GENERAL ORGANIZATION

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CHAPTER VII

SOILS

Chapter VII SOILS

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7.1 Introduction

An Order 2 soils baseline study was designed and conducted to meet the rules and regulations of the Utah Division of Oil, Gas and Mining (DOGM) for a Maintenance and Reclamation Plan for the idled Horse Canyon Mine. Information contained in this chapter includes soil characteristics, chemical and physical analyses, and their interpretations for soils management. Information collected for this study was both quantitative and qualitative in nature.

7.2 Soil Resources

7.2.1 Introduction

The Horse Canyon Mine soils study area included the idled facilities area, all currently disturbed and adjacent areas, and an outwash fan between Middle Canyon and Horse Canyon (Plate VII-1). It should be noted that past mining was initiated prior to topsoil salvage requirements, therefore no topsoil was salvaged for use in reclamation of the present disturbed area. Soil borrow materials will be required for use in selected areas in order to establish successful reclamation. For ease of reading, soil material to be used for reclamation purposes will be referred to as 'topsoil' instead of soil borrow materials.

The detailed soil survey 1) identifies the mapping units at a second-order level (SCS unpublished), 2) describes the soils and the soil samples of each unit, 3) analyzes and evaluates the soil samples for physical and chemical parameters suggested by the DOGM, and 4) determines the quality and quantity of suitable topsoil.

7.2.2 Soils/Environmental Setting

The Horse Canyon Mine permit area includes approximately 556 acres of canyon bottom along the Horse Canyon Creek and outwash fan located at the mouth of the canyon. This mine area is a part of the Book Cliffs range, and includes steep and very steep canyon walls and escarpments composed of alternating siltstones, shale, and sandstones (Osterwald and others, 1981). Elevation near the mouth of the canyon is about 6,000 feet, and reaches 7,600 feet east and above the canyon sideslope.

Thick stands of Utah juniper, mountain mahogany, and pinyon pine commonly occur on the glacial terrace, outwash fan at the mouth of the canyon, and on the drier south-facing canyon walls. Alluvial bottoms are comprised of open areas vegetated with sagebrush and grasses.

Generally, the soils on the terraces and fans are very deep, coarse textured, and well drained. These are primarily glacial and alluvial soils which cap a shale and sandy shale bedrock. The narrow canyon floors are comprised of colluvial and alluvial soils that are stony, very deep, and well drained. Steep canyon sideslopes are comprised mostly of rock outcrop, rubble, and very shallow rocky soils.

7.2.3 Methodology

7.2.3.1 Preliminary Activities and Findings

The U.S. Soil Conservation Service (SCS) soil survey report for Carbon Area, Utah-Parts Carbon and Emery Counties (Unpublished, 1984) was the primary resource for this soil survey. An intensive Order 2 soil survey was conducted on the permit area according to SCS and DOGM guidelines. Additional literature and resources included: a geological survey of the Sunnyside Coal-Mine District (Osterwald and others, 1981); the results of a vegetation survey for the area; local and regional revegetation research; and soil samples and the subsequent laboratory analyses from the local area.

The SCS office in Price assisted with the correlation of the Horse Canyon soils with data presented in the National Cooperative Soil Survey. Established soil series for this area were used. Mapping of the soils for the Order 2 survey primarily entailed refining the soil delineations previously established by the SCS Order 3 survey.

7.2.3.2 Soil Surveys

The soil sampling and field survey were completed during the week of September 9, 1985. This study identified potentially

toxic soils, rated soils for suitability as topsoil, and identified substitute topsoil or borrow material that could be used to support revegetation efforts.

The Order 2 level mapping included the facilities area, disturbed and adjacent areas, and areas that may provide a source of topsoil. Within this mapping area, 6 mapping units and 8 series or miscellaneous land types were identified (Table 7.2.3.2-1). The detailed descriptions of the soil mapping units for the permit area are included in Appendix VII-1. Descriptions of the soil series or pedons of the study area are described in Appendix VII-2.

Table 7.2.3.2-1 Summary of Topsoil Mapping Units

Mapping Unit	Comp. of Map Unit (%)	General Texture Class
Ge-Ba		
Gerst Part	50	Stony Loam
Badland Part	30	Unsuitable Material
Rubbleland Part	15	Unsuitable Material
Gl		
Glenberg	100	Sandy Loam
Ro-Ru		
Rock Outcrop Part	45	Unsuitable Material
Rubbleland Part	35	Unsuitable Material
Travesilla Part	10	Gravelly Sandy Loam
xSt		
Strych	100	Bouldery Sandy Loam
St		
Strych	100	Stony Sandy Loam

Table 7.2.3.2-1 Continued

Ge-St			
	Gerst Part	45	Stony Loam
	Strych Part	30	Stony Sandy Loam
	Badland Part	20	Unsuitable Material

A number of soil profiles were examined to determine the nature and extent of the soils. Genetic horizons were examined for color, texture, structure, and other characteristics in hand-dug holes, along road cuts, and in gullies. Mapping unit delineations were then drawn on 1 = 500' scale color aerial photographs, and later transferred to a 1 = 400' scale topographic map (Plate VII-1). Table 7.2.3.2-2 provides a legend for the soil map with symbol, mapping units and sample numbers.

Table 7.2.3.2-2 Legend for Soil Map

Symbol	Mapping Unit	Sample Number
Ge-Ba	Gerst, Badland, Rubbleland complex, 15 to 50 percent slopes	GE 10
Ge-St	Gerst-Strych-Badland complex, 50 to 70 percent slopes	
GL	Glenberg fine sandy loam, 1 to 3 percent slopes	GL 9
Ro-Ru	Rock outcrop-Rubbleland-Travesilla complex, 30 to 70 percent slopes	
St	Strych very stony loam, 5 to 15 percent slopes	St 11
xSt	Strych very bouldery loam, 15 to 45% slopes	

Soils were identified at the series level; however, it should be noted that the phase unit of classification was also used to map detail at an Order 2. That is, the degree of slope, amount of erosion, and content of stones and boulders were used to separate the mapping units.

7.2.3.3 Soil Sampling and Analysis

For the purposes of the baseline study, fourteen samples were collected from three different soil series or families. It was judged that only these soil units could potentially yield salvageable topsoil. All other identified series or mapping units would be unsuitable for such use. The general location was described for each sample site in a field notebook as part of the profile description. Soil sample locations are labeled on the soils map (Plate VII-1).

For each soil profile, continuous, representative 1 quart samples were taken. When possible, the samples were taken within the major genetic horizons. However, subsurface sample horizons were generally separated to facilitate laboratory analyses and not always separated for morphological differences. The sample layers were identified by numbering each subdivision consecutively starting at the top. Generally, the layers were split to insure that most samples did not represent a layer greater than 12 inches thick. The soils were described and

sampled to a depth of 60 inches or to indurated bedrock, whichever occurred first.

All soil samples were identified and double bagged. Soil samples were shipped to Bookcliffs Commercial Laboratories at Steamboat Springs, Colorado for analysis. They were analyzed for the parameters listed in Table 7.2.3.3-1 in accordance with the indicated laboratory procedures. Soils were also analyzed for boron and selenium content because of the high pH of some samples and because of the potential influence of naturally occurring shale. These samples were not analyzed for nitrogen, phosphorous, or potassium because more definitive data will be obtained at the time of final reclamation.

Table 7.2.3.3-1 Analysis and Procedures for Determining Soil Suitability for Topsoil.

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1. Preparation of soils for analysis: USDA Handbook 60, 1954- Diagnosis and Improvement of Saline and Alkali Soils, pp. 83-84; all analyses conducted on samples that have been passes through at least a 20-mesh sieve.

2. pH (determination on paste): USDA Handbook 60, page 102.

3. Conductivity mmhos/cm on saturation extract: USDA Handbook 60, pages 88 & 89.

4. Saturation percentage: USDA Handbook 60, page 84, Method 2 and 3a.

5. Calcium Report in meq/l on extract: Preparation of extract USDA Handbook 60, page 84, Method 2 and 3a. Analysis by atomic absorption spectrophotometry (see Perkin-Elmer Analytical Methods).

Table 7.2.3.3-1 Continued

6. Magnesium - Report in meq/l: Same as for Calcium.

7. Sodium - Report in meq/l: Same as for Calcium.

8. SAR (Sodium Adsorption Ratio): USDA Handbook 60, page 26,

$$SAR = \frac{Na^{+}}{\left(\frac{Ca^{2+} + Mg^{2+}}{2}\right)^{1/2}}$$

Where Na^{+}, Ca^{2+}, and Mg^{2+} are the concentrations of those ions found in 5, 6, and 7 above.

9. Boron - Hot water extract reported as ppm: ASA Agronomy Monograph #9, 1965. Methods of Soil Analysis, part 2. Method 75-4, pp. 1062-1063.

10. Particle size distribution (mechanical analysis as % sand, silt and clay): ASA Agronomy Monograph #9, part 1, Method 43-5, pp. 562-566. If EC is 4 or more mmhos/cm include field texture determination.

11. Selenium (ppm): Hot Water Extract - sum of water soluble selenate, selenite, and organic Se. Extraction Procedure- ASA Monograph #9, part 2 80-3.2.2, p. 1122. Analysis of extract by sodium borohydride method. See Advances in Vapor Generation, 1974, presented at Silver Anniversary, Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Cleveland, Ohio.

12. Organic Matter (percent): ASA Monograph #9, part 2, Method 90-3, pp. 1372-1376.

13. Alkalinity: USDA Handbook No. 60, Method (23b), pp. 105.

14. Cation Exchange Capacity: USDA Handbook 525, No. 5B, pp. 8 & 9.

Soil samples were also collected from the 1986 interim reclamation area (Plates II-1 A,B) within the disturbed area according to the procedures previously described. Horse Canyon sample #1 was a composite sample obtained from several sediment pond embankment areas adjacent to the facilities area. Sample #2

was a composite sample obtained from the area revegetated at the north portal and road area. Sample #3 was obtained from the south fan and road. Sample #4 was obtained from the tipple area and road and sediment pond. Samples were composite samples from a minimum of three sites; samples were taken at 0 to 8 inches depth. Approximate sample locations are shown on Plate VI-1B. Significant compaction prevented samples from being taken at lower depths. Samples were analyzed for all parameters listed in Table 7.2.3.3-1, as well as for soil fertility because these soils would be fertilized for the purposes of interim reclamation.

7.2.3.4 Topsoil Suitability and Availability

The Utah DOGM "Guidelines for Preparation of Topsoil Management Plan" and Schafer's Guidelines (1979) were used to rank the suitability of topsoil material (Table 7.2.3.4-1 and Appendix VII-3). Only when there was agreement between the two guidelines on critical levels of key properties were those critical levels accepted. When discrepancies or apparent printing errors existed, the Schafer guidelines were used. Schafer's recommendations have been accepted as a standard in the industry (NCSS, 1978).

Table 7.2.3.4-1 DOGM Suitability Guidelines for Topsoil Substitute Materials and Topsoil Material

	Good	Fair	Poor	Unsuitable
pH	6.1-7.8	5.1-6.1 7.9-8.4	4.5-5.0 8.5-9.0	<4.5 >9.0
Organic Matter	1.5	0.5-1.0	0.5-1	<0.5
USDA Textural Class	SL, L SiL, SCL USFL, FSL	CL, SICL, SC, LS LFS	SIC S	C
Electrical Conductivity	<4	4-8	9-16	>16
Sodium Adsorption Ratio (SAR)	<5	6-10	10-15	>15
USLE Water Erodibility Factor (K)	.35	.37		
Wind Erodibility Group (WEG)	3	3	1.2	
Rock Fragments (% Volume)				
3-10 inches	0-15	15-25	25-35	30
More than 10 inches	0-3	3-7	7-10	10
Alkalinity as Calcium Carbonate meq/100g	0-15	15-25	25-35	>35
Cation Exchange Capacity	>20	10-20	5-9	<5
Saturation Percentage (%)	25-80	25-80	<25, >80	

Four suitability ratings (Good, Fair, Poor, and Unsuitable) were used to determine the salvage depths of each mapping unit. Limiting factors were noted for each component of a soil series or phase. Soils with more than 35 percent coarse fragments are rated unsuitable for use as topsoil, but can be improved by removing the stones and boulders.

7.2.4 Results

7.2.4.1 Soils Descriptions

Generally, soils in the study area are deep, well drained, stony soils. They should cause very few engineering problems and limited problems in revegetation. Physical and chemical characteristics of the soils for the permit area and for the areas sampled for the interim reclamation in 1986 are listed in Appendices VII-4 and VII-5, respectively.

Within the Horse Canyon permit area, the Gerst-Badland-Rubbleland, Rock Outcrop-Rubbleland-Travesilla Complex and the Gerst-Strych-Badland Complex soils are located on the canyon slopes, terraces and escarpments. This group of soils is more rock or rock debris than soil material. The Strych soils are deeper rocky soils of the alluvial fans and glacial terraces. The Glenberg soils derived from alluvium are found in the narrow canyon bottom.

The topsoil material suitability rating for each of the soil mapping units found in the Order 2 survey are presented in Table 7.2.4.1-1.

Table 7.2.4.1-1 Topsoil Material Suitability by Mapping Unit

Mapping Unit	TOPSOIL RATING AND DEPTH Good (in)	Fair (in)	Poor (in)	Unsuitable (in)	Limitations
Ge-Ba					
Gerst Part				0-16*	Stones, shallow soil
Badland Part				———	Bedrock
Rubbleland Part				———	Rocks
Gl					
Glenberg	0-60				Fair, salts 44-60", fair cation exchange
Ro-Ru					
Rock Outcrop Part				———	Bedrock
Rubbleland Part				———	Rocks
Travesilla Part	0-10				Shallow soil
xSt					
Strych	30-60			0-30*	Boulders
St					
Strych	30-60			0-30*	Stones
Ge-St					
Gerst Part				0-16*	Stones, shallow soil
Strych Part	30-60			0-30*	Stones
Badland Part				———	Bedrock

* = If stones and boulders are removed, the soil will be upgraded from unsuitable to fair, poor, or good, depending on the amount of stone removed.

7.2.4.2 Present and Potential Productivity

Production potential and other interpretations for the soils found within the Order 2 survey area are discussed in the mapping unit descriptions and pedon description (Appendices VII-1 and VII-2). These interpretations were largely obtained from the SCS

Descriptions should be site specific

unpublished soil survey for Carbon County (1984). Where production estimates are not provided, the potential vegetation cover or SCS land use capability class is indicated. Estimates of range production are provided for vegetation types identified within the permit area in Vegetation Resources Information (Chapter VIII).

7.2.5 Physical and Chemical Properties

Detailed testing procedures are presented in Table 7.2.3.3-1; the results of these analyses are presented in Appendices VII-5 and VII-6.

All of the soils tested throughout the project area contained low concentrations of selenium and boron. Soils near or overlying shale, however, sometimes indicated the presence of salts. Only slight to moderate levels of salts were found in the Gerst and Glenberg soils. No soils were found to have chemical constituents or concentration levels that would pose a potential hazard to plants or animals.

None of the in-place soil materials that were tested for the 1986 interim reclamation were found to have any apparently limiting characteristics within the top 12 inches.

7.2.6 Reclamation Characteristics

Soils are evaluated for use as suitable topsoil or borrow material by analyzing the individual horizons sampled. The overall suitability rating for the soil is determined by the most limiting criterion in any horizon. For example, many of the Strych soils have more than 35 percent coarse fragments in the uppermost 6 inches. Therefore, the soil is rated as unsuitable for use as topsoil. This soil, however, can be upgraded to a poor or fair rating suitable for use as topsoil by removing the stones and boulders in the upper profile. Similarly, this soil can be used as topsoil by using only the soils below the surface stony layer. Generally, the primary limiting characteristics for soils within the permit area are the significant amounts of stones and large boulders, shallow soil depth of many mapping units, and steep slopes.

Some adverse surface conditions may be created during final reclamation operations that will require consideration and mitigation. During regrading and soil handling operations, soil compaction and accelerated erosion may occur, particularly on steep slopes. Furthermore, some mixing of calcareous material in the lower horizons with topsoil will also occur. Field conditions as well as soils data will be taken into consideration so that the proper reclamation practice and mitigation techniques are used.

Only those sub-surface soils directly over shale indicated a higher pH and salt accumulation. These are the only potentially unsuitable soils that will be evaluated before utilizing them as topsoil.

Soil material which is proposed as a plant growth medium (i.e. substitute topsoil) for final reclamation and shown on Plates IV 1A- 1F has been sampled and analyzed to characterize its physio-chemical quality. Samples 1T, 2S, 4T, 5T, 6T, 7D, 8D, 11S, 12D, 13D, 14D, and 15D represent this soil material (Plates IV-1B, 1D, and 1E). The analyses of these samples are in Appendix VIII-1. Barrow material will be added to those areas indicated with a stippled pattern on Plates IV 1A-1F.

7.3 Prime Farmland Investigation and Determination

Land designated as prime farmland consists of soils that are best suited to continuous crop production. None of the soils found within the permit area are listed as soils that would meet the requirements for prime farmland. All of the soils within the permit area are listed as rangeland or woodland in the SCS Soils Report for Carbon and Emery Counties (SCS, 1982); none are listed as potential prime farmland soils. None of the lands located either at the mouth of the canyon or within the canyon itself have been historically used as cropland.

A letter from the SCS documenting the unsuitability of the permit area soils for prime farmland classification is located in Appendix VII-6.

7.4 Topsoil Removal

7.4.1 Landfill

Virtually no stockpiled topsoil is available for reclamation at the Horse Canyon Mine, and consequently none will be stored or utilized during final reclamation. The one exception to this is the topsoil stored near the Road Junction Refuse Pile. This pile contains approximately 30 BCY, and will be utilized as topsoil during final reclamation of the pile.

7.4.2 Borrow Area

Borrowed topsoil will be obtained from a single area located south of the Road Junction Refuse Pile (Plate VII-1). Approximately 27,540 BCY of topsoil will be required for application on the areas to be revegetated. The borrow area will be approximately 5 acres in size, 5 feet deep, with 3h:1v sideslopes. The soils to be borrowed will be a combination of Strych stony loam and Strych bouldery loam. The location of this borrow area was chosen to obtain the best soil material available on the Kaiser fee property. The Glenberg soil in this area is located adjacent to the Horse Canyon Creek and borrowing this material would involve disturbing the channel thus this material will not be used. The soil will be removed with a truck/loader system or with scrapers. Once the soils are removed from the

borrow area, they will be immediately hauled on existing roads and redistributed on the required areas as described in Sections 3.9.4 and 7.4.4. No soils will be stockpiled.

Specific activities that will involve the borrow area include: 1) preparation of the borrow area by removing existing vegetation, 2) sampling and analyzing borrow material horizons to determine depth of suitable material, fertilizer and amendment requirements, 3) removing adequate amounts of material for reclamation purposes, and 4) regrading and revegetating the borrow area.

Prior to removal of borrow material for use in final reclamation, the existing vegetation will be removed. Clearing and grubbing will consist of removing any large trees that would interfere with the soil removal operation. Trees will be either removed from the site, or placed into brush piles adjacent to the borrow area to enhance small mammal wildlife habitat. Smaller tree branches and shrubby vegetation will be removed as a part of the soil removal process. These smaller woody materials will not interfere with the soil removal process, and will increase organic composition of the materials, as well as provide limited small wildlife habitat on the reclaimed areas.

The stony and bouldery nature of the soils to be removed may require the selective removal of large stones and boulders as the

soils are mined to produce a material which meets the DOGM suitability guidelines (Table 7.2.3.4-1). It is expected that the soils will be suitable with the removal of only a small percentage of the larger rocks and boulders. This discarded material will be pushed into a designated pile within the borrow area to provide small mammal habitat.

Because virtually all areas to receive topsoil will receive soils from this one borrow area, soil samples will be obtained from the area two months prior to the soil removal operation. These materials will be sent to an authorized laboratory and analyzed for soil chemistry and nutrients according to the procedures discussed in Section 7.2.3, and in accordance with DOGM Guidelines.

The topsoil stripping depth is presently set at 5 feet because this is the limit of the baseline sampling. The actual topsoil stripping depth will be confirmed by testing of the borrow area by qualified personnel in the field prior to commencing the borrow operations.

Soil samples were taken for this soil series during the baseline survey to a depth of 5 feet. The results of the chemical and physical analyses of these proposed materials are presented in Appendix VII-4. These tests indicate that the borrow materials should be suitable for use in reclamation of the

disturbed areas at the Horse Canyon Mine.

Sufficient suitable material will be left at the bottom of the borrow area for use in reclamation of the area itself. Once the total amount of required material is removed, the area will be regraded to final configuration, with slopes not exceeding 3h:1v. The final configuration of the borrow area has been designed to act as a catchment basin in order to provide water for wildlife species. The entire area including sideslopes will then be prepared, fertilized, and permanently revegetated according to the procedures discussed in Sections 7.5 and 8.4.

7.5 Topsoil Redistribution

Within the Horse Canyon permit area, the areas that will receive topsoil include the following:

1) Road Junction Coarse Refuse Pile--1 foot
2) Landfill--2 feet
3) Facilities and Tipple areas--1 foot (as required)

One foot of topsoil will be applied to all areas, following regrading operations, where refuse material is exposed. Where the regraded surfaces consist of clean earth material, topsoil will not be applied. Past experience with the 1986 interim reclamation indicates that the clean earth utilized in the pads and roads is satisfactory for reclamation with the proper preparation. Rubble and inert debris from demolition of the facilities will be utilized as backfill material near portals and highwalls, and will be covered with a minimum of 4 feet of backfill. If this backfill cover is refuse, the resulting slopes will be topsoiled. If the backfill cover is clean earth, no additional topsoil will be added. The anticipated areas for topsoil application have been delineated on Plates IV-1 A-F. These areas are based on the present apparent distribution of refuse material in the area to be regraded. Any other areas which might require topsoil will be determined at the time of final reclamation, and will necessarily be based on unpredictable

exposure of refuse or other undesirable materials. Descriptions of all areas to be reclaimed are discussed in Section 3.7 and are shown on Plate IV-1 A-F.

The recontoured surfaces of disturbed areas that will receive topsoil will be prepared by ripping to a minimum depth of 12 inches. Ripping will alleviate compaction caused by equipment and will also provide a roughened surface for bonding with the topsoil material. Ripping is particularly important in the steeper sloped portions of the recontoured areas where bonding of the soil material to the regraded slope is needed to reduce soil material slippage. The regraded clean earth areas will also be ripped to alleviate compaction prior to seedbed preparation.

After appropriate surface regrading and ripping is completed, topsoil will be applied. The material will be placed and spread by dozers, front-end loaders, trucks, scrapers, and graders where appropriate. The topsoil will be applied as evenly as is practicable, and will be worked on the contour whenever possible. Only a minimum amount of heavy equipment activity will be allowed during handling operations to prevent compaction.

Prior to seeding, the regraded surface will receive a light disking, or be otherwise scarified along the contour if a crust has developed since final grading or other soil preparation activities. Otherwise, no special soil preparation will be

necessary.

In some areas, such as on steep slopes, it may be necessary to create a roughened surface to prevent water erosion. Water erosion will be controlled by using a shallow chisel plow on level contour, using a lister or rangeland pitter, or by other appropriate means depending upon soil conditions. The purpose is to leave an uneven, erosion-resistant surface that will aid water infiltration and enhance germination and establishment of seeded species. The use of water bars or other erosion control measures will also be utilized as necessary.

Areas that will receive topsoil include areas such as those occupied by pavement, refuse, or any other unsuitable plant growth medium. Paved areas will be ripped to a minimum depth of 18 inches and covered with a minimum of 1 foot of topsoil. Refuse will generally be utilized as fill material to remove it from the surface however, where refuse materials remains on the surface, 1 foot of topsoil will be utilized to cover the refuse. Any other areas located at the time of final reclamation that are occupied by unsuitable plant growth medium will be treated as necessary and covered with 1 foot of topsoil.

Some disturbed areas on the mine area will not receive topsoil. Such areas include those that are not contaminated by refuse, oil, concrete rubble, or other unsuitable plant growth

material. For example, heavily compacted pads which have 'clean' soil materials underlying them. The in-place soils will be sampled and tested for the parameters listed in Section 7.2.3, and in accordance with DOGM Guidelines. Soil testing may be performed after or concurrently with regrading and ripping operations. The clean soil surfaces will then be ripped, prepared, seeded, fertilized, and mulched according to procedures discussed in Section 8.5.

7.6 Nutrients and Soil Amendments

In this climatic zone (8 to 17 inches annual precipitation), soil moisture is essential to plant establishment and revegetation efforts. Good response to fertilizer application can be expected when soil moisture is sufficiently high during the spring such that active plant growth is promoted. Because the application of fertilizer is unpredictable with respect to plant response, the 1986 interim stabilization revegetation efforts will be evaluated during the Maintenance Period to determine the effects of fertilization on plant establishment. These qualitative observations will be utilized in conjunction with soils data to determine appropriate levels of fertilizer application at the time of final reclamation.

It is expected that the applied topsoil will require fertilizer amendments at the time of final reclamation. Because the majority of the disturbed area will be covered with topsoil taken from one location, soil samples will be obtained from the borrow area according to the procedures outlined in the Soil Resources Section 7.2.3, and in accordance with DOGM Topsoil and Reclamation Guidelines.

In-place soil materials that will be reclaimed without additional application of topsoil will be tested to determine the appropriate levels of fertilizer application.

For bonding purposes, is it is estimated that fertilizer will be applied at a rate of 313 pounds of 16-16-8 per acre. This will supply 50 lbs/acre of N, 50 lbs/acre of P_{205} and 25 lbs/acre of K_{205}. While short on K, additional fertilizer rates might overload these arid soils. However, final fertilization rated will be determined at the time of final reclamation based on the results of topsoil sampling and on the plant response to fertilization during interim stabilization efforts.

Analyses will be conducted according to methods prescribed in Section 7.2.3, and by the DOGM Topsoil Guidelines. At a minimum, soils will be tested for fertility, texture, pH, conductivity, lime, organic matter, nitrogen, phosphorus, potassium, zinc, iron, manganese, and copper. In addition, analyses for toxic metals will be run if the conditions warrant. The results of the soil testing will be used to establish recommendations for fertilizer or other soil amendments. In general, soil amendments will be applied during the fall or spring as concurrent with reseeding operations as possible to maximize plant response.

All of the soils in the project area, as well as the borrow soils, appear to be adequate for reclamation purposes and should respond well to fertilizer application if moisture conditions are favorable.

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List of Appendices

Appendix VII-1

Soil Mapping Unit Descriptions

Ge-Ba Gerst-Badland-Rubbleland complex, 15 to 50 percent slopes

This mapping unit is on terrace breaks and canyon sideslopes. Elevation is 6,000 to 6,800 feet. The average annual precipitation is about 8 to 14 inches, the mean annual temperature is 45 degrees F. Average freeze-free period is 100 to 120 days.

This unit is 50 percent Gerst very stony loam; 30 percent Badland; 15 percent Rubbleland; 5 percent other soils.

Gerst is a shallow well drained soil. It formed in colluvium or residuum, derived dominantly from sandstone and shale. The surface is light brownish gray, very stony loam, 8 inches thick. Underlying material of Gerst soil is a light brownish gray to gray cobbly sandy loam and loam over weathered shale. Depth to weathered shale is 18 inches.

Permeability of Gerst soil is moderately slow and the available water capacity is 2 to 3 inches. This shallow soil has only a water supplying capacity of 3 to 5 inches and an effective rooting depth of 10 to 20 inches. The organic matter content of the surface layer is 1.4 percent. Runoff is rapid and the water erosion hazard is high.

Badland consists of steep and very steep nearly barren beds of actively eroding shale, interbedded gypsum, and an occasional area of shale capped by sandstone.

Rubbleland consists of areas covered by stones and with very little or no soil exposed. Rubbleland supports very little vegetation.

The potential vegetation on the Gerst soil is an overstory of pinyon and Utah juniper with a canopy cover of 15 percent. Understory vegetation is 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Important plants are Salina wildrye, Indian ricegrass, birchleaf mountain mahogany, and Utah serviceberry.

The site index for Utah juniper and pinyon is 15 to 25. Productivity is low with an average yield of only 1 to 2 cords of wood per acre. The suitability for grazing use is poor.

This mapping unit is in capability subclass VIIe, nonirrigated. The Gerst soil is in the Upland Very Steep Shallow clay loam woodland site. The Badland and Rubbleland are not placed in a range site.

GL Glenberg fine sandy loam, 1 to 3 percent slopes

The Glenberg soil is a very deep, well drained soil located on the canyon valley floor. It is developing in alluvium derived from sandstone and shale. Elevation is 6,000 to 6,500 feet. The average annual precipitation is 8 to 12 inches; the mean annual air temperature is 47 to 49 degrees F; and the average freeze-free period is 110 to 135 days.

The surface layer is a brown sandy loam about 4 inches thick. A pale brown sandy loam and loamy sand subsurface material is at a depth of 60 inches or more. This soil may have a buried topsoil since it appears to be a water transported stratified layer.

Permeability of this Glenberg soil is moderately rapid and the available water capacity is 7 to 10 inches. Water supplying capacity of this deep soil is 4.5 to 5.5 inches and the effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 1 to 2 percent. Runoff is slow, the water erosion hazard is moderate. Hazard of this soil blowing is high.

Potential plant community for this soil is 60 percent grasses, 10 percent forbs, and 30 percent shrubs. Important plants include Indian ricegrass, needle and thread, galleta, and fourwing saltbush.

This unit is in capability subclass VIIc, nonirrigated. Glenberg soil is in Semidesert Sandy Loam range site.

RO-RL Rock outcrop-Rubbleland-Travessilla complex, 30 to 70 percent slopes

This mapping unit is located on mesa escarpments and canyon sideslopes. The unit is on very steep slope gradients of 30 to 70 percent. This delineation is mapped as 45 percent Rock outcrop; 35 percent Rubbleland; 10 percent Travessilla very gravelly fine sandy loam, and 10 percent other soils. Components of this unit are so intricately intermixed that they would be very difficult to separate.

The Travessilla soil is described, but it was not sampled. It would be highly impractical to attempt to salvage this shallow, very gravelly soil for topsoil material.

Travessilla has a pale brown, very gravelly sandy loam surface about 2 to 3 inches thick. The underlying material is brown to light brown gravelly sandy loam over sandstone bedrock. Sandstone is at a depth of 8 to 15 inches.

This unit is not grazable by livestock because of steep slopes and stony surface soil. Classification of this unit is capability subclass VIIIs, nonirrigated. The Travessilla soil is in the Upland Very Steep Shallow Loam woodland site. Rock outcrop and Rubbleland are not placed in a range site.

xSt Strych very bouldery loam, 15 to 45 percent slopes

This soil is a very deep, well drained soil developing on steep dissected alluvial fans and fan terraces. The parent material is alluvium and glacial outwash derived dominantly from sandstone and shale. Elevation ranges from 6,000 to 6,700 feet. The average annual precipitation is about 10 to 14 inches; the mean annual air temperature is 45 to 47 degrees F; and average freeze-free period is 115 to 140 days.

Typically, the surface layer is a pale brown to brown very bouldery loam 6 inches thick. The underlying layer is a grayish brown to pale brown calcareous bouldery loam. The deeper stratified layers are a light yellowish brown cobbly fine sand loam to sandy clay loam.

Permeability of this Strych soil is moderately rapid and the available water holding capacity is 3.5 to 7 inches. Water supplying capacity is 4 to 5 inches. Effective rooting depth is greater than 60 inches. Organic matter in the surface layer is low, runoff is medium and the water erosion hazard is moderate.

The potential plant community is Utah juniper and pinyon in a Site Class III. Potential yields are 9 cords of wood per acre in an average site index of 65. Understory is Indian ricegrass, shadscale, Salina wildrye, and galleta.

Soil Salvage: The large boulders and stones are the limitation of this soil. To make this soil suitable for topsoil material, 10 to 20 percent of the stones and boulders must be removed. There is an increase in large stones and boulders in the soil profile on the steeper slopes near the canyon wall.

St Strych very stony loam, 5 to 15 percent slopes

This deep, well drained, undulating sloping soil occurs on alluvial fan and terraces. This soil formed in alluvium and glacial outwash derived mainly from sandstone and shale. The average annual precipitation is 10 to 14 inches. Mean annual air temperature is 45 to 47 degrees F, and the average freeze-free season is 115 to 140 days.

Typically, the surface layer is pale brown very stony loam about 6 inches thick. The underlying layer is light gray calcareous very stony fine sandy loam about 32 inches thick. Deeper in the profile the soil is stratified with layers of very pale brown and brown cobbly fine sandy loam and sandy clay loam. There is a decrease in stones deeper in the profile, however there sometimes is an increase in salts below 100 inches deep.

Permeability is moderately rapid. Available water capacity is about 3.75 to 5.0 inches to a depth of 60 inches. Water supplying capacity is about 5 to 6 inches. Organic matter content in the surface layer is low. Effective rooting depth is greater than 60 inches. Surface runoff is medium and erosion hazard is moderate. The Erosion Condition Class is slight--32.

The potential plant community is Utah juniper and pinyon in a Site Class III. Potential yields are 9 cords of wood per acre in an average site index of 65.

Soil Salvage: The dominant soil limitation is the very stony soil. Stones and some of the cobble must be removed from the top 32 to 42 inches to make the Strych soils suitable borrow material. If 10 to 15 percent of the stones and cobble are removed they would be rated fair to good salvageable soil material to use for revegetation. Soils below 42 inches have less than 5 percent stones and are rated mostly fair, but with some good for soil salvage.

Ge-St Gerst-Strych-Badland complex, 50 to 70 percent slopes

This mapping unit is found on terrace breaks, mountain slopes and toe slopes. In this complex is an intricate mixture shallow, stony Gerst soil; a deep glacial, stony Strych soil; and eroded shale bedrock. This unit is 45 percent Gerst, 30 percent Strych, 20 percent Badland, and 5 percent other soils.

The Gerst soil is a very stony, shallow, and well drained soil developing in residual and colluvial material derived from shale and sandstone. Typically, the surface horizon is light brownish gray, very stony sandy loam about 6 inches thick. Gray and light brownish gray cobbly loam is the underlying layer about 4 inches thick. A 6 inch layer of silt loam cover the shale bedrock at 16 inches.

Permeability of the Gerst soil is moderately slow and the available water capacity is about 2 to 3 inches. Water supplying capacity is 3 to 5 inches and the effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 1.5 to 2 percent. Runoff is rapid and the water erosion hazard is high to severe.

Strych is a very stony, deep and well drained soil developing on alluvium and glacial outwash. Typically the surface layer is pale brown very stony loam about 6 inches thick. The underlying layer is a light gray, calcareous, very stony sandy loam about 25 inches thick. The substratum very pale brown stratified layers of cobbly sandy loam to a depth of 60 inches or more.

Permeability of the Strych soil is moderately rapid and the available water capacity is 3.5 to 6.5 inches. Water supplying capacity is 4 to 7 inches. Effective rooting depth is 60 inches or more. The organic matter content of the surface layer is 1.1 to 1.2 percent. Runoff is medium and the water erosion hazard is moderate to high.

Badland consists of steep and very steep nearly barren areas of shale with some areas of interbedded sandstone. Runoff is rapid to very high and geologic erosion is active.

The potential vegetation on the Gerst soil is an overstory of pinyon and Utah juniper with a canopy of 15 percent. The understory is 40 percent grasses, 20 percent forbs, and 40 percent shrubs. Gerst soil has a site index of 15 to 25 for Utah juniper and pinyon. Productivity is low and average yields are 1 to 2 cords of wood per acre.

Potential vegetation on the Strych soil is an overstory of pinyon and Utah juniper with a canopy of 30 percent. The understory vegetation is 45 percent grasses, 10 percent forbs,

and 45 percent shrubs. Site index for pinyon and Utah juniper is 65. The average productivity is moderate. Average yields are 9 cords of wood per acre.

This mapping unit is in capability subclass VIIs, nonirrigated. The Gerst soil is Upland Shallow Clay Loam woodland site, and the Strych soil is in Upland Stony Loam woodland site. Badland is not placed in a range site.

Appendix VII-2

Description of Soil Pedons

Badland Type

Badland is steep or very steep, nearly barren areas of shale that are dissected by many intermittent drainage channels; some areas are interbedded with sandstone. Runoff is rapid to very high and geologic erosion is active. It is associated mainly with Mancos Shale Formation and is located in the Carbon County part of Castle Valley at the base of the Book Cliffs and Gentry Mountains.

Included in this unit is about 5 percent Chipeta and 5 percent Gerst, dry. Also included are small areas that are moderately steep.

This unit is used for wildlife habitat.

This map unit is in capability subclass VIIIs, nonirrigated. This unit is not placed in a range site.

Gerst Series

The Gerst series are shallow, well drained, moderately permeable soils on canyon sideslopes. These soils are developing in residuum and colluvium derived from shale and sandstone. Slopes are 50 to 70 percent grade. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 8 to 14 inches, and the mean annual air temperature ranges from 45 to 50 degrees F.

These soils are loamy, mixed (calcareous), mesic, shallow Ustic Torrorthents.

A1--0 to 8 inches; light brownish gray (10 YR 6/2) very stony loam, brown (10 YR 5/3) moist; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few fine and coarse roots; few fine pores; 10 percent cobbles and 17 percent stones; strongly calcareous, mildly alkaline (pH 7.8); clear smooth boundary.

C1--8 to 14 inches; light brownish gray (10 YR 6/2) cobbly sandy loam, grayish brown (10 YR 5/2) moist; weak, medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and coarse roots; few fine pores; 10 percent gravel and 15 percent cobbles; strongly calcareous, mildly alkaline (pH 7.9); clear smooth boundary.

C2--14 to 18 inches; light brownish gray to gray (10 YR 6/1) cobbly loam, gray (10 YR 5/1) moist; massive; hard, friable, slightly sticky and plastic; very fine and medium roots; 10 percent gravel, 15 percent cobbles and 8 percent stones; strongly calcareous; moderately alkaline (pH 8.1); clear smooth boundary.

C3r--16 inches; partly weathered shale.

Glenberg family

Glenberg family are very deep, well drained, moderately rapid permeable soils on the canyon floors and low terraces. These soils formed in alluvium derived from sandstone and shale. Slopes are 1 to 3 percent. Elevation is 6,000 to 6,500 feet. Average annual precipitation is 8 to 12 inches, and mean annual air temperature is 47 to 49 degrees F.

Soils are coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents.

A1--0 to 4 inches; pale brown (10 YR 6/3) fine sandy loam, dark brown (10 YR 3/3) moist; weak fine granular structure; slightly hard, very friable, slightly sticky; many fine and few medium roots; slightly calcareous; moderately alkaline (pH 7.9) abrupt smooth boundary.

C1--4 to 17 inches; pale brown (10 Yr 6/3) fine sandy loam, brown (10 YR 4/3) moist; weak very fine granular structure to single grain; soft, very friable; common fine and medium roots; moderately calcareous; moderately alkaline (pH 7.9); abrupt wavy boundary. It should be noted that the buried horizon 10 YR 4/4 moist appears to be weak in layer as one stratified layer at 9 inches.

C2--17 to 29 inches; brown (7.5 YR 5/2) loamy sand and fine sandy loam, brown (7.5 YR 4/2) moist; weak very fine granular structure to single grain; soft to loose; few fine and medium roots; few fine and medium pores; moderately calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C3--29 to 44 inches; pale brown (10 YR 6/3) fine sandy loam, brown (10 YR 5/3) moist; weak very fine granular structure to single grain; soft to loose; few fine and medium roots; few fine pres; moderately calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C4--44 to 60 inches; pale brown (10 YR 6/3) dark grayish brown (10 YR 4/2/0 moist; weak fine granular structure to single grain; soft to loose; slightly sticky and slightly plastic; few fine roots; few fine pores; moderately calcareous; strongly alkaline (pH 8.5).

Strych Series

The Strych series consists of very deep, well drained soils occurring on outwash plains, alluvial fans and toeslopes. These soils formed in alluvium, glacial outwash, and colluvium derived dominantly from sandstone and shale in the Horse Canyon area. Slope grades range from 5 to 15 percent. Average annual precipitation at the elevation of 6,000 to 6,500 is 10 to 14 inches, while the mean annual air temperature ranges from 45 to 47 degrees F.

These soils are loamy-skeletal, mixed mesic Ustollic Calciorthoids.

A1--0 to 5 inches; pale brown (10 YR 6/3) very stony loam, dark brown (10 YR 3/3) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine and coarse roots; few fine pores; 10 percent gravel and cobbles, and 15 percent stones; strongly calcareous; mildly alkaline (pH 7.3); gradual wavy boundary.

C1ca--5 to 18 inches; light gray (10 YR 7/2) very stony loam, grayish brown (10 YR 5/2) moist; weak very fine granular to loose; soft, very friable, slightly sticky and slightly plastic; many fine and coarse roots; few fine pores; 10 percent gravel, 10 percent cobbles, and 10 percent stones; strongly calcareous; moderately alkaline (pH 7.6); gradual wavy boundary.

C2ca--18 to 30 inches; very pale brown (10 YR 7/4) very stony sandy loam, pale brown (10 YR 6/3) moist; weak very fine granular structure to loose; soft, loose, slightly sticky, slightly plastic; few fine and medium roots; few fine pores; 10 percent gravel, 15 percent cobbles, and 15 percent stones; strongly calcareous; moderately alkaline (pH 8.0); gradual wavy boundary.

C3--30 to 60 inches; very pale brown (10 YR 7/3) to brown (10 YR 5/3) cobbly sandy clay loam, light yellowish brown (10 YR 6/4) to brown (10 YR 5/3) moist; moderate fine subangular blocky structure; slightly hard, firm, slightly sticky, plastic; few medium roots, few fine pores; 15 percent gravel, 10 percent cobble and 5 percent stones; strongly calcareous; moderately to strongly alkaline (pH 7.8 to 8.1).

Travessilla Series

Travessilla series are shallow, well drained, moderately to rapidly permeable soils on steep canyon sideslopes. These are soils developing in residuum and colluvium derived from sandstone and interbedded shale. Slopes are 50 to 70 percent. Elevation is 6,900 to 7,900 feet. Average annual precipitation is 10 to 14 inches, and the mean annual air temperature is 45 to 50 degrees F.

Soils are loamy, mixed (calcareous), mesic Latonic Ustic Torrorthents.

A1--0 to 2 inches; pale brown (10 YR 6/3) gravelly sandy loam, brown (10 YR 5/3) moist; weak very fine platy structure; soft, very friable; few fine and medium roots; few fine pores; slightly calcareous; mildly alkaline (pH 7.7); clear, smooth boundary.

C1--2 to 10 inches; brown (10 YR 5/3) gravelly sandy loam, dark brown (10 YR 4/3) weak fine subangular blocky structure; soft, very friable; few fine and medium roots; few fine pores; 15 percent gravel; mildly alkaline (pH 7.5) abrupt wavy boundary.

R--10 inches; sandstone.

Appendix VII-3

Schafer Guidelines for Rating the Suitability of Topsoil

Factors Affecting Suitability of Soil Material	Good	Fair†	Poor‡	Ref.§	Methods
Texture class	vfsl, fsl, sl, l, sil	lfs, ls, cl, scl, sicl	s, c, sc, sic	16, 17, 20	ASA. Agron. Mono. Methods of Soil Analysis II. 75–4. pp. 1062-1063.
Moist consistence	vfr, fr	lo, fi	vfi, exfi	16, 17, 20	Soil Survey Manual. p. 233.
EC (mmhos/cm)	<4	4–8	>8	16, 17, 20	USDA Hndbk. 60. pp. 88–89.
ESP	0–5	5–15	>15	3	Soil Survey Investigations. Rpt. 1. p. 21. Method 5D1.
pH	5.6–7.8	4.5–5.6; 7.8–8.4	<4.5, >8.4	3, 20, 24	Soil Survey Investigations. Rpt. 1. p. 59. Method 8cla. Use indicator dyes for field estimate
Stoniness class	0	1	2–5	16,17	Soil Survey Manual. pp. 217–219.
Available water	>10	5–10	<5	3, 20	Soil Survey Investigations. Rpt. 1. p. 14 Method 4C1
Rock fragments (%)	<15	15–35	>35	3, 20	Estimate
Saturation water (%)		25–80	<25: >80	24	USDA Hndbk. 60. p. 84 Method 2, 3a.

†Mitigation of adverse properties will increase reclamation potential.
‡Materials rated as poor may be suitable as topsoil only if adverse factor can be treated.
§Numbers relate to references at the end of this report.

Source: Schafer (1979).

Appendix VII-4

Physical and Chemical Data for Permit Area

KAISER COAL COMPANY
P.O. BOX 2679
102 S. TEJON
COLORADO SPRINGS, CO 80903

ATTN: MS. SUSAN HASENJAGER

BOOKCLIFFS COMMERCIAL LABORATORIES
OVERBURDEN ANALYSIS

Report Date: NOVEMBER 21, 1985
Date Received SEPTEMBER 12, 1985

LAB. NO.	SAMPLE I.D.	SAMPLE FOOTAGE	SAMPLE DATE	SATURATED PASTE EXTRACTION SATURATION %	pH (Units)	E.C. mmhos/cm @	CALCIUM meq/l	MAGNESIUM meq/l	SODIUM meq/l	SAR
85-0126-0B	GL9 A1	0" - 4"	UNKNOWN	31	7.9	0.65	4.34	1.64	1.14	0.66
85-0127-0B	GL9 C1	4" - 17"	UNKNOWN	29	7.9	1.73	8.56	3.99	5.24	2.09
85-0128-0B	GL9 C2	17" - 29"	UNKNOWN	27	8.2	3.08	5.71	6.37	24.0	9.77
85-0129-0B	GL9 C3	29" - 44"	UNKNOWN	31	8.2	1.93	4.62	6.64	13.3	5.61
85-0130-0B	GL9 C4	44" - 60"	UNKNOWN	27	8.5	1.02	2.30	1.63	8.11	5.79
85-0131-0B	GE10 A1	0" - 8"	UNKNOWN	34	7.8	0.66	5.67	1.93	0.56	0.29
85-0132-0B	GE10 C1	8" - 14"	UNKNOWN	31	7.9	0.63	4.90	2.31	0.59	0.31
85-0133-0B	GE10 C2	14" - 18"	UNKNOWN	31	8.1	0.71	4.33	3.12	1.22	0.63
85-0134-0B	ST11 A1	0" - 5"	UNKNOWN	36	7.3	0.58	4.92	1.55	0.79	0.44
85-0135-0B	ST11 C1	5" - 18"	UNKNOWN	36	7.6	0.40	3.44	1.59	0.87	0.55
85-0136-0B	ST11 C2	18" - 30"	UNKNOWN	30	8.0	0.40	2.44	2.36	0.67	0.43
85-0137-0B	ST11 C3	30" - 42"	UNKNOWN	28	8.1	0.44	1.39	2.98	0.91	0.62
85-0138-0B	ST11 C4	42" - 54"	UNKNOWN	33	8.1	0.46	1.68	2.97	1.04	0.68
85-0139-0B	ST11 C5	54" - 60"	UNKNOWN	32	7.8	1.35	12.1	5.68	1.12	0.38

Ralph V. Poulsen

Ralph V. Poulsen, Director

BOOKCLIFFS COMMERCIAL LABORATORIES
OVERBURDEN ANALYSIS

Report Date: NOVEMBER 21, 1985
Date Received SEPTEMBER 12, 1985

KAISER COAL COMPANY
P.O. BOX 2679
102 S. TEJON
COLORADO SPRINGS, CO 80903

ATTN: MS. SUSAN HASENJAGER

LAB. NO.	SAMPLE I.D.	SAMPLE FOOTAGE	BORON (Hot Wate Extract) ppm	SELENIUM (Hot Water Extract) ppm	ORGANIC MATTER %	SAND %	SILT %	CLAY %	TEXTURE	NEUTRALIZATION POTENTIAL AS CACO3 %	CEC (meq/100 gm)
85-0126-0B	GL9 A1	0" - 4"	0.7	-0.01	2.9	72	20	8	SL	8.8	7.35
85-0127-0B	GL9 C1	4" - 17"	1.0	-0.01	1.0	69	21	10	SL	9.6	9.15
85-0128-0B	GL9 C2	17" - 29"	0.7	-0.01	0.4	78	14	8	LS SL	10.1	9.35
85-0129-0B	GL9 C3	29" - 44"	0.6	-0.01		69	20	11	SL	11.0	8.38
85-0130-0B	GL9 C4	44" - 60"	0.6	-0.01		71	19	10	SL	11.2	7.28
85-0131-0B	GE10 A1	0" - 8"	1.0	0.01	1.4	48	33	19	L	12.0	8.68
85-0132-0B	GE10 C1	8" - 14"	0.6	0.01	0.6	56	30	14	SL	13.6	5.45
85-0133-0B	GE10 C2	14" - 18"	0.4	-0.01	0.4	46	43	11	L	17.4	5.03
85-0134-0B	ST11 A1	0" - 5"	0.5	-0.01	1.1	51	28	21	SCL L	11.3	7.68
85-0135-0B	ST11 C1	5" - 18"	0.3	-0.01	1.2	49	31	20	L	12.6	6.98
85-0136-0B	ST11 C2	18" - 30"	0.2	-0.01	0.5	64	20	16	SL	10.2	4.30
85-0137-0B	ST11 C3	30" - 42"	0.3	-0.01		84	6	10	LS	6.0	2.63
85-0138-0B	ST11 C4	42" - 54"	0.8	-0.01		56	25	19	SL	7.1	5.55
85-0139-0B	ST11 C5	54" - 60"	0.8	0.01		59	25	16	SL	1.1	7.83

Ralph V. Poulsen

Ralph V. Poulsen, Director

Appendix VII-5

Physical and Chemical Data for Interim Reclamation in 1986

ACZ INC./LABORATORY DIVISION
SOILS ANALYSES REPORT

Client: Kaiser Coal Company
Sunnyside Mine
Sunnyside, Utah 84539
Attn: Mr. Doug Pearce
CC: Ms. Susan Hasenjager

Report Date: October 10, 1986
Date Received: September 15, 1986

LAB NO.	SAMPLE I.D.	SAMPLE DATE	Saturation %	pH 1 (units)	Conductivity 1 (mmhos/cm @ 25 C)	Calcium 1 meq/l	Magnesium 1 meq/l	Sodium 1 meq/l	SAR	Nitrogen, 2 Nitrate mg/kg	Phosphorus 3 mg/kg	Potassium 3 mg/kg	Neutralization Potential as CaCO3 %	Organic Matter %
86-1245-Soil	Horse Canyon #1	Unknown	35	7.7	2.80	27.6	10.9	7.03	1.60	-0.1	0.5	25	12.3	1.2
86-1246-Soil	Horse Canyon #2	Unknown	31	7.6	1.86	19.2	7.87	2.59	0.70	6.7	1.0	20	11.7	1.0
86-1247-Soil	Horse Canyon #3	Unknown	31	7.7	2.74	28.2	10.9	4.70	1.06	3.2	1.5	25	11.8	0.7
86-1248-Soil	Horse Canyon #4	Unknown	32	7.7	2.89	37.7	6.99	2.52	1.09	1.7	0.6	35	12.6	0.7

LAB NO.	SAMPLE I.D.	SAMPLE DATE	Sand %	Silt %	Clay %	Texture
86-1245-Soil	Horse Canyon #1	Unknown	57	28	15	SL
86-1246-Soil	Horse Canyon #2	Unknown	66	21	13	SL
86-1247-Soil	Horse Canyon #3	Unknown	54	32	14	SL
86-1248-Soil	Horse Canyon #4	Unknown	51	29	20	L

1 Saturated Paste Extraction 2 Hot Water Extraction 3 AB-DTPA Extraction

Ralph V. Poulsen

Ralph V. Poulsen, Director

Appendix VII-6

SCS Letter Regarding Prime Farmland

United States Department of Agriculture

Soil Conservation Service

P. O. Box 11350
Salt Lake City, UT 84147

May 24, 1983

Glenn H. Sides
Chief Engineer
U. S. Steel
Mining Co., Inc.
P. O. Box 807
East Carbon, UT 84520

Dear Mr. Sides:

Keith Beardall, District Conservationist, had a review made of the site indicated below which is located at the Geneva Mine site in Horse Canyon about 10 miles east of East Carbon City.

Lot 3, 6, 11, 12 NW 1/4 SW 1/4 Section 3 T. 16 S., R. 14 E.
S 1/2 SW 1/4, SE 1/4. Lot 9 Section 4 T. 16 S., R. 14 E.
NE 1/4 NE 1/4 Section 9 T. 16 S., R 14 E.
N 1/2 NW 1/4 Section 9 T. 16 S., R. 14 E.
NW 1/4 NE 1/4 Section 15 T. 16 S., R. 14 E.
SW 1/4 SE 1/4 Section 10 T 16 S., R. 14 E.

On the basis of his report, the soils in this area do not meet the requirements for prime farmland because no irrigation water is available and the area is too steep.

If we can be of further assistance, please let us know.

Sincerely,

FRANCIS T. HOLT
State Conservationist

cc: Keith Beardall, DC, SCS, Price, UT