay Loam F462 f - Darvey: 26-60"98009 C58834Sandy Clay Loam F463 g - Darvey: 0-11"98015 AP602218Sandy Loam F464 h - Darvey: 11-28"98015 BW2642016Sandy Loam F465 i - Darvey: 28-67"98015 8W1681814Sandy Loam F466 j - Darvey: 22-48"98030 Bk2521236Sandy Clay F467 k - Darvey: 7-17"98030 Bw621820Sandy Clay Loam/sandy LoamF468 l - Darvey: 17-22"98030 Bk1562618Sandy Loam F469 m - Bowbac: 0-2"98031 AP622414Sandy LoamF470 – Bowbac: 8-2498031 BK741016Sandy LoamF471 o - Bowbac: 2-8"98031 BT641422Sandy Clay LoamF472 - Haplargids: 1-8"98034 ABT642016Sandy LoamF473 q - Haplargids: 8-29"98034 BT661024Sandy Clay LoamF474 r - Haplargids: 29-37"98034 BTK601426Sandy Clay LoamF475 s - Bowbac: 2-6"98046 ABT483418LoamF476 t - Bowbac: 12-24"98046 BK622018Sandy LoamF477 u - Bowbac: 6-12"98046 BT562618Sandy LoamF478 v - Monierco: 0-6"98049 A602416Sandy LoamF479 w - Monierco: 6-13"98045 BT642016Sandy LoamF480 x - Begay: 0-5"98052 A483220LoamF481 y - Begay: 5-31" 98052 BW582616Sandy LoamF482 z - Begay: 31-72"98052 C682012Sandy LoamF483 aa - Monierco: 0-598058 A641422Sandy Clay LoamF484 bb - Monierco: 5-19"98058 Bt66286Sandy LoamF485 cc - Endoaquepts: 0-13"98062 Ag324028Clay LoamF486 dd - Endoaquepts: 13-72"98062 Bg701416Sandy LoamF487 ee - Begay: 0-5"98069 a404020LoamF488 ff - Begay: 5-28"98069 Bt 503218LoamF489 gg - Begay: 28-72"98069 C681814Sandy LoamF490 hh - Endoaquepts: 0-10"98047

~~Ag482824Sandy Clay Loam/LoamF491 ii - Endoaquepts: 10-39"98047 Bt 522226Sandy Clay LoamF492 jj - Monierco: 13-19"98049 BTK601426Sandy Clay Loam~~

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98036
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98F

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S	Cosist. M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-1	5YR 3/3	FSL	14	55		1f gr			0	—	7.2 e	
1	ABT	1-13	5YR 4/3	SCL	22	60		2mc SBK			0	2f pf	7.4 e	cs
1	BT	13-26	5YR 4/4	SCL	32	60		2mc pr			0	3d pf	7.6 e	cw
2	BTK	26-78	5YR 5/4	SCL	30	70		1c SBK			5 0 0	1d pf	7.8 e	gl
	Cr	78			Soft	wx			5	5				

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98040
SAMPLE

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor: Jim Irvine, CPSS ARCPAC # 2404**

98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	ABT	0-5	5YR 4/2	SCL	26	60		2C pr		0	2d pf	7.8 e	CS
1	BT	5-23	5YR 4/4	SCL	32	60		3C pr		0	3d pf	7.6 eo	CS
2	BTK	23-36	7.5YR 5/6	SCL	26	65		2mc SBK		5 0 0	1d pf	8.0 ev	aw
	R	36		HARD		SS							

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98059
SAMPLE

Date: 2/26/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-3	7.5YR 5/4	SiL	20	25		2c gr		0	—	7.6 e	cs
1	BT	3-12	10YR 5/4	CL	28	35		2m SBK		0	2n pf	7.8 es	cs
2	BTK	12-24	10YR 6/4	CL	28	35		2mf SBK		10 0 0	2n pf	8.0 en	gs
	Cr	24		SOFT		WX		SMAGE					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98022

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98F

Date: 4/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ap	0-4		fSL	16	65				0	—	7.0	cs
1	Bw	4-21		fscl	20	65				0	?	7.4	as
	Cr	21-30		soft	wx	ss		w/3md sbk		5/8 ¢		ev	gw
	R	30											

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98034
SAMPLE( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98F

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-1	5YR 3/3	FSL	12	60		1f gr		0	—	7.2 eo	cs
1	ABT	1-8	5YR 4/3	SL	16	(64) 60		2m SBK		0	2n pf	7.4 eo	cs
1	BT	8-29	7.5YR 4/4	SCL	(24) 30	(66) 60		3mc pr		0	3d pf	7.6 eo	ci
2	BTK	29-37	5YR 4/4	SCL	(26) 22	(66) 70		1c SBK		0	1n pf	7.8 es	gi
	Cr	37	SOFT WX				SS						

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98062
SAMPLE ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98F

Date: 2/26/98 Surveyor: Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ag	0-13	3/	(CL) SiL	(28) 18	(32) 25		?		0	—	7.2	CS
2	Bg	13-72	10YR 5/4 *	(SL) SCL	(16) 22	(70) 60		?		0	—	7.4	—

Notes: 10YR 4/ & 10YR 6/8 OXIDATION
HAPLAQUOLLS

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98065

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ag	0-6	10YR 3/1	SiL	15	25		1C SBK		0	—	7.0 e0	CS
2	BT	6-28	5YR 5/4*	SCL	22	60		2C SBK		0	2m pf	7.8 e	AS
	R	28		HARD	5	5							

Notes: 10YR 6/3

Phone:(970) 626-3639 http://www.irim.com

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98021

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
			FROZEN										

Notes: ENDOAQUOLLS FROZEN

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98047

SAMPLE ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry	
1	Ag	0-10	5YR 4/1	L SiL	(24) 18	(48) 65		2c		0		7.6 e	CS	*
2	Bg	10-39	5YR 5/4	SCL	(20) 28	52 65		2c		0	2 pf	7.8 e	—	*
	R	39												

Notes: * 3fm d fp 7.5YR 6/8 5YR 6/8 10YR 6/8

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98045
SAMPLE ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/25/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98F

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	Ag	0-5	5YR 4/2	FSCL	20	55		2m pl		—	—	7.8 e	CS
2	Bw	5-33	5YR 5/4	SCL	22	60		2m SBK		5 0 0	—	7.8 es	as X
	R	33	HARD	SS									

Notes: H_2O TABLE 30"
Bw 2m d 5YR 6/8 10YR 6/8 OXIDATION

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98074

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

98G

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D S M P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-3	7.5YR 4/3	SCL	22	60		1m SBK		0	—	7.6 eo	CS
1	Bw	3-16	5YR 4/4	SCL	22	60		2m SBK		0	1m pf	7.8 e	gs
2	Bk	16-26	5YR 4/4	fSL	15	60		2m SBK		0	—	8.0 es	as
	R	26		HARD			SS						

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98073

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/27/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404

98G

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	A	0-2	7.5YR 4/3	L	15	45		2m gr		5 0 0	—	7.6 ev	cs
1	BW	2-12	5YR 4/4	fSL	12	75		2m SBK		10 0 0	1~ pf	7.8 e	cs
2	Bk	12-24	7.5YR 7/3	grv LS	5	90		1m SBK		30 10 0	—	8.4 ev	gs
	Cr	24	SOFT		WX			SS					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

BOISAC

Intermountain
Resource
Inventories Inc.
182 County Road 24 • Ridgway, CO 81432

98031
SAMPLE ( )

Client:
New Horizon Mine
Western Fuels-Colorado LLC
1998 Order I Soil Survey

Date: 2/24/98 **Surveyor:** Jim Irvine, CPSS ARCPAC # 2404 98G

Lift Layer	Horizon	Depth (inch)	Color Dry Moist	Texture	Clay	Sand	Silt	Structure	Cosist. D M S P	Coarse Frag. GR CB ST	Clay Films	PH Eff. Concen.	Bndry
1	AP	0-2	5YR 4/3	fSL	14	(62) 60		1f sr		5 5 0	—	7.4 e0	cs
1	Bt	2-8	5YR 4/4	CB SCL	22	(64) 60		2MC SBK		10 15 0	2n pf	7.8 e	ci
2	BK	8-24	5YR 7/4	CBV SL	(16) 12	(74) 70		M		20 25 0		8.2 ev	gs
	R	24		HARD		SS		BEDROCK					

Notes:

Phone:(970) 626-3639 http://www.irim.com Fax: (970) 626-5591

Attachment 2.04.~~9 - 8~~9-8

Soil Test Location Photos

~~Attachement 2.04.9 - 9~~


98005.JPG
98010.JPG
98015.JPG
98004.JPG
98009.JPG
98014.JPG
98003.JPG
98008.JPG
98013.JPG
98002.JPG
98007.JPG
98012.JPG
98001.JPG
98006.JPG
98011.JPG


98016.JPG

98017.JPG

98018.JPG

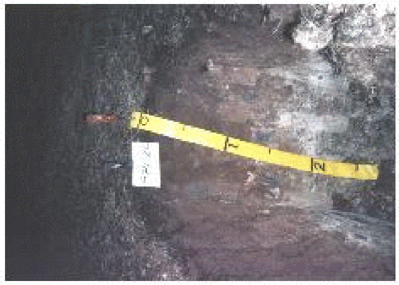
98019.JPG

98020.JPG

98022.JPG

98023.JPG

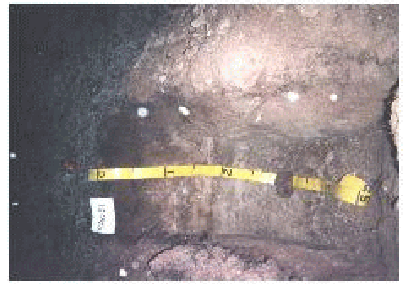
98024.JPG

98025.JPG

98026.JPG

98027.JPG

98028.JPG

98029.JPG

98030.JPG

98031.JPG


98032.JPG


98033.JPG


98034.JPG


98035.jpg


98036.jpg


98037.jpg


98038.jpg


98039a.jpg


98040.JPG


98041.JPG


98042.JPG


98043.JPG


98044.JPG


98045.JPG


98046.JPG


98051.JPG
98056.JPG
98061.JPG
98050.JPG
98055.JPG
98060.JPG
98049.JPG
98054.JPG
98059.JPG
98048.JPG
98053.JPG
98058.JPG
98047.JPG
98052.JPG
98057.JPG


98062.JPG


98063.JPG


98064.JPG


98065.JPG


98066.JPG


98067.JPG


98068.JPG

98069.JPG


98071.jpg


98072.JPG


98074.JPG


98075.JPG


98076.JPG

Attachment 2.04.9-9

Soil Map Unit Descriptions

MAP UNIT: 98A – Begay fine sandy loam, 0 to 3 percent slopes

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5530-5560 feet

Aspect: All

Landform: Stream Terrace

Parent Material: Alluvium

State Geologic Symbol: Qa

COMPOSITION

90 percent Begay soil

Contrasting Inclusions: 5 percent Barx soil on terrace head slopes

5 percent Endoaquepts near drainage bottoms

INTERPRETATIONS

Lift Layers:

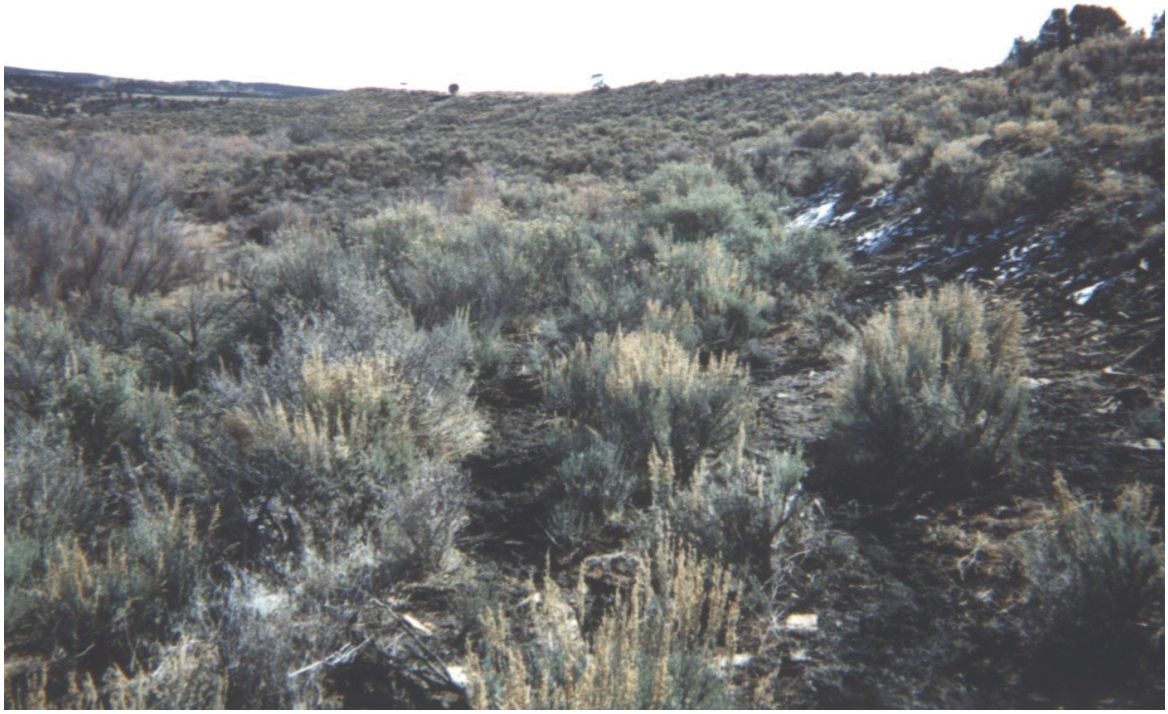
Lift Layer 1 Average Depth: 24 inches

Lift Layer 2 Average Depth: 48 inches

Total Lift Layer Average Depth: 72 inches

Other Considerations: Depth to bedrock varies and may be deeper than 72 inches in some place.

MAP UNIT: 98B – Valleycity - Rock outcrop complex, 30 to 60 percent slopes



MAP UNIT SETTINGS

Slope Range: 30 to 60 percent

Elevation Range: 5560 to 5760 feet

Aspect: All

Landform: Mesa sideslope

Parent Material: Residuum

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

70 percent Valleycity soil

20 percent rock outcrop as rim rock and cliffs

Contrasting Inclusions: 10 percent Bowbac soil on colluvial slopes

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 4 inches

Lift Layer 2 Average Depth: 12 inches

Total Lift Layer Average Depth: 16 inches

Other Considerations: Rock outcrop generally occurs as mesa rim rock at the top of the mesa side slopes. Coal seams often occur at the base of the mesa side slopes. Most delineations in this map unit have naturally occurring vegetation.

MAP UNIT: 98C – Monierco fine sandy loam, 0 to 10 percent slopes

MAP UNIT SETTINGS

Slope Range: 0 to 10 percent

Elevation Range: 5600 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: Residuum

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

90 percent Monierco soil

Contrasting Inclusions: 10 percent Bowbac soil in swales

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 7 inches

Lift Layer 2 Average Depth: 11 inches

Total Lift Layer Average Depth: 18 inches

Other Considerations: Hardness of bedrock varies from weathered shales, mudstones and siltstones to some hard sandstone.

MAP UNIT: 98D – Bowbac – Bowdish complex, 0 to 3 pecent slopes.

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5600 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: Eolian deposits over residuum

State Geologic Symbol: Qe – Eolian Sand over Kdb - Dakota and Burro Canyon Formations

COMPOSITION

65 percent Bowbac soil

25 percent Bowdish soil

Contrasting Inclusions:

8 percent Progresso soil over hard sandstone

2 percent shallow soil on convex slopes

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 13 inches

Lift Layer 2 Average Depth: 17 inches

Total Lift Layer Average Depth: 30 inches

Other Considerations: Hardness of bedrock varies from weathered shales, mudstones and siltstones to some hard sandstone. Bowbac differs from Bowdish as follows: Bowbac has a weak argillic horizon, Bowdish has a cambic horizon. Both have secondary accumulations of carbonates. Bowbac occurs over soft weathered shales, siltstones and sandstones. Bowdish occurs over hard sandstone.

MAP UNIT: 98E – Darvey – Barx complex, 0 to 3 percent slopes

MAP UNIT: 98E – Darvey – Barx complex, 0 to 3 percent slopes

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5600 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: eolian deposits

State Geologic Symbol: Qe – Eolian Sands

COMPOSITION

65 percent Darvey soil

30 percent Barx soil

Contrasting Inclusions: 5 percent Bowbac soil on convex slopes

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 17 inches

Lift Layer 2 Average Depth: 36 inches

Total Lift Layer Average Depth: 53 inches

Other Considerations: Hardness of bedrock varies from weathered shales, mudstones and siltstones to some hard sandstone. Darvey varies from Barx as follows: Darvey has a cambic horizon. Barx has a weak argillic horizon. Both have secondary accumulation of carbonates. Both soils occur in a random complex and differ only slightly pedogenically with Barx having slightly more clay accumulation in the B horizon.

MAP UNIT: 98F – Haplargids – Endoaquolls association, 0 to 3 percent slopes

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5530 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: Alluvium over residuum

State Geologic Symbol: Qa – Quaternary Alluvium over Kdb - Dakota and Burro Canyon Formations

COMPOSITION

75 percent Haplargids on drainage side slopes

20 percent Endoaquepts on drainage bottoms

Contrasting Inclusions: 5 percent Endoaquolls on some naturally occuring depressions

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 18 inches

Lift Layer 2 Average Depth: 28 inches

Total Lift Layer Average Depth: 46 inches

Other Considerations: Depth to bedrock of the Haplargids varies greatly in this map unit. Endoaquepts have been created with the accumulation of irrigation water in naturally occurring drainage bottoms.

MAP UNIT: 98G – Bowdish – Bowbac complex, 3 to 15 percent slopes

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5640 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: Residuum

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

45 percent Bowdish soil

40 percent Bowbac soil

Contrasting Inclusions: 15 percent Monierco soil on convex slopes

~~INTERPRETATIONSLift~~INTERPRETATIONS Lift Layers:

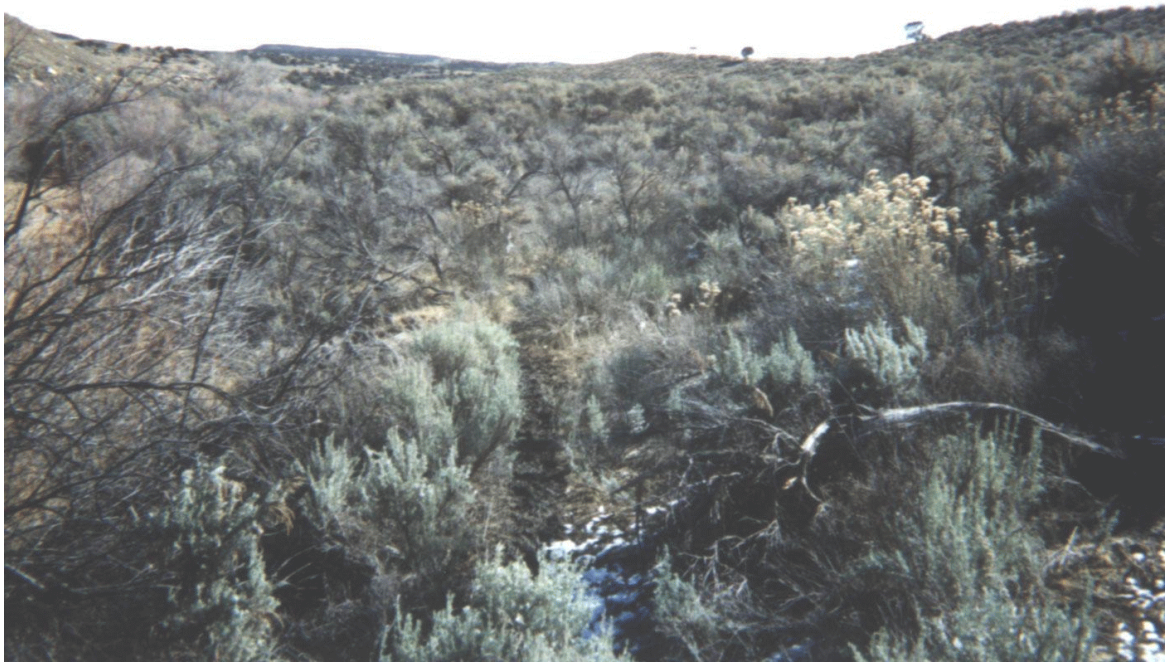
Lift Layer 1 Average Depth: 13 inches

Lift Layer 2 Average Depth: 20 inches

Total Lift Layer Average Depth: 33 inches

Other Considerations: Hardness of bedrock varies from weathered shales, mudstones and siltstones to some hard sandstone.

MAP UNIT: 98H – Wahweap fine sandy loam,10 to 30 percent slopes



MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5560 to 5760 feet

Aspect: All

Landform: Mesa side slopes

Parent Material: Residuum

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

90 percent Wahweap soil

Contrasting Inclusions: 10 percent Bowdish soil in swales

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 3 inches

Lift Layer 2 Average Depth: 15 inches

Total Lift Layer Average Depth: 18 inches

Other Considerations: Hardness of bedrock varies from weathered shales, mudstones and siltstones to some hard sandstone. The vegetation in this map unit is naturally occurring sagebrush and gramma grass.

MAP UNIT: C – Coal

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5560 to 5620 feet

Aspect: All

Landform: Mesa sideslopes

Parent Material: Residuum

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

95 percent naturally exposed or mined Coal

Contrasting Inclusions: 5 percent soil from adjacent map units

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 0 inches

Lift Layer 2 Average Depth: 0 inches

Total Lift Layer Average Depth: 0 inches

Other Considerations: Coal occurs as naturally exposed seams or as small exploratory prospects at or near the bottom of mesa side slopes.

MAP UNIT: NST – No Suitable Topsoil

MAP UNIT SETTINGS

Slope Range: 0 to 3 percent

Elevation Range: 5600 to 5760 feet

Aspect: All

Landform: Mesa

Parent Material: Disturbed

State Geologic Symbol: N/A

COMPOSITION

85 percent areas with no suitable topsoil for salvage.

Contrasting Inclusions: 15 percent soil from adjacent map units

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 0 inches

Lift Layer 2 Average Depth: 0 inches

Total Lift Layer Average Depth: 0 inches

Other Considerations: This map unit consists of houses, outbuildings, foundations, driveways, walkways, parking areas and other man made features. Some soil material related to adjacent map units maybe salvaged from yards, lawns and gardens surrounding or near man made features.

MAP UNIT: P – Ponds

MAP UNIT SETTINGS

Slope Range: 0 percent

Elevation Range: 5600 to 5740 feet

Aspect: All

Landform: Mesas and valleys

Parent Material: Water

State Geologic Symbol: N/A

COMPOSITION

95 percent ponds filled with irrigation water for livestock watering.

Contrasting Inclusions: 5 percent soil surrounding ponds from adjacent map units.

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 0 inches

Lift Layer 2 Average Depth: 0 inches

Total Lift Layer Average Depth: 0 inches

Other Considerations: All the ponds in the survey area are man made stockponds.

MAP UNIT: RO – Rock Outcrop

MAP UNIT SETTINGS

Slope Range: 0 to 100 percent

Elevation Range: 5640 to 5760 feet

Aspect: All

Landform: Mesas and mesa sideslopes

Parent Material: residuum -sandstone

State Geologic Symbol: Kdb - Dakota and Burro Canyon Formations

COMPOSITION

95 percent rock outcrop that occurs as mesa rim rock, and exposed surface rock on mesa summits.

Contrasting Inclusions: 5 percent soil surrounding rock outcrop from adjacent map units.

INTERPRETATIONS

Lift Layers:

Lift Layer 1 Average Depth: 0 inches

Lift Layer 2 Average Depth: 0 inches

Total Lift Layer Average Depth: 0 inches

Other Considerations: There is five percent or less suitable soil for salvage in this map unit.