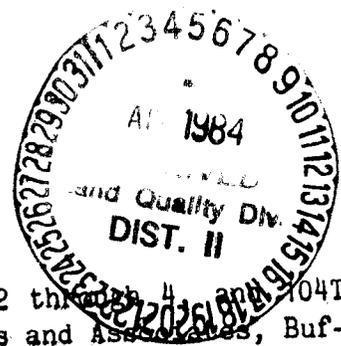


D-7. SOILS

INTRODUCTION



Soil assessments for Pits 73T phase 2, 98T phases 2 through 4, and 104T phases 1 and 5 through 7 were done by Don Bailey, Sanders and Associates, Buffalo, Wyoming. Although the soil assessment covered a large area, only those areas and soil map units affected by these pits are included with proposed Amendment 6. After mine plans were developed by WYO-BEN, soils were planimetered for acreage and volumetric calculations.

The soil assessment for Pit 75T phase 2 in the Red Hole area was done by Brian Pruiett, soil scientist for WYO-BEN, INC. It was completed in June, 1982.

The soil assessments for Pit 102T phases 1 through 3, and Pit 108T phases 1 through 17, were done by Jean MacCubbin of James P. Walsh and Associates, Boulder, Colorado. They were completed in January, 1982.

These assessments are presented in this order: first - Bailey's work; second - Pruiett's work; third - MacCubbin's work. Final acreage and volume calculations were conducted independently by WYO-BEN to reflect final mine plans. It is necessary to recognize that soil volume determinations are based on calculations and estimates from soil sampling and mapping programs. Actual salvage volumes may vary from original estimates because of spillage during salvage, swelling during removal, and compaction during stockpiling. No attempt has been made to manipulate volume estimates to reflect these factors.

The narrative descriptions submitted in the Sanders and Associates original report have been edited to an acceptable format. Some soil map unit description names were changed to match the lab data to the pedon descriptions. Consequently, some horizon designations were changed to match lab data. Other than these particular changes, the original field assessments have not been significantly altered. Bailey's Methods section has been preserved in its entirety. Further methods are listed in a methodology section added by WYO-BEN.

For this amendment application, a tabular format developed in conjunction with Walsh and Associates is used to present soil assessment data. When several soil types are encountered on a site, the tabular format presents information in a more clear and concise manner than the lengthy and somewhat verbose standard SCS system. The tables in DEQ-LQD Guideline No. 1 are incorporated into the format. The tabular format has cut down substantially on the time required for document preparation, yet presents more technical data than the SCS descriptions have done historically.

In Walsh's tabular format system, tables show the following information:

Table D-7.1	Detailed Soil Series Characteristics
Table D-7.2	Soil Map Unit Characteristics
Table D-7.3	Evaluation Of Topsoil Suitability By Typical Soil Pedon
Table D-7.4	Depth Of Suitable Topsoil Material By Map Unit
Table D-7.5	Soil Stripping and Redistribution Rates

A table showing the DEQ-LQD criteria for topsoil suitability is included in Appendix D-7.E, page 151. This criteria was used to make the suitability ratings shown on Table D-7.3 for each soil.

RED HOLE AREA SOILS

Pits 73T, 98T and 104T

Sanders and Associates: Don Bailey

Site Description

The soils to be disturbed consist primarily of residual soils immediately above and below the Peay sandstone and extending onto the more level benches at the southern end of the Torchlight sandstone escarpment (see Figure 7.1, Soils Catena). Pit 104T, phases 1 and 5 through 7, are in the Frontier formation. Pits 98T, phases 2 through 4, and 73T, phase 2, are in the Mowry shale formation.

Soils Description

Beginning at the crest of the Mowry escarpment and progressing down dip, the ridge-top soils are moderate to deep with well developed structure in the B horizon and with or without clay skins. The residual soils of the side slopes are brown, shallow and loamy over the Peay sandstone or gray, clayey and deep elsewhere. Colluvial and/or alluvial soils are generally found below the Peay sandstone and at the toe of the steeper Mowry soils. B horizons have not formed in these soils. Of these, RH9, at the toe of the Peay sandstone, is a very pale brown loam with some halophytic vegetation.

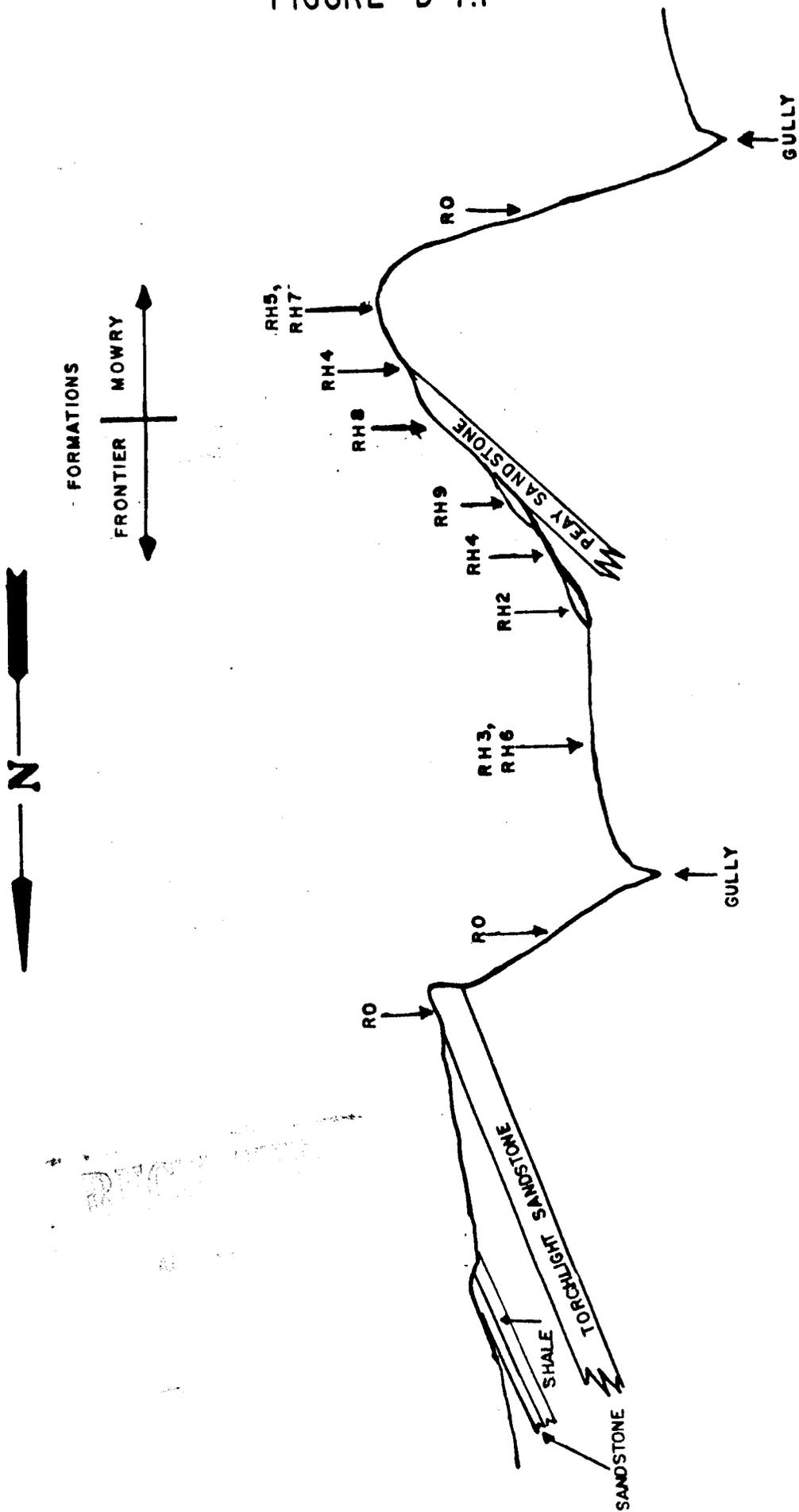
The main level bench between the backslope of the Mowry monocline and the toe of the Torchlight sandstone is comprised primarily of very similar brown deep loams. Of these, RH6 has no clay skins in the B horizons and gets lighter in the B horizon. These soils are found on similar landforms and support the same vegetation.

Methods (Don Bailey)

A reconnaissance of the area was made to discover all possible soil types in the area found on the Frontier and Mowry formations. In performing this reconnaissance, special note was made of parent material, slope, color of the A horizon, presence or absence of a B horizon, structure of the B horizon, clay skins in the B horizon, color of the B horizon and vegetation. When this reconnaissance was finished, pits were dug for description of the soil profiles. Following profile description, mapping was begun at a specific pit. Soils were sampled and observed radiating out from the pit until significant changes were found. Generally, the changes made could be correlated to a soil described from a nearby pit. If not, a new pit was excavated and a new soil type was described.

This method of mapping soils was inductive. Soils were not correlated with existing taxa or classification systems in use in the area. Soil mapping units and the descriptions representing those mapping units were derived from scratch on site. This method of mapping soils was arbitrary - no attempt was made to identify basic series and phases of these series.

FIGURE D-7.1



SOILS CATENA: RELATIONSHIP OF SOME SOILS IN THE PROPOSED AMENDMENT 6 AREA TO LANDFORMS AND UNDERLYING STRATA (SCHEMATIC DIAGRAM—NOT TO SCALE).

The details of the soil mapping units, profile descriptions and maps used were sufficient to delineate soil units in areas smaller than one acre with less than 10% inclusion of unmapped soils. In several areas this detail of mapping was not possible. Such areas were those in which changes occurred repeatedly over very short distances (e.g., RH5 and RH7) or where two soil types were found in a homogeneous area with the only difference being subtile (sic) characteristics of the B horizon (e.g., RH3 and RH6). These areas were mapped as complexes.

As mapping progressed, composite samples were made for laboratory analyses according to DEQ-LQD guidelines and notes were made concerning variable properties of mapping units.

Methodology (WYO-BEN, INC.)

Bailey's original soil mapping boundaries were checked for veracity using rectified aerial photos and planimetered to obtain estimated acreages. Volumetric figures were then calculated. The rectified photos are at a scale of 1:4800 (one inch equals 400 feet).

A small amount of error is endemic with any planimetry method, but the volumetric figures given on the D-7.5 tables represent best estimates of pre-mine quantities.

The table in Appendix D-7.E detailing criteria for Evaluation of Topsoil Suitability, is based upon DEQ-LQD, WY Guideline No.1 (January, 1981) and was used as a guideline for determining the salvage depths of topsoil and subsoil. However, where abundant roots were present in subsoil, the material generally declared as being salvageable was salvaged despite being designated as poor-unsuitable by Guideline No. 1. This material will be used as subsoil only and will be covered with topsoil during final reclamation.

Because Sanders and Associates wrote the Red Hole area soil assessment prior to the development of the tabular system, their SCS format is preserved in this document. Corresponding to the Walsh format, Table D-7.1 is incorporated within Bailey's SCS format writeup. WYO-BEN has added a set of tables (D-7.2 through D-7.5) to the Red Hole soil section following development of a mine plan for each pit proposed in this application. Tables D-7.2 - D-7.5 are presented on a pit by pit basis. Laboratory results are listed for each soil in Appendix D-7.A.

SOIL RH2

Soil RH2 is a gently sloping well-drained soil forming on alluvial and mixed colluvial parent material. The dominant vegetation on the soil is big sagebrush and bluebunch wheatgrass accompanied by Astragalus grayi.

In a representative profile the surface layer is brown, mildly alkaline to neutral clay about 7 inches thick. The underlying layer is brown, mildly alkaline clay loam, silt loam and clay that reaches to a depth of 60 inches or more.

Permeability is moderate to slow, and the available water capacity is high. The effective rooting depth is 40 to 60 inches.

This soil is used for grazing and wildlife habitat.

Representative profile in native range, NW1/4 SW1/4 Section 16, T43N, R93W:

A1 - 0 to 7 inches, brown (10YR 5/3) clay, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; soft, friable; slightly sticky and slightly plastic, many roots; weak effervescence; mildly alkaline; gradual smooth to gradual wavy boundary.

C - 7 to 60 inches, brown (10YR 5/3) clay loam, mottled with white, grayish brown (10YR 5/2) moist; weakly cemented, porous massive structure; common, medium distinct, white thread-like mottles; some black shale in 2 mm size range; slightly hard, friable, slightly sticky and slightly plastic; roots common to 40 inches; violent effervescence, mildly to moderately alkaline.

The thickness of the A1 horizon varies from 6 to 8 inches. The dry color ranges from 10YR 4/3 to 10YR 5/3. Moist color of this horizon is consistently dark grayish brown (10YR 4/2). The texture ranges from clay loam to clay. The transition from the A1 to C horizons is gradual and smooth to wavy.

The C horizon is clay loam to silty clay loam above changing to silt loam at 43 to 44 inches from the surface. Color of the C horizon is a reasonably uniform brown (10YR 5/3 to 10YR 4/3) dry and grayish brown (10YR 5/2) to dark grayish brown (10YR 4/2) moist. The C horizon is mottled with white mildly alkaline material. The mottles are faint, few and fine above to prominent, common and coarse below. Thread-like mottles are always found. In some pits spherical mottles are found ranging from 2 cm to 3 cm in diameter. The C horizon had discontinuous streaks of various parent materials. The streaks are not laminar implying mass movement.

SOIL RH3

Soil RH3 is a gently sloping, well-drained soil forming on Frontier residuum parent material. The dominant vegetation on the soil is big sagebrush and bluebunch wheatgrass.

In a representative profile the surface is brown neutral loam about 7 inches thick. The subsoil is dark brown to dark yellowish brown, mildly to moderately alkaline loam to clay loam about 27 inches thick. The substratum

is dark yellowish brown, moderately alkaline silty loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 40 to 60 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, SW1/4 NE1/4 Section 17, T43N, R93W:

A - 0 to 7 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak, coarse, subangular blocky structure; soft, very friable, sticky to slightly sticky, and slightly plastic; no effervescence, neutral; clear smooth boundary.

B1 - 7 to 21 inches, dark brown (10YR 3/3) loam, dark brown (10YR 3/3) moist; strong, coarse, subangular blocky structure; weak cementation; thin patchy clay skins; slightly hard, friable, sticky, and slightly plastic; no effervescence, mildly alkaline; gradual smooth boundary.

B2t - 21 to 48 inches, dark yellowish brown (10YR 4/4) clay loam, brown (10YR 4/3) moist; massive structure blending to weak, very coarse, subangular blocky, weak cementation; no clay skins, slightly hard, friable, slightly sticky, and plastic; common, fine, distinct white mottles appearing as diffuse speckles; moderate effervescence; moderately alkaline; gradual smooth boundary.

BC - (No description of this horizon by Bailey, but lab data shows it from 34 - 48").

C - 48 to 60 inches, yellowish brown (10YR 5/4) silt loam, dark yellowish brown (10YR 4/4) moist; massive structure; very weak cementation; soft, very friable, slightly sticky, and slightly plastic; few, fine, distinct white mottles appearing as diffuse speckles; violent effervescence, moderately alkaline.

This soil is found on the benches formed on the backslope of Mowry formation uplifts. It is generally located between the Peay sandstone and the "Frontier escarpment" which is capped by the Torchlight sandstone. In the areas to be mined the dense big sagebrush and bluebunch wheatgrass are accompanied by Koeleria macrantha, Poa spp. and Arenaria hookeri.

SOIL RH4

Soil RH4 is a sloping clay soil forming on Mowry residuum parent material. The dominant vegetation on the soil is vigorous big sagebrush and bluebunch wheatgrass.

In a representative profile the surface layer is gray neutral clay about 7 inches thick. The subsoil is dark grayish brown mildly alkaline clay about 30 inches thick. The substratum is brown mildly alkaline silty clay to clay loam that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 24 to 37 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 SE1/4 Section 17, T43N,
R93W:

- A1 - 0 to 7 inches, gray (10YR 5/1) clay, very dark grayish brown (10YR 3/2) moist; weak to moderate, coarse, subangular blocky structure parting to moderate, fine crumbs; slightly hard, very friable, slightly sticky, and plastic; no effervescence, neutral; clear smooth boundary.
- B1 - 7 to 24 inches, dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; strong, very coarse, subangular blocky structure parting readily to strong, coarse prisms; weak cementation; thick continuous clay skins; hard, very firm, slightly sticky, and very plastic; few fine distinct white mottles appearing as spheres; no effervescence; mildly alkaline; gradual smooth boundary.
- B2 - 24 to 37 inches, dark grayish brown (10YR 4/2) clay, dark grayish brown (10YR 4/2) moist; moderate, coarse, subangular and angular blocky structure; weak cementation; thin to medium thick patchy (80% coverage) clay skins, hard, friable, sticky, and plastic; moderate effervescence, mildly alkaline; clear smooth boundary.
- C1ca - 37 to 43 inches, brown (10YR 4/3) silty clay, dark grayish brown (10YR 4/2) moist; massive structure; weak cementation; slightly hard, friable, sticky, and plastic; strong effervescence, moderately alkaline; abrupt smooth boundary.
- C2ca - 43 to 60 inches, brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; massive structure; weak cementation; slightly hard, very friable, slightly sticky, and slightly plastic; many, medium to coarse, prominent white mottles appearing as spheres and threads; strong effervescence; mildly alkaline.

This soil is particularly distinctive because of the mottling in the B1 and C2ca horizons and absence of mottles in the B2 and C1 horizons. Mottles in the C2ca horizon are threads which average 20 mm long by 2 mm wide and circular mottles which average 5 mm in diameter. About 30% of the surface of this horizon is covered by mottles.

The predominant vegetation species, bluebunch wheatgrass and big sagebrush, are accompanied by Poa spp., Vicia americana and Koeleria macrantha.

The soil surface is dark and cracked when dry. Small buff sandstone channery fragments are strewn about on the surface.

This soil was described when the backhoe pit was somewhat wet, making structure of the peds difficult to determine. This may have led to small errors in structure description.

SOIL RH5

Soil RH5 is a nearly level clay soil forming on Mowry formation residual parent material. The dominant vegetation on the soil is sparse and short big sagebrush and sparse bluebunch wheatgrass.

In a representative profile the surface layer is light brownish gray, mildly alkaline clay loam about 7 inches thick. The subsoil is light brownish gray above to dark grayish brown below, moderately to mildly alkaline clay about 34 inches thick. The substratum is dark grayish brown, mildly alkaline clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 7 to 21 inches deep.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 SE1/4 Section 17, T43N, R93W:

A2 - 0 to 7 inches, light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, subangular blocky structure parting to strong, fine, granules; slightly hard, very friable, slightly sticky, and plastic; few angular sandstone and shale fragments in the 1-2 mm size range; mild effervescence, mildly alkaline, gradual smooth boundary.

B1ca - 7 to 22 inches, light brownish gray (10YR 6/2) clay, grayish brown (10YR 5/2) moist; weak to moderate, coarse, subangular blocky structure; few angular sandstone and shale fragments (10 mm x 10 mm x 1-2 mm) covered with calcium carbonate; weak cementation; slightly hard, friable, very sticky, and very plastic; few, fine, distinct white mottles appearing as diffuse spots; moderate effervescence, moderately alkaline; clear wavy boundary.

BCsa - 22 to 41 inches, dark grayish brown (10YR 4/2) clay, brown (10YR 5/3) moist; weak to moderate, coarse to very coarse, subangular blocky structure; few angular sandstone and shale fragments (10 mm x 10 mm x 1-2 mm) weak cementation; slightly hard, friable, very sticky, and very plastic; many, coarse, distinct white mottles appearing as threads and ragged spots; weak effervescence, mildly alkaline; gradual smooth boundary.

C - 41 to 60 inches, dark grayish brown (10YR 4/2) clay, dark grayish brown (10YR 4/2) moist; massive structure; strong cementation; hard, friable, sticky, and plastic; many, medium to coarse, distinct white mottles appearing as threads and ragged spots; weak effervescence, mildly alkaline.

Vegetation cover on this soil is sparse compared to other soils supporting bluebunch wheatgrass and big sagebrush. Subdominant species are Atriplex gordonii, Vicia americana, Phlox hoodii, Poa sp., and Aster sp. The surface of the soil tends to crack readily when dry, into small plates. About 10% of the surface is covered with angular buff-colored sandstone fragments in the 2 to 5 mm size range.

Peds in the B1 horizon are very tight giving the impression that this horizon is massive. The B1 horizon is prone to produce very large cracks. The C horizon material tends not to break readily, but is "carvable". This horizon lacks channery, but has some rock-like crystals of selinite.

Thickness of the A horizon is between 5 to 9 inches. The lower boundary of the B1 horizon fluctuates between 18 and 27 inches from the surface. The lower boundary of the BCsa horizon varies from 38 to 43 inches in depth.

SOIL RH6

Soil RH6 is a gently sloping well-drained, silt loam forming on Frontier formation residual parent material. The dominant vegetation on the soil is big sagebrush and bluebunch wheatgrass.

In a representative profile the surface layer is brown, mildly alkaline loam about 5 inches thick. The subsoil is pale brown, moderately to mildly alkaline silt loam about 27 inches thick. The substratum is light yellowish brown, moderately alkaline silt loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 32 to 50 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, SW1/4 NE1/4 Section 17, T43N, R93W:

- A1ca - 0 to 5 inches, brown (10YR 5/3) loam, grayish brown (10YR 5/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine crumbs; soft, very friable, slightly sticky, and slightly plastic; moderate effervescence, mildly alkaline; clear smooth boundary.
- B2tca - 5 to 18 inches, pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; moderate, coarse, subangular blocky structure; trace of platy black shale fragments in the 3 mm size range; moderate cementation; slightly hard, very friable, slightly sticky, and slightly plastic; few, fine, distinct white mottles appearing as spots; strong effervescence, mildly alkaline; gradual smooth boundary.
- B3ca - 18 to 32 inches, pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak, very coarse, subangular blocky structure; trace of platy shale fragments in the 3 mm size range; weak cementation; soft, very friable, slightly sticky, and slightly plastic; few, fine to medium, distinct white mottles appearing as spots; strong effervescence, moderately alkaline; gradual smooth boundary.
- C1ca + C2ca - 32 to 70 inches, light yellowish brown (10YR 6/4) silt loam, grayish brown (10YR 5/3) moist; massive structure parting to single grain; weak cementation; soft, very friable, slightly sticky, and slightly plastic; common, medium, distinct white mottles appearing as spots; strong effervescence, moderately alkaline.

In addition to the dominant species, bluebunch wheatgrass and big sagebrush, subdominant species are Carex sp., Phlox hoodii and Koeleria cristata. Astragalus grayi is found in abundance. Sporobolus airoides is found in rills.

Thickness of the A horizon ranges from 5 to 7 inches. Moist color ranges from brown (10YR 5/3) to very dark grayish brown (10YR 3/2); and the lower boundary ranges from clear and smooth to abrupt and wavy.

The B2tca horizon varies in thickness from 5 to 13 inches, from subangular blocky structure to angular blocky structure, from friable to slightly hard, from pale brown (10YR 6/3) to very brown (10YR 3/3) for dry color and from brown (10 YR 5/3) to dark brown (10YR 3/3) moist.

The B3 horizon varies in thickness from 10 to 14 inches. The structure ranges from subangular blocky to prismatic, the dry consistence from slightly hard to friable, the dry color from pale brown (10YR 6/3) to very pale brown (10YR 7/3).

The C1ca horizon ranges in consistence from soft to slightly hard and from very friable to friable. The color of the C1ca horizon ranges from very pale brown (10YR 7/3) to light yellowish brown (10YR 6/4) dry and from dark brown (10YR 3/3) to brown (10YR 5/3) moist.

The C2 horizon begins at a depth of 40 to 50 inches and extends to 70 inches or more. Moist consistence ranges from friable to very friable. Colors range from light yellowish brown (10YR 6/4) to very pale brown (10YR 7/4) dry and from brown (10YR 5/3) to brown (10YR 4/3) moist.

SOIL RH7

Soil RH7 is a level to sloping well-drained saline-sodic clay loam soil forming on Mowry formation residual parent material. The dominant vegetation on the soil is big sagebrush and bluebunch wheatgrass.

In a representative profile the surface layer is pale brown, mildly alkaline clay loam about 4 inches thick. The subsoil is pale brown, saline-sodic clay about 8 inches thick. The substratum is yellowish brown, strongly sodic silt loam that is about 28 inches thick. This is underlain by weathered, saline-sodic sandstone high in boron at the 40 inch depth.

Permeability is very slow, and the available water capacity is high. The effective rooting depth is 4 to 12 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 Section 18, T43N, R93W:

A1ca - 0 to 4 inches, pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak, coarse, subangular blocky structure; slightly hard, friable, slightly soft, and very plastic; medium effervescence, mildly alkaline; sharp smooth boundary.

B2tcasa - 4 to 12 inches, pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; moderate, very coarse, prismatic structure parting to coarse, subangular blocky; slightly hard, extremely firm, and non-

wetable; strong effervescence, moderately alkaline; sharp smoothboundary.

Ccasa - 12 to 40 inches, yellowish brown (10YR 5/4) silt loam, grayish brown (10YR 5/2) moist; massive structure parting readily to single grain; friable, very friable, very sticky, and plastic; many, medium, distinct white mottles appearing as threads; strong effervescence, moderately alkaline; gradual smooth boundary.

R - 40 inches, interbedded sandstone and shale.

The shallow rooting depth, due to high clay content, high salt content and high SAR causes the big sagebrush and bluebunch wheatgrass to be sparse and short. These soil factors are also most likely responsible for the presence of Atriplex gordonii and A. confertifolia on this soil.

Other common species on this soil are Chrysothamnus nauseosus, Opuntia polyacantha, Poa juncifolia, Allium textile, Grindellia squarrosa, Gutierrezia sarothrae and Plantago patigonica.

This soil has wide variability in thickness of the C horizon.

At the time of examination the C and R horizons were at field capacity. There was some mottling in the R. These were oxidized mottles (orange and white); and the effervescence in the R was strong.

SOIL RH8

Soil RH8 is a steep, well-drained soil forming on residual Peay sandstone parent material. The dominant vegetation on the soil is sparse big sagebrush and bluebunch wheatgrass.

In a representative profile the surface layer is brown, mildly alkaline clay loam about 6 inches thick. The underlying layer is light yellowish brown, mildly alkaline loam about 15 inches thick. This is underlain by poorly consolidated sandstone, bedrock at a depth of about 21 inches.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 19 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 Section 18, T43N, R93W:

Aca - 0 to 6 inches, brown (10YR 4/3) clay loam, brown (10YR 4/3) moist; weak, medium, subangular blocky structure parting to single grains; soft, very friable, slightly sticky, and very plastic; weak effervescence, mildly alkaline; abrupt smooth boundary.

Cca - 6 to 21 inches, light yellowish brown (10YR 6/4) loam, light gray (2.5Y 7/2) moist; massive structure to single grain; soft, very friable, slightly sticky, and slightly plastic; many, medium, distinct white mottles appearing as very diffuse spots and threads; strong effervescence, mildly alkaline.

CR - 21 inches, poorly consolidated pale brown (10YR 7/3) sandstone.

This soil has fragments of the Peay sandstone on the surface. These are about 12 inches by 8 inches by 1 to 2 inches thick. The R material has salt accumulations running parallel to the bedding plane.

SOIL RH9

Soil RH9 is a sloping well-drained saline-sodic silty clay loam formed on mixed alluvial and colluvial parent material. The dominant vegetation on the soil is big sagebrush and bluebunch wheatgrass.

In a representative profile the surface layer is very pale brown, mildly alkaline clay loam about 6 inches thick. The underlying layer is light yellowish brown, strongly sodic silty clay loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is to 60 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 Section 18, T43N, R93W:

A1 - 0 to 6 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) moist; weak, very coarse, crumb structure parting to single grains; soft, very friable, slightly sticky, and slightly plastic; moderate effervescence, mildly alkaline; gradual smooth boundary.

C - 6 to 60 inches, light yellowish brown (10YR 6/4) silty clay loam, brown (10YR 5/3) moist; massive structure parting to single grain; weak cementation; small fragments of black shale present; slightly hard, very friable, sticky, and very plastic to plastic; few, medium, distinct white mottles appearing as threads and diffuse spots; moderate effervescence, moderately alkaline.

This alluvial/colluvial soil receives water, sediment and salt from the Peay sandstone and Mowry formations above it. This accounts for its high conductivity and SAR values. This also accounts for the subdominant vegetation: Sporobolus airoides, Agropyron smithii, Atriplex confertifolia and Sarcobatus vermiculatus. Astragalus grayi is also found on this soil.

The C horizon is sometimes different from that described above in the lower part (below 21 inches). The dry consistence is soft. It is only slightly plastic. It is brown (10YR 4/3) dry and dark grayish brown (10YR 4/2) moist. The mottles in the lower part of the C horizon are fewer.

SOIL RH10

Soil RH10 is a sloping to moderately steep well-drained soil forming on mixed colluvial and slope wash parent material which has buried underlying Frontier shale. The dominant vegetation on the soil is bluebunch wheatgrass and big sagebrush.

In a representative profile the surface is brown, mildly to moderately alkaline loam over clay loam about 16 inches thick. The subsoil grades in color from very dark grayish brown above to black below, and is moderately

alkaline clay loam about 11 inches thick. The substratum is black, moderately alkaline clay about 13 inches thick, underlain by hard, gray shale at a depth of about 40 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 18 to 25 inches.

This soil is used for range and wildlife habitat.

Representative profile in native range, NE1/4 SE1/4 Section 17, T43N, R 93W:

A1 - 0 to 9 inches, brown (10YR 5/3) loam, brown (10YR 4/3) moist; weak, coarse, subangular blocky structure single grain; soft, very friable, slightly sticky, and slightly plastic; no effervescence, mildly alkaline; clear smooth boundary.

C1 - 9 to 16 inches, yellow brown (10YR 5/4) clay loam, brown (10YR 5/3) moist; moderate, coarse, subangular blocky structure; weak cementation; soft, very friable, sticky, and slightly plastic; strong effervescence, mildly alkaline; clear smooth boundary.

C2ca - 16 to 27 inches, very dark grayish brown (10YR 3/2) grading to black (5Y 2/5) below, clay loam, dark brown (10YR 4/3) above grading to black (5Y 2/5) below when moist; strong, coarse, prismatic structure; weak cementation; thick continuous clay skins, hard dry consistence, peds not wettable enough for determination of moist consistence, stickiness and plasticity; few, fine, faint white mottles appearing as spots; moderate effervescence, moderately sodic; clear smooth boundary.

C3ca - 27 to 40 inches, black (5Y 2/5) clay, gray (5Y 5/1) moist; massive structure; weak cementation; thick continuous clay skins, soft friable, sticky, and plastic; many, medium, predominant white mottles appearing as spherical holes in soil filled with powdery salt; no effervescence, moderately alkaline; clear smooth boundary.

IIR - 40 inches, gray shale.

The discontinuity between the A horizon and underlying material has apparently resulted from deposition of lighter colored material by slope wash and/or colluvial processes from above. The C2ca horizon is particularly striking because of its structure; and because of the fact that while the structure and boundaries are discrete, the color changes very gradually from very dark grayish brown above to black below. This has obviously resulted from the process of discontinuity noted above.

Cracks in the C3ca (30-90 cm x 10 mm) have been filled with brown and yellow brown soil material from the A horizon.

TABLE D-7.2-1

PIT 73T Phase 2

SOIL MAP CHARACTERISTICS

Map Unit Symbol	Name	Textural Phase of Soil series	Percent of Map Unit	Erosion Factors		Capability Subclass	Range Site	Land Use*
				K	WEG			
RH7	----	CL	80	.22	6	VIIc	SwLy	g,wh
RH8 (RH8S)	----	CL	85	.26	6	VIwc	SwLy	g,wh
RH9	----	SiCL	80	.42	6	Vec	Ly	g,wh

* g = grazing, wh = wildlife habitat

TABLE D-7.3-1

PIT 73T Phase 2

EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse Fragments	Consis- tency	Boron	Overall Rating	Restric- tive Features
RH7 (RH7)	A1	0-4	g	g	g	g	f	----	g-f	f	f	texture
	B2t	4-12	g	g	g	u	p	----	f-p	f	p-u	texture, SAR
	C	12-26	g	p	g	u	g	----	g	u	u	boron, SAR
	C	26-40	g	u	g	u	g	----	g	u	u	boron, SAR, EC
	R	40-60	g	p	g	u	g	----	p	u	u	boron, SAR
RH8 (RH8S)	Aca	0-6	g	g	g	g	f	g	g	g	g	sandy
	Cca	6-21	g	g	g	g	g	g	g	g	g	----
	CR	21-31	g	g	g	g	g	u	---	g	u	channery
RH9 (RH9)	A1	0-6	g	g	g	p	f	----	g	g	p	salty, sodic
	C	6-21	g	p	g	u	f	----	f	g	p	salty, sodic
	C	21-34	f	u	g	u	f	----	f	f	u	salty, sodic
	C	34-47	f	u	g	u	f	----	f	p	u	salty, sodic
	C	47-60	g	u	g	u	f	----	f	u	u	salty, sodic boron

g = good, f = fair, p = poor, u = unsuitable

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Table D-7.4-1

Pit 73T Phase 2

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
RH7	RH7	80	40	f-u	22" (boron, SAR, texture)
	RO	20	0	u	0"
RH8	RH8	85	31	g-u	31" (channery)
	RH8S	5	22	g-u	22" (channery)
	RH9	10	60	p-u	34" (salty, sodic)
RH8S	RH8S	90	22	g-u	22" (channery)
	RH8	10	31	g-u	31" (channery)
RH9	RH9	80	60	p-u	34" (salty, sodic)
	RH8S	20	22	g-u	22" (channery)

TABLE D-7.5-1

PIT 73T Phase 2

SOIL STRIPPING AND REDISTRIBUTION RATES

Location	Map Unit	Salvage Acreage	Topsoil B.C.Y.	Topsoil Depths Stripping ^c /Redistribution	Subsoil Depths Stripping ^c /Redistribution	Subsoil B.C.Y.
T43N, R.93W, Sec. 17, NW1/4 S1/2	RH7	2.4487	1,053.5	4" / 5.4"	22" / 21.8"	5,794.2
	RH8 ^a	5.1546	4,158.0	6" / 5.4"	25" / 21.8"	15,584.2
	RH8S ^b	1.5916	1,271.1	6" / 5.4"	16" / 21.8"	3,616.3
	RH9	4.8117	3,881.4	6" / 5.4"	28" / 21.8"	16,560.1
	ML	0.1714	0.0	0" / 5.4"	0" / 21.8"	0
TOTALS		14.1780	10,364.0			41,555.5

^a 0.49 acres of RH8 will be disturbed for subsoil stockpile locations. Only topsoil will be salvaged off this acreage.

^b RH8S is merely a shallower phase of map unit RH8.

^c Stripping depths will not be uniform across the entire salvage acreage for each unit because of variations in percent composition of the component soils. Please refer to Table D-7.4.

TABLE D-7.2-3

PIT 98T Phases 2-4

SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Textural Phase of Soil series	Percent of Map Unit	Erosion Factors		Capability Subclass	Range ^a Site	Land ^b Use
				K	WEG			
RH4	----	C	100	.14	4	IVec	Cy	g,wh
RH5	----	C	100	.24	4	IVec	Cy	g,wh
RH8	----	CL	100	.26	6	IVwc	SwLy	g,wh

a. USDA-SCS-WY Technical Guide Section II E.

b. These soils are all used primarily for livestock grazing (g) and wildlife habitat (wh).

TABLE D-7.3-3

PIT 98T Phases 2-4

EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse Fragments	Consis- tency	Boron	Overall Rating	Restric- tive Features
RH4 (RH4)	A	0-7	g	g	g	g	p	----	f	g	f	clayey, hard
	B1	7-24	g	g	g	g	p	----	p	g	f	clayey, hard
	B2	24-37	g	g	f	f	p	----	f	g	f	clayey, sodic, hard
	C1ca	37-43	g	g	g	f	p	----	f	g	f	clayey, sodic, hard
	C2ca	43-60	g	f	g	f	f	----	f	g	f	salty, sodic
RH5 (RH5)	A2	0-7	g	g	g	g	f	----	f	g	f	sodic, hard
	B1	7-22	g	g	g	u	p	----	f	g	u	sodic, clayey
	BCsa	22-41	g	f	g	u	p	----	f	g	u	sodic, clayey
	C	41-60	g	f	g	p	p	----	f	g	p	sodic, clayey
RH8 (RH8)	Aca	0-6	g	g	g	g	f	g	g	g	g	sandy
	Cca	6-21	g	g	g	g	g	g	g	g	g	----
	CR	21-31	g	g	g	g	g	u	---	g	g	channery

g = good, f = fair, p = poor, u = unsuitable

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Table D-7.4-3

Pit 98T Phase 2-4

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
RH4	RH4	90	60	g-p	24" (saline, sodic, clayey)
	Gullies	10	0	N/A	N/A
RH5	RH5	85	60	f-u	22" (sodic, clayey)
	Gullies	15	0	N/A	N/A
RH8	RH8	100	31	g-u	31" (channery)

TABLE D-7.2-5

PIT 104T Phases 1 and 5-7

SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Textural Phase of Soil series	Percent of Map Unit		Erosion Factors		Capability Subclass	Range ^a Site	Land ^b Use
			P. 1 & 5	P. 6 & 7	K	WEG			
RH6	----	SiL	85	87	.39	5	IVc	Ly	g,wh
RH8S	----	CL	97	97	.26	6	VIwc	SwLy	g,wh
RH9	----	SiCL	80	90	.42	6	Vec	Ly	g,wh
RH10	----	CL	100	100	.37	6	Vec	Ly	g,wh
DL	(RH6 Soil)	SiL	100	100	.39	5	IVc	Ly	g,wh

a. USDA-SCS-WY Technical Guide Section II E.

b. These soils are all used primarily for livestock grazing (g) and wildlife habitat (wh).

TABLE D-7.3-5

PIT 104T Phases 1 and 5-7

EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse Fragments	Consis- tency	Boron	Overall Rating	Restric- tive Features
RH6 (RH6)	A1	0-7	g	g	g	g	g	----	g	g	g	----
	B2t	7-12	g	g	g	g	g	----	f	g	g	hard
	B3	12-22	g	f	g	f	g	----	g	g	f	salty, sodic
	C1ca	22-40	f	g	g	p	g	----	g	g	p	alkaline, sodic
	C2	40-60	f	f	g	u	g	----	f	f	u	sodic
RH8S (RH8S)	Aca	0-6	g	g	g	g	f	g	g	g	g	sandy
	Cca	6-21	g	g	g	g	g	g	g	g	g	----
	CR	21-31	g	g	g	g	g	u	-	g	u	channery
RH9 (RH9)	A1	0-6	g	g	g	p	f	----	g	g	p	salty, sodic
	C	6-21	g	p	g	u	f	----	f	g	p	salty, sodic
	C	21-34	f	u	g	u	f	----	f	f	u	salty, sodic
	C	34-47	f	u	g	u	f	----	f	p	u	salty, sodic
	C	47-60	g	u	g	u	f	----	f	u	u	salty, sodic boron
RH10 (RH10)	A1	0-9	g	g	g	g	g	----	g	g	g	----
	C1	9-16	g	g	g	g	f	----	g	g	g	clayey
	C2	16-27	g	g	p	u	f	----	f	g	u	sodic, clayey
	C3ca	27-40	g	p	g	u	p	----	g	g	u	sodic, clayey
DL (RH6)	B2t	7-12	g	g	g	g	g	----	f	g	g	hard
	B3	12-22	g	f	g	f	g	----	g	g	f	salty, sodic
	C1ca	22-40	f	g	g	p	g	----	g	g	p	alkaline, sodic
	C2	40-60	f	f	g	u	g	----	f	f	u	sodic

g = good, f = fair, p = poor, u = unsuitable

Table D-7.4-5

Pit 104T Phases 1 and 5-7

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit		Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
		P 1,5	P 6,7			
RH6	RH6	85	87	60	g-p	40" (sodic, pH, EC)
	GC	15	13	0	N/A	N/A
RH9	RH9	80	90	60	p-u	60" (sodic, salty, boron)
	GC	20	10	0	N/A	N/A
RH10	RH10	--	100	40	g-u	40" (sodic, clayey)
GC	GC	85	40	0	N/A	N/A
	RH6	10	60	60	g-p	40" (sodic, pH, EC)
	RH9	5	--	60	p-u	60" (sodic, salty, boron)
DL	RH6 (subsoil only)	100	100	28	p	28" (sodic, pH)

APPENDIX D-7.A

Pits 73T, 98T and 104T

TOPSOIL MAP LEGEND

NO. SOIL NAME

- RH2 Deep saline-sodic brown clay torrifuvents
- RH3 Deep brown loam of the Frontier formation
- RH4 Deep developed residual gray clay of the Mowry formation
- RH5 Deep fine loamy over calcareous clay soil of the Mowry formation
- RH6 Deep calcareous silt loam of the Frontier formation
- RH7 Moderately deep developed calcareous saline-sodic clay loam of the Mowry formation
- RH8 Shallow calcareous clay loam loess over Peay sandstone residuum
- RH9 Deep calcareous saline-sodic silty clay loam torrifuvent
- RH10 Moderately shallow loam over sodic clay loam

UNDESCRIBED SOILS

- AL Alluvial soils
- Road Land disturbed by existing roads
- ML Mined land
- DL Disturbed land

SYMBOLS

- X Backhoe pit
- Soil boundary



Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH2

Horizon	A1	C	C	C
Depth (inches)	0-7	7-25	25-43	43-60
pH(1)	7.6	7.9	7.7	7.8
COND., mmhos(2)	0.58	0.78	4.59	7.70
SATURATION, %(1)	49.6	43.7	46.2	42.5
PARTICLE SIZE				
% SAND	31	23	25	23
% SILT	25	50	44	52
% CLAY	44	27	31	25
% VFS(3)	10	8	7	9
CALCIUM, meq/l(4)	4.82	2.80	24.6	24.9
MAGNESIUM, meq/l(4)	0.88	1.39	17.6	30.7
SODIUM, meq/l(4)	0.33	3.89	21.0	48.6
SAR(5)	0.20	2.69	4.57	9.22
LIME, % as CaCO ₃				
SELENIUM, ppm(6)	0.02	0.02	0.02	0.02
BORON, ppm(6)	0.4	0.02	2.9	4.4
NITRATE-N, ppm(7)	1.7	1.0	1.0	1.0
MOLYBDENUM, ppm(8)				
TEXTURE(9)	C	CL	CL	SiL
ORGANIC MATTER, %	2.0	0.7	0.9	0.5



Laboratory Analyses
Pits 73T, 98T, 104T

SOIL RH3



Horizon	A	B1	B2t	BC	C
Depth (inches)	0-7	7-21	21-34	34-48	48-60
pH(1)	6.9	7.4	8.0	8.1	7.9
COND., mmhos(2)	0.43	0.60	0.97	1.00	2.90
SATURATION, %(1)	43.5	49.5	49.5	45.1	42.5
PARTICLE SIZE					
% SAND	35	27	39	19	23
% SILT	44	48	30	56	54
% CLAY	21	25	31	25	23
% VFS(3)	11	10	7	9	10
CALCIUM, meq/1(4)	3.27	3.22	2.50	2.52	5.10
MAGNESIUM, meq/1(4)	1.90	1.27	1.18	1.10	5.20
SODIUM, meq/1(4)	0.90	1.61	6.55	6.70	19.1
SAR(5)	0.56	1.08	4.83	4.82	8.42
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.02	0.02	0.02
BORON, ppm(6)	0.1	1.3	0.7	0.7	1.0
NITRATE-N, ppm(7)	1.1	1.0	1.0	1.0	1.0
MOLYBDENUM, ppm(8)					
TEXTURE(9)	L	L	CL	SiL	SiL
ORGANIC MATTER, %	1.8	1.2	1.1	0.8	1.2

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH4

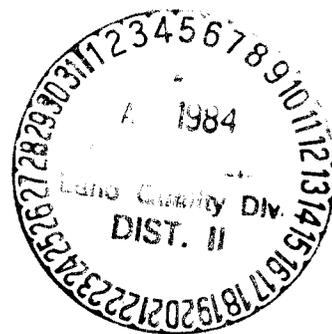


Horizon	A	B1	B2	C1ca	C2ca
Depth (inches)	0-7	7-24	24-37	37-43	43-60
pH(1)	7.0	7.7	7.6	7.6	7.4
COND., mmhos(2)	0.78	0.98	2.89	3.65	4.95
SATURATION, %(1)	63.8	69.0	75.4	55.2	57.5
PARTICLE SIZE					
% SAND	23	23	19	19	21
% SILT	31	33	35	41	48
% CLAY	46	44	46	40	31
% VFS(3)	5	5	6	6	7
CALCIUM, meq/1(4)	4.97	3.19	7.90	10.8	26.4
MAGNESIUM, meq/1(4)	1.85	0.80	2.75	4.10	9.75
SODIUM, meq/1(4)	2.09	5.98	19.9	22.3	28.5
SAR(5)	1.13	4.23	8.62	8.17	6.70
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.03	0.10	0.15
BORON, ppm(6)	0.2	0.8	0.8	0.9	0.8
NITRATE-N, ppm(7)	1.3	1.0	1.2	1.0	1.0
MOLYBDENUM, ppm(8)					
TEXTURE(9)	C	C	C	SiC	CL
ORGANIC MATTER, %	2.5	1.4	2.3	1.3	1.2

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH5



Horizon	A2	B1	BCsa	C
Depth (inches)	0-7	7-22	22-41	41-60
pH(1)	7.7	8.0	7.6	7.7
COND., mmhos(2)	0.86	1.40	7.10	5.99
SATURATION, %(1)	57.1	62.3	61.1	58.3
PARTICLE SIZE				
% SAND	27	19	15	21
% SILT	37	35	37	35
% CLAY	36	46	48	44
% VFS(3)	10	5	3	5
CALCIUM, meq/l(4)	3.17	1.52	25.2	25.4
MAGNESIUM, meq/l(4)	0.82	0.38	6.12	6.77
SODIUM, meq/l(4)	4.90	12.5	52.2	39.6
SAR(5)	3.47	12.8	13.2	9.87
LIME, % as CaCO ₃				
SELENIUM, ppm(6)	0.02	0.02	0.14	0.31
BORON, ppm(6)	0.6	1.6	1.8	1.1
NITRATE-N, ppm(7)	3.8	1.0	1.0	1.0
MOLYBDENUM, ppm(8)				
TEXTURE(9)	CL	C	C	C
ORGANIC MATTER, %	1.8	1.5	1.2	1.2

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH6



Horizon	A1	B2t	B3	C1ca	C2
Depth (inches)	0-7	7-12	12-22	22-40	40-60
pH(1)	7.3	7.8	7.7	8.5	8.6
COND., mmhos(2)	0.89	0.50	4.35	1.44	4.89
SATURATION, %(1)	39.7	45.3	41.6	39.0	40.9
PARTICLE SIZE					
% SAND	41	19	21	26	27
% SILT	43	58	58	57	57
% CLAY	16	23	21	17	16
% VFS(3)	15	8	10	11	11
CALCIUM, meq/1(4)	4.26	3.10	14.3	1.81	2.27
MAGNESIUM, meq/1(4)	2.56	1.19	8.78	1.09	4.22
SODIUM, meq/1(4)	2.29	1.88	25.9	12.7	43.6
SAR(5)	1.25	1.28	7.62	10.6	24.2
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.02	0.02	0.07
BORON, ppm(6)	0.3	0.3	0.6	0.4	2.3
NITRATE-N, ppm(7)	2.0	1.1	1.0	1.0	1.0
MOLYBDENUM, ppm(8)					
TEXTURE(9)	L	SiL	SiL	SiL	SiL
ORGANIC MATTER, %	2.5	1.8	1.5	1.5	0.5

Laboratory Analyses
Pits 73T, 98T, 104T
SOIL RH6
(Replicate from second pit)



Horizon	A1	B1	B2	C1	C2
Depth (inches)	0-5	5-18	18-32	32-50	50-70
pH(1)	7.6	7.8	7.9	7.8	8.0
COND., mmhos(2)	0.79	0.60	0.56	5.01	13.2
SATURATION, %(1)	45.0	43.2	39.0	38.5	43.6
PARTICLE SIZE					
% SAND	29	21	20	21	19
% SILT	50	54	55	56	56
% CLAY	21	25	25	23	25
% VFS(3)	14	10	6	6	8
CALCIUM, meq/1(4)	5.36	3.60	1.54	21.2	23.2
MAGNESIUM, meq/1(4)	1.17	1.28	0.58	7.21	21.1
SODIUM, meq/1(4)	2.31	1.75	3.60	32.8	101
SAR(5)	1.28	1.12	3.50	8.70	21.5
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.02	0.02	0.09
BORON, ppm(6)	0.4	0.2	0.3	1.0	5.4
NITRATE-N, ppm(7)	2.1	1.0	1.0	1.0	1.0
MOLYBDENUM, ppm(8)					
TEXTURE(9)	L	SiL	SiL	SiL	SiL
ORGANIC MATTER, %	2.1	1.2	0.6	0.5	0.5

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH7



Horizon	A1	B2t	C	C	R
Depth (inches)	0-4	4-12	12-26	26-40	40-60
pH(1)	7.6	7.9	8.1	8.3	8.3
COND., mmhos(2)	3.62	2.64	14.0	19.2	13.5
SATURATION, %(1)	45.9	71.3	60.0	61.8	42.2
PARTICLE SIZE					
% SAND	35	23	30	40	54
% SILT	38	33	32	28	20
% CLAY	27	44	38	32	26
% VFS(3)	12	9	9	8	9
CALCIUM, meq/1(4)	20.5	2.46	22.3	26.0	27.0
MAGNESIUM, meq/1(4)	3.59	1.08	16.4	32.4	44.0
SODIUM, meq/1(4)	15.6	23.45	148	182	126
SAR(5)	4.49	17.6	33.7	33.7	21.2
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.15	0.27	0.16
BORON, ppm(6)	0.6	1.3	7.3	12	15
NITRATE-N, ppm(7)	4.6	1.4	3.5	2.5	1.9
MOLYBDENUM, ppm(8)					
TEXTURE(9)	CL	C	SiL	SiL	L
ORGANIC MATTER, %	2.1	1.9	1.5	0.6	0.9

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH8

Horizon	Aca	Cca	R
Depth (inches)	0-6	6-21	21-31
pH(1)	7.3	7.6	7.6
COND., mmhos(2)	0.95	1.30	2.69
SATURATION, %(1)	47.1	40.9	44.8
PARTICLE SIZE			
% SAND	39	47	61
% SILT	32	32	31
% CLAY	29	21	8
% VFS(3)	15	15	10
CALCIUM, meq/l(4)	6.92	9.50	35.2
MAGNESIUM, meq/l(4)	1.30	1.41	1.19
SODIUM, meq/l(4)	0.40	2.49	1.00
SAR(5)	0.20	1.07	0.23
LIME, % as CaCO ₃			
SELENIUM, ppm(6)	0.02	0.02	0.02
BORON, ppm(6)	0.2	0.4	0.3
NITRATE-N, ppm(7)	1.4	1.2	1.0
MOLYBDENUM, ppm(8)			
TEXTURE(9)	CL	L	SL
ORGANIC MATTER, %	1.9	1.8	0.5





Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH9

Horizon	A1	C	C	C	C
Depth (inches)	0-6	6-21	21-34	34-47	47-60
pH(1)	7.8	8.1	8.5	8.4	8.2
COND., mmhos(2)	2.65	9.28	21.0	21.0	18.1
SATURATION, %(1)	47.7	57.4	54.1	55.6	60.3
PARTICLE SIZE					
% SAND	23	17	19	21	17
% SILT	50	52	52	50	49
% CLAY	27	31	29	29	34
% VFS(3)	12	9	8	8	8
CALCIUM, meq/l(4)	6.98	17.6	20.3	25.2	24.5
MAGNESIUM, meq/l(4)	2.10	8.27	26.5	37.9	31.5
SODIUM, meq/l(4)	21.8	91.5	207	236	189
SAR(5)	10.2	25.4	42.8	42.0	35.7
LIME, % as CaCO ₃					
SELENIUM, ppm(6)	0.02	0.02	0.02	0.04	0.09
BORON, ppm(6)	0.8	1.3	2.2	4.5	4.7
NITRATE-N, ppm(7)	3.6	1.2	1.2	1.1	1.0
MOLYBDENUM, ppm(8)					
TEXTURE(9)	CL	SiCL	SiCL	CL	SiCL
ORGANIC MATTER, %	1.6	0.9	0.5	0.5	0.6

Laboratory Analyses

Pits 73T, 98T, 104T

SOIL RH10

Horizon	A1	C1	C2	C3ca
Depth, inches	0-9	9-16	16-27	27-40
pH(1)	7.3	7.7	8.2	8.0
COND., mmhos(2)	1.35	0.82	3.68	12.2
SATURATION, %(1)	43.0	40.9	89.4	66.8
PARTICLE SIZE				
% SAND	47	25	31	33
% SILT	35	46	33	21
% CLAY	18	29	36	46
% VFS(3)	21	16	20	17
CALCIUM, meq/l(4)	5.33	3.11	3.19	24.2
MAGNESIUM, meq/l(4)	3.16	1.85	3.99	32.2
SODIUM, meq/l(4)	5.40	3.70	31.1	82.5
SAR(5)	2.62	2.35	16.4	15.5
LIME, % as CaCO ₃				
SELENIUM, ppm(6)	0.02	0.02	0.02	0.04
BORON, ppm(6)	0.2	0.2	1.7	3.4
NITRATE-N, ppm(7)	1.5	1	1.1	1
MOLYBDENUM, ppm(8)				
TEXTURE(9)	L	CL	CL	C
ORGANIC MATTER, %	1.1	1.7	1.5	0.6

Pit 75T, Phase 2

INTRODUCTION

The following section was prepared following the Wyoming Department of Environmental Quality's (DEQ-LQD, WY.), Guideline No. 1 (January, 1981) for Appendix D-7, topsoil assessment. Data obtained form the basis for WYO-BEN, INC.'S soil stripping and revegetation programs.

Soil assessment for the proposed affected areas of Pit 75T, phase 2, was conducted by Brian Pruiett, soil scientist. The assessment included a soil survey based on soil profile descriptions and a soil sampling program. Soil unit boundaries were mapped, as were the locations of the described and sampled profiles. Mapping was done to approximate an SCS order one or highly detailed order two soil survey. Laboratory analysis was done by the WYO-BEN Research Center Laboratory in Billings, Montana.

Topsoil suitability of the major soils at the site was evaluated. The evaluation included depth and volume assessment of both the topsoil and subsoil material available in the area to be affected. A map was prepared outlining the mean topsoil, subsoil, and stripping depths within each map unit to be affected.

Methodology

A site reconnaissance was completed, including determination of access, boundaries of disturbed areas, and identification of outcrops and landforms.

Soil mapping was conducted on foot using a sharpshooter and an Oakfield sampler. Soils were observed primarily for depth, textural class, salts, gypsum masses, coarse fragment content, parent material, structure, color, horizon designation, slope, aspect, and physiographic location. Mapping was done in accordance with the standards of the National Cooperative Soil Survey (USDA-SCS, 1951; 1975).

A soil sampling and description program was conducted after mapping units and major soil types were identified. Sampling consisted of using backhoe pits dug to either 5 feet, or to paralithic or lithic contact. A soil map and legend are provided. The map shows mapping unit boundaries and location of sampled pedons.

Soils were sampled and described by horizon using a revision of SCS form 232. These field sheets are not included with this submission. Copies are available for review at the WYO-BEN field office in Greybull. Soil descriptions included physiographic characteristics such as legal description, vegetation, parent material, slope, elevation, aspect, drainage, runoff, groundwater depth, root distribution, stoniness, rockiness, erosion, precipitation, climate, and current use.

Characteristics described for each diagnostic horizon included horizon designation and depth, texture, pH, EC, presence of lime, boundary, color, consistency, structure, roots, and percent coarse fragments. Coarse fragments were estimated by hand texturing. Other characteristics noted were the presence of salts, clay films and mottles, if any. Detailed soil description

forms for major soils are included in the D-7 tables. Major soils are named by using physical characteristics (ie. depth, texture, slope and formation). These soils are classified in Appendix D-7.B.

Soils were sampled by horizon and collected in paper bags for transport to the laboratory. Parameters tested include those required for topsoil suitability according to Wyoming DEQ Guideline No. 1. Tests included saturated paste pH, saturated extract electrical conductivity (EC), sodium adsorption ratio (SAR), saturation percentage, and texture. Some soils were selected for testing of boron, selenium, and lime. Laboratory results and methods are included in Appendix D-7.B.

Evaluation of the reclamation suitability of topsoil material was based on laboratory analysis, field observations and guidelines as proposed by WY DEQ, Guideline No. 1. Topsoil depths and volumes were then calculated for each mapping unit within the affected area. Adjustments for range in characteristics within soil phases or slope classes have been made. A soil depth map is also provided.

Site Description - Pit 75T, Phase 2

Approximately 10 acres were mapped for the area to be affected by Phase 2 of Pit 75T. This phase is an eastern extension of Pit 75T, phase 1. Phase 2 is bounded on the east and west ends by ravines. The ravine on the west end of this phase is comprised by a portion of Rock Springs Draw. This draw separates the previously mined area of Pit 75T from phase 2.

The west end of phase 2, adjacent to the draw, is a terrace overlain by alluvial sediment deposition.

The central portion of the pit is mainly a complex of east-west oriented bare clay exposures bisected by north-south lines of shallow soils developed from weathered sandstone outcrops. These thin solons support sparse mixed brush and grass vegetation. The outcrop complex lies in the center of an east-trending V-shaped hollow with the open end facing towards Rock Springs Draw. The sides and bottom of the V are hills with shallow, clayey, sodic soils comprised of materials from the Thermopolis Shale formation.

The east portion of the pit covers a small ridge at the bottom of the V and is bordered on the east by a steep ravine. Soils on the ridgetop are mostly residual sheetwash in origin but show some eolian influences in buried horizons.

The climate and edaphic factors are the same as stated by Bailey in his Red Hole Soil Assessment.

Soil Descriptions

A detailed, tabular summary of the major soils and map units is presented in Tables D-7.1-2 through D-7.5-2.

About 30 to 60 inches of soil is available for salvage on the west half of Phase 2. The dominant soil, HS24-1, is a deep, mixed (calcareous), moderately developed, loamy depositional soil formed over the Thermopolis Shale formation. The remaining two major soils are shallow to moderately shallow and are dominated by clay shale close to the surface (HS24-2) or are very high in

sodium (HS24-3). These two soils have 6 to 8 inches of suitable topsoil and 6 to 12 inches of material that will be salvaged as subsoil.

A full list of abbreviations used in the format is in Appendix D-7.E (SCS-Soil Survey Staff, 1960).

The locations of the described profiles are shown on the Soils Map 2 of 4.

The classification of the soils is presented on a table in Appendix D-7.B (SCS-Soil Survey Staff, 1975).

Map Unit Descriptions

Table D-7.2-2, page 109, summarizes the major distinguishing characteristics of each map unit within the affected area. The land form or type of slope and terrain which each map unit occupies is also listed.

The percent of the map unit which is occupied by the major soil type is given on Table D-7.4-2, page 111, as well as the minor inclusions and their percentages.

TABLE D-7.1-2

PIT 75T Phase 2

DETAILED SOIL SERIES CHARACTERISTICS

Soil Series Pedon No.; (Map Unit)	Depth (Inches)	Drainage Class	Slopes (%)	Parent Material and Landform	Native Vegetation	Permeability	A.W.C.	Effective Rooting Depth (Inches)
HS24-1; (HS1)	60+	Well	1-2	terrace- alluvial fan	Sagebrush/ mixed grass	moderate	10"	10
HS24-1S; (HS1S)	30	Well	1-2	alluvium over rock and clay outcrops	mixed brush and sparse grass	moderate	5"	6-10
HS24-2; (HS2)	13+	Moderately Well	15	residuum and loess over Thermopolis shale slope	sagebrush/ bluebunch wheatgrass	moderate/ moderately slow	2.2"	36
HS24-3; (HS3)	28	Moderate	2-5	eroded hogback, residuum with interbedded loess over Thermopolis shale	sagebrush/ mixed grass	slow	5"	14

TABLE D-7.1-2 (Cont.)

PIT 75T Phase 2

PROFILE CHARACTERISTICS: FIELD ANALYSIS

Soil Series; Pedon No; (Map Unit)	Horizon	Depth (Inches)	Boundary	Color		Consistency			Structure			Coarse Fragments (Percent)
				Dry	Moist	Dry	Moist	Wet	Grade	Type	Size	
HS24-1; (HS1)	A2	0-5	c,s	yel.brn./dk.brn.		h	fr	ss,ps	2	pl	th	5
	C1ca	5-12	c,s	dk.yel.brn./dk.gry.brn.		h	fr	ss,ps	2	pl	m	5
	C2tca	12-19	c,w	dk.yel.brn./dk.yel.brn.		vh	fi	ss,p	1-2	col-abk	g-m	5
	C3ca	19-60	---	dk.yel.brn./dk.yel.brn.		vh	fi	s,p	m	--	--	5
HS24-2; (HS2)	A2	0-3	c,s	dk.gry.brn./brn.		sh	vfr	ss,ps	1	gr	f	2
	B1	3-6	c,s	dk.gry.brn./brn.		h	fr	s,ps	1	sbk	c	2
	BCca	6-13	c,s	dk.gry.brn./brn.		vh	fi	s,p	m	--	--	2
	CR	13-36	---	dk.gry.brn./brn.		eh	vfi	s,p	m	--	--	2
HS24-3; (HS3)	A1	0-2	c,s	lt.yel.brn./yel.brn.		sh	fr	ss,po	2	pl	th	-
	B2tca	2-5	c,s	lt.yel.brn./yel.brn.		h	fi	ss,ps	2	sbk	m	-
	Cca	5-12	c,w	lt.yel.brn./yel.brn.		h	vfi	s,p	m	--	--	-
	II Bbca	12-28	a,i	lt.yel.brn./yel.brn.		h	vfi	vs,p	m	--	--	-
	III CR	28-60	---	--/v.dk.gry.brn.&yel.brn.		-	vfr	vs,ps	sg	--	--	-

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TABLE D-7.2-2

PIT 75T Phase 2

SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Textural Phase of Soil series	Percent of Map Unit	Erosion Factors		Capability Subclass	Range Site	Land Use
				K	WEG			
HS1	HS1	loamy	60	.5	3	VI	Si	g,wh
HS1S	HS1S	shallow loamy	30	.5	3	VII	Si	g,wh
HS2	HS2	loamy	90	.36	5	VII	TH	g,wh
HS3	HS2	fine loamy	75	.42	6	VI	Cy	g,wh

g = grazing / wh = wildlife

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TABLE D-7.3-2

PIT 75T Phase 2

EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse Fragments	Consis- tency	Boron	Overall Rating	Restric- tive Features
HS24-1; (HS1, HS1S)	A2	0-5	g	g	g	g	g	g	g	-	g	----
	Caca	5-12	g	g	g	g	g	g	g	-	g	----
	C2tca	12-14	g	g	g	g	g	g	f	-	g	hard
	C3ca	14-60	g	g	g	p	g	g	f	g	f-p	sodic
HS24-2; (HS2, GC)	A2	0-3	g	g	g	g	g	g	g	-	g	----
	B1	3-6	g	g	g	g	g	g	g	g	g	----
	BCca	6-13	g	g	g	p	g	g	f	-	f-p	sodic
	CR	13-40	g	g	g	u	f	g	p	g	u	sodic
HS24-3; (HS3)	A1	0-3	f	g	g	u	g	g	g	-	u	sodic
	B2tca	3-5	f	g	g	u	p	g	f	g	u	sodic
	Cca	5-12	g	g	g	u	f	g	p	-	u	sodic
	BCbca	12-28	g	p	g	u	g	g	p	g	u	sodic
	CR	28 +	g	p	f	u	p	g	g	-	u	sodic

g = good, f = fair, p = poor, u = unsuitable

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Table D-7.4-2

Pit 75T Phase 2

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
HS1	HS1	60	60	g-p	60" (sodic, hard)
	HS1S	30	18	g-f	18" (hard)
	OC	10	6	N/A	N/A
HS1S	HS1S	90	18	g-f	18" (hard)
	OC	10	6	N/A	N/A
HS2	HS2	60	40	g-u	36" (sodic, hard)
	OC	35	6	N/A	N/A
	GC	5	13	N/A	N/A
HS3	HS3	75	28	u	28" (sodic, saline)
	RC	20	0	N/A	N/A
	GC	5	13(x40%)	N/A	N/A
GC	HS2	40	13	g-u	13" (sodic, hard)
	Gullies	60	0	N/A	N/A
OC	Shale Outcrops	65	0	N/A	N/A
	Sandstone Outcrops	35	6	N/A	N/A
RC	Ravine Complex	100	0	N/A	N/A

APPENDIX D-7.B (Part 1)

SOIL MAP LEGEND AND CLASSIFICATION

Pit 75T Phase 2

Map Unit Symbol	Name	Percent Slope
HS1	deep, calcareous (mixed), loamy, mollic udifluent	2-4
HS1S	shallow phase of HS1	2-8
HS2	moderately deep, mixed (calcareous) loamy, typic torriorthent	22-25
HS3	moderately shallow, calcareous, typic torriorthent	2-6
GC	gully complex	8-20
OC	bare sandstone and shale outcrops	0-30
RC	ravine complex	6-60

APPENDIX D-7.B (Part 2)

LABORATORY ANALYSIS

PIT 75T Phase 2

Soil Series; Pedon No., (Map Unit)	Horizon Depth (in.)	Cond.		Satura- tion %	Calcium Carbonate Reaction (% Lime)	%			VF Sand	Soil Textural Class	Ca meg/1	Mg meg/1	Na meg/1	SAR	Se ppm	Boron ppm
		ph	mmhos/cm			Sand	Silt	Clay								
HS24-1;	0-5	7.5	0.67	31	eo	27	46	8	19	L	4.7	2.1	0.46	0.25	---	---
	5-12	7.8	0.51	29	e	24	48	12	16	L	2.6	1.4	0.78	0.55	---	---
	12-14	8.1	0.56	30	es	30	34	22	14	L	1.9	1.7	2.7	2.0	0.03	---
	14-60	7.3	2.1	29	es	26	40	18	16	L	1.2	2.5	20.0	15.0	---	1.2
HS24-2;	0-3	7.1	0.61	37	eo	35	40	14	11	L	2.5	2.0	2.2	1.5	---	---
	3-6	7.3	0.63	37	eo	34	36	22	8	L	2.4	1.5	3.9	2.8	0.03	0.4
	6-13	8.0	0.68	37	e	25	42	22	11	L	0.65	0.41	7.6	10.0	(Mo	0.05)
	13 +	8.1	2.1	41	e	28	24	30	8	CL	1.5	1.7	21.0	17.0	0.02	1.5
HS24-3;	0-3	8.4	1.6	35	e	15	56	18	11	SiL	0.45	0.16	18	33	---	---
	3-5	8.5	3.5	41	es	9	48	34	9	SiC	0.70	0.41	53	71	---	0.6
	5-12	8.3	3.1	45	es	10	44	38	8	SiCL	0.70	0.49	40	52	0.05	---
	12-28	8.3	13	38	es	13	74	4	9	SiL	11	15	191	53	---	1.2
	28 +	8.3	10	71	eo	24	24	48	4	C	10	9.0	148	48	---	---

COAL AND WIND AREA SOILS

Pits 102T and 108T

James Walsh and Associates: Jean MacCubbin

INTRODUCTION

The following sections have been prepared to fulfill the regulations for topsoil assessment of the Wyoming Department of Environmental Quality's (WY. DEQ), Guideline No. 1, Appendix D-7. Data collection and analysis were completed in January of 1982.

Soil surveys were conducted on the proposed affected areas for two proposed bentonite pits. Soil descriptions and sampling programs were also conducted. Soil maps outlining soil map unit boundaries and locations of described and sampled profiles are included. Mapping was done to approximate a 1st or highly detailed 2nd order soil survey.

Topsoil suitability evaluations of the major soils on the sites were made. Evaluations include depth and volume assessments of topsoil, as well as subsoil material, available in the areas to be disturbed. A topsoil depth map outlines the mean topsoil stripping depth within each map unit to be affected.

METHODOLOGY

A site reconnaissance was done at each proposed pit area to find access and boundaries, and to identify the outcrops and landforms.

Soil mapping was conducted on foot using a bucket auger and a shovel. Soil parameters observed were primarily: depth, horizon designation, texture, salts, coarse fragments, parent material, slope, aspect, dominant vegetation, and physiographic position. Mapping was done in accordance with the standards of the National Cooperative Soil Survey (USDA-Soil Conservation Service, 1951; 1975), except that established soil series were not used.

Soil description and sampling were done after major soil types and mapping units had been inventoried. Pits were dug by hand to approximately 40 inches and hand-augered to 60 inches, or bedrock, whichever was shallower.

Soils were described and sampled by horizon, recording the information on a revised SCS form 232. Soil descriptions include the following site characteristics:

- o legal description of location
- o vegetation
- o parent material
- o landform
- o aspect
- o slope
- o depth to ground water
- o permeability

- o present erosion condition
- o climate
- o current use

Characteristics described for each diagnostic horizon include:

- o horizon designation and depth
- o color
- o mottles
- o texture
- o structure
- o consistence
- o reaction
- o boundary
- o roots
- o clay films
- o coarse fragments (volume)

Coarse fragments were estimated by using a 2 mm sieve at time of sampling. Characteristics visually estimated were the presence of salts, clay films and mottles, if any. Detailed soil description forms for the major soils are included in the Appendices. Major soils are named (see Map Legend, Appendices) by using the physical characteristics of depth, texture, degree of development, and parent material. Soils are classified using Soil Taxonomy (USDA-SCS, 1951; 1975).

Soils were sampled by horizon and collected in paper bags for transport to the laboratory. Parameters tested include those suggested for minimal testing for topsoil suitability by WY. DEQ Guideline No. 1 (revised 1/81). The following tests were performed:

- o saturated paste pH
- o electrical conductivity (EC)
- o sodium adsorption ratio (SAR)
- o saturation percentage
- o particle size analysis

Some soils were tested for boron, lime or gypsum. Laboratory results and methods are included in the Appendices following the soil profile descriptions.

The evaluation of topsoil material was based on laboratory analyses, field observations and guidelines as proposed by WY. DEQ, Guideline No. 1. Topsoil depth was estimated for each mapping unit within the affected area using the above information. Adjustments for range in characteristics within slope phases have been made. A soil depth map for each permit area is also provided.

This soil assessment was completed in January of 1982.

SOIL DESCRIPTIONS

A detailed, tabular summary of the major soils (major components of the map units) is presented in Tables D-7.1. Also listed in this table are

detailed soil descriptions of typical profiles using a modified Soil Conservation Service (SCS) form 232 and standard SCS abbreviations (SCS, Soil Survey Staff, 1960).

The location of the described profiles and soil boundaries are shown on the soil maps 3 of 4 (Pit 108T) and 4 of 4 (Pit 102T).

The classification of the soils are presented in tables included in Appendices D-7.C and D-7.D. Classification of soils is defined as per Soil Taxonomy (SCS Soil Survey Staff, 1975).

SOIL MAP UNIT DESCRIPTIONS

Tables D-7.2 summarize the major distinguishing characteristics of each map unit within the permit area. Each map unit is identified by numerical and letter symbols (e.g., 3bc) which signify major soil type (as described in profile 3) and slope range (e.g., 2 to 12 percent slopes).

The percent of the map unit which is occupied by the major soil type is given as well as the minor inclusions and their percentages. Other included characteristics pertinent to the map unit are water and wind erosion factors, capability subclass, range site, and land use.

EVALUATION OF TOPSOIL MATERIAL

Evaluations are based on criteria outlined in WY. DEQ Guideline No. 1 -- Topsoil Suitability Ratings. The topsoil suitability ratings of the typical profiles of the major soils are presented in Tables D-7.3. The overall rating for each horizon is the rating for the most limiting criterion. These ratings are used to evaluate the depths of suitable topsoil material for each soil map unit as listed in Tables D-7.4.

Many of the soil horizons are rated poor (by the WDEQ criteria) because of their clayey texture and/or hardness when dry. These properties can be used to advantage. If these soils are manipulated when dry they will compact very little. However if compacted, the natural surficial processes of shrinking and swelling of the clays and freeze-thaw in the winter will rapidly create a new soil structure.

The good, fair, and poor ratings are relative. Almost all the soil horizons rated good, fair, or poor are suitable for topsoil. The few exceptions include horizons high in cobbles, high in salts, and very high in clay.

Soils rated poor using the above criteria were recommended for salvage unless rooting depth was restricted.

Tables D-7.5 are summaries of the average recommended depth for topsoil and subsoil salvage by map unit. Each map unit within the affected area was planimetered for acreage and a bank cubic yard estimate was made for available topsoil for redistribution from the acreage and the salvage depths. Note that the depths given in Tables D-7.5 are average salvage depths using the recommended depths from Tables D-7.4 and multiplying that figure by the percent

each soil occupies within that map unit. An overall redistribution rate (acre-inches) is tabulated in Tables D-7.5.

Pit 102T

SITE DESCRIPTION

Approximately 60 acres make up the area of pit 102T for which the following descriptions and evaluations are made. The pit is located in T. 44 N., R. 96 W., Section 28, Hot Springs County, Wyoming.

The site consists of nearly level, rolling to moderately steep shale-derived soils occurring on bottomlands, knolls, and upland ridges. Also included are areas where alluvium has washed from the interbedded sandstones and shales of the Mowry Formation. The area has an overall south and southwesterly aspect. Some areas have an east aspect.

The soils range from barren, very shallow, gypsiferous, clayey soils over rippable, dark, weathered, clayey shales to deep and very deep, loamy alluvial soils of mixed origin. The alluvium supports a big sage-greasewood-blue bunch wheatgrass community. Included are areas which are sparsely vegetated, gullied, have evidence of sheet erosion, and have accumulated salts (CaCO_3 , CaSO_4) and/or channers at the surface.

The average annual precipitation is about 10 to 14 inches (USDA-SCS, August, 1978); the average annual air temperature is 47° to 55° F. The growing season for cool season plants is April 15 to July 15. Most of the soils at the site were slightly moist below the surface (about 3 in.), due to the high clay content and inherent high water-holding capacity of the soils.

Overall, available topsoil and subsoil material within the affected area approximates 15.4 and 17.3 acre-inches, respectively.

TABLE D-7.1-4

PIT 102T

DETAILED SOIL SERIES CHARACTERISTICS

Soil Series ^a Profile No.; (Map Unit)	Depth (Inches)	Drainage Class	Slopes (%)	Parent Material and Landform	Native Vegetation	Permeability	A.W.C. (in./in.)	Effective Rooting Depth Inches)
55-1 (DL)	var. ^b	mod. well	--	interbedded sandstone and shale; topsoil stockpile	--	--	.12-.13 in./in.	--
102T-1 (1ac, 1-3ab)	mod. deep (24-40)	mod. well to some- what poorly below	2 to 25	alluvium over residuum from clayey, gyp- siferous shale on fans and bottomlands	big sage, blue bunch wheatgrass	moderate to moderately slow	.10-.16 in./in.	to bedrock (24 to 40)
102T-2 ^c (2bc)	shallow (17-21)	moderate	8 to 15	residuum from interbedded sandstone and shale on rol- ling ridges, sideslopes of ridges and ridge crests	big sage, blue bunch wheatgrass	moderate	.07-.11 in./in.	to bedrock (17 to 21)

TABLE D-7.1-4 (Cont.)

PIT 102T

DETAILED SOIL SERIES CHARACTERISTICS

Soil Series ^a Profile No.; (Map Unit)	Depth (Inches)	Drainage Class	Slopes (%)	Parent Material and Landform	Native Vegetation	Permeability	A.W.C. (in./in.)	Effective Rooting Depth Inches)
102T-3 (1-3ab, 3 ab, 4-3ab)	deep to very deep (43-60+)	moderate	2 to 10	alluvium from interbedded sandstone and shale on gul- lied fans and bottomlands	big sage, blue bunch wheatgrass, greasewood	moderate	.10-.16 in./in.	Limited to depth of surface horizon (4 to 5)
102T-4 (4ac, 4-3ab)	very shallow to shallow (11-14)	mod. slow to slow	2 to 25	residuum from gypsiferous shale on bottomlands, knolls, and fans	halophytic vegetation	moderately slow to slow	.08-.16 in./in.	Limited to depth of surface horizon (1 to 2)

^a The descriptive name of the soil is included in Appendix 7.1. The symbol used here identifies the pit number and the soil pedon number.

^b Composite sample of soil stockpile taken from 0 to 8 inches; original soil depth not available.

^c Described pedon is outside affected area.

-- = Information not available.

mod. = moderately

TABLE D-7.1-4 (Cont.)

PIT 102T

PROFILE CHARACTERISTICS: FIELD ANALYSIS

Soil Series; Pedon No; (Map Unit)		Horizon	Depth (Inches)	Boundary	Color Dry / Moist	Consistency Dry Moist Wet			Structure Grade / Type / Size			Coarse Fragments (Percent)
102T-1; (1ac, 1-3ab)	A1		0-5	g,s	lt.brn.gr./dk.brn.gr.	sh	fr-sfi	s,p	1	gr,pl	vf	30
	B2		5-12	g,s	brn./dk.brn.gr.	sh	vfi	vs,vp	2	sbk	m	0
	B3		12-19	d,s	brn./dk.brn.gr.	sh-h	fi	vs,vp	2	pr,abk	m,c	0
	C1		19-35	a,s	dk.gr.brn./v.dk.gr.brn.	sh	vfi	vs,vp	3	pr,abk	m,c	20
	CR		35+	---	very channery, black, gypsiferous shale				-	---	---	--
102T-2; (2bc)	A1		0-7	g,s	gr.brn./dk.gr.brn.	lo	vfr	s,p	2	gr	f	50
	ACca		7-16	a,s	dk.gr.brn./v.dk.gr.brn.	so	vfr	ss,ps	2	sbk	m	65
	C1cs		16-21	a,s	dk.gr.brn./v.dk.gr.brn.	so	vfr	vs,p	m	--	--	60
	R		21+	---	hard, interbedded shale and sandstone			---	-	--	--	0
102T-3; (1-3ab, 3ab, 4-3ab)	A2		0-5	g,s	lt.brn.gr./dk.gr.brn.	sh-so	sfi	s,p	2	gr	f	15
	ACcs		5-13	d	dk.gr.brn./v.dk.gr.brn.	sh	vfr	ss,p	2	sbk	f&m	0
	C1cs		13-34	a,w	gr.brn./v.dk.gr.brn.	sh	fr	s,p	2	sbk	f&m	0
	IIC2		34-59	a,s	dk.gr.brn./v.dk.gr.brn.	so	fr	ss,p	2-m	gr	f	45
	IIC3		59-74	---	dk.gr.brn./v.dk.gr.brn.	sh	vfr	ss,ps	2-m	gr	f	70
102T-4; (4ac, 4-3ab)	A2		0-2	ND	lt.gr./lt.brn.gr.	sh	vfr	so,po	2	gr	vf-f	0
	C1		2-7	ND	ND/lt.brn.gr.	sh	fi	vs,vp	m	--	--	0
	C2		7-10	ND	white/lt.gr.	lo	fr	vs,vp	m	--	--	0
	IICR		10-18	ND	ND/dk.yel.brn.	sh-lo	vfr	so,po	m	--	--	70
	R		18-23+	--	green bentonitic clay and shales			---	-	--	--	0

ND= not described

TABLE D-7.2-4

PIT 102T
SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Soil Series (Inclu- sions)	Percent of Map Unit	Erosion Factors		Capability Subclass	Range Site ^b	Land Use
				K	WEG			
1ac	moderately deep, cal- careous, moderately developed, channery, fine-textured soils over channery, black, gypsiferous shale	102T-1	80	.31	4	7c	clayey	grazing, wildlife habitat
		(102T-2)	10					
		(102T-3)	10					
1-3ab	moderately deep, cal- careous, moderately developed, channery, fine-textured soils over channery black, gypsiferous shale -- deep to very deep loamy over loamy skeletal -- alluvial soils complex	101T-1	65	.31	4	7c	clayey overflow	grazing, wildlife habitat
		101T-3	25					
		(other soils)	10					
2bc	shallow, calcareous, gravelly, clayey and loamy undeveloped soils over sandstones and shales	102T-2	75	.17	3	7c	shallow clayey	grazing, wildlife habitat
		(RO)	10					
		(102T-1)	15					
3ab	deep to very deep, loamy over loamy skeletal, alluvial soils	102T-3	85	.18	4	6c	overflow	grazing, wildlife habitat
		(102T-1)	15					

TABLE D-7.2-4 (Cont.)

PIT 102T
SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Soil Series (Inclusions)	Percent of Map Unit	Erosion Factors		Capability Subclass	Range Site ^b	Land Use
				K	WEG			
4ac	shallow, clayey, gypsiferous residual soils over shale -- shale outcrop complex	102T-4	65	.16	4	7c	shallow clayey, saline upland	grazing, wildlife habitat
		SO	35					
S4ac	very shallow, clayey, gypsiferous residual soils over shale -- shale outcrop complex	102T-4	55	.16	4	7c	very shallow clayey, saline upland	grazing, wildlife habitat
		SO	45					
4-3ab	shallow, clayey, gypsiferous, residual soils over shale -- deep to very deep, loamy over loamy-skeletal, alluvial soils complex	102T-4	40	.16	4	7c	overflow, saline upland	grazing, wildlife habitat
		102T-3	35					
		(SO)	10					
		(102T-4, very shallow) (other soils)	10 5					
DL ^a	Disturbed land	--	100	--	--	--	--	grazing, wildlife habitat

a Disturbed land includes land disturbed by mining activities, e.g., mine pits, haul roads, stockpiles, etc.

b Range sites have not been correlated with site-specific vegetation data or with the SCS. Range sites used are from 10-14" precipitation zone, basins and foothills east, (USDA-SCS, WY, Nov. 1977. Technical Guide, Section II E).

TABLE D-7.3-4

PIT 102T
EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse ^c Fragments	Consistency	Boron ^b	Overall Rating	Restrictive Features
55-1 (DL) ^a	--	---	f	u	g-f	u	p	g	g-f	--	p-u	saline, sodic, clayey
	A1	0-5	g	g	g-f	g	p	g	f	g	f-p	clayey
	B-2	5-12	g	u	g-f	p	p	g	f	g	p-u	saline, sodic, clayey
	B3 C1	12-19 19-35	g f	p g	g-f g-f	f g	p p	g f-p ^d	f g	g g	f-p f-p	saline, clayey coarse fragments, moist consistence
102T-2	A1	0-7	g	g	g-f	g	g	g	g	--	g-f	saturation percent
	ACca	7-16	g	g	g-f	g	g	g-fe	g	--	g-f	coarse fragments
	C1cs	16-21	g	p	g-f	p	g	g	g	--	p	saline, sodic
102T-3	A2	0-5	g	f	g-f	g	p	g	f	--	f-p	clayey
	ACcs	5-13	g	g	g-f	g	p	g	g-f	--	f-p	clayey
	C1cs	13-25	g	f	g-f	g	p	g	g-f	--	f-p	clayey
	C1cs	25-34	g	g	g-f	g	p	g	g	--	f-p	clayey
	IIC2	34-59	g	f	g-f	g	g	g	g-f	--	g-f	saline
108T-4	A2	0-3	g	g	g	g	g	g	g	--	g	----
	C1	3-7	g	g	g	g	f	g	g	--	g-f	finest

g = good, f = fair, p = poor, u = unsuitable

^aSample taken from topsoil stockpile; is not representative of all soils occurring with map unit DL.

^bNot analyzed for all samples.

^cField estimated using 2mm sieve.

^dApproximately 20% black, shaley channers. epercentage of coarse fragments may affect available water-holding capacity.

Table D-7.4-4

Pit 102T Phase 1

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
1ac	102T-1	80	35	f-u	35" (clayey, sodic)
	102T-2	10	21	g-p	21" (sodic, saline)
	102T-3	10	59	f-p	59" (clayey, sodic)
1-3ac	102T-1	65	35	f-u	35" (clayey, sodic)
	102T-3	25	59	f-p	59" (clayey, sodic)
2bc	102T-2	75	21	g-p	21" (sodic, saline)
	(RO)	10	N/A	N/A	N/A
	102T-1	15	35	f-u	35" (clayey, sodic)
3ab (3a, 3ac) gullies	102T-3	85	59	f-p	59" (clayey, sodic)
		15	0	N/A	N/A
4ac	102T-4	65	18	f-u	18" (clayey, sodic, saline)
	S0	35	N/A	N/A	N/A
4-3ab	102T-4	40	18	f-u	18" (clayey, sodic, saline)
	102T-3	35	59	f-p	59" (clayey, sodic)
	S0	10	N/A	N/A	N/A
	(102T-4, very shallow)	10	8	f-u	8" (clayey, sodic, saline)

Table D-7.4-4 (Cont.)

Pit 102T Phase 2

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
1ac	102T-1	80	35	f-u	35" (clayey, sodic)
	102T-2	10	21	g-p	21" (sodic, saline)
	102T-3	10	59	f-p	59" (clayey, sodic)
1-3ac	102T-1	65	35	f-u	35" (clayey, sodic)
	102T-3	25	59	f-p	59" (clayey, sodic)
2bc	102T-1	100	35	f-u	35" (clayey, sodic)
4ac	102T-4	65	18	f-u	18" (clayey, sodic, saline)
	S0	35	N/A	N/A	N/A
4-3ab	102T-4	40	18	f-u	18" (clayey, sodic, saline)
	102T-3	35	59	f-p	59" (clayey, sodic)
	S0	10	N/A	N/A	N/A
	(102T-4, very shallow)	10	8	f-u	8" (clayey, sodic, saline)

Table D-7.4-4 (Cont.)

Pit 102T Phase 3

Depth of Suitable Topsoil Material by Map Unit

Map Unit	Component Soils	Percent of Map Unit	Total Depth (Inches)	Rating	Recommended Depth of Suitable Material (Principle restrictive features of suitable material)
1ac	102T-1	80	35	f-u	35" (clayey, sodic)
	102T-2	10	21	g-p	21" (sodic, saline)
	102T-3	10	59	f-p	59" (clayey, sodic)
3ab	102T-3	85	59	f-p	59" (clayey, sodic)
	gullies	15	0	N/A	N/A
4ac	102T-4	65	18	f-u	18" (clayey, sodic, saline)
	S0	35	N/A	N/A	N/A
S4ac	102T-4	55	8	f-p	8" (clayey, sodic, saline)
	S0	45	N/A	N/A	N/A
4-3ab	102T-4	40	18	f-u	18" (clayey, sodic, saline)
	102T-3	35	59	f-p	59" (clayey, sodic)
	S0	10	N/A	N/A	N/A
	(102T-4, very shallow)	10	8	f-u	8" (clayey, sodic, saline)
DL	55-1 (topsoil stockpile)	--	--	p-u	(clayey, saline, sodic)

APPENDIX D-7.C (Part 1)

CLASSIFICATION OF PIT 102T SOILS

Soil Series	Family	Subgroup ¹
102T-1	fine, montmorillonitic, (calcareous)	Ustollic Haplargids
102T-2	loamy-skeletal, mixed (calcareous)	Lithic Torriorthents
102T-3	fine over loamy-skeletal, mixed	Ustic Torrifuvents
102T-4	fine, montmorillonitic, shallow	Ustic Torriorthents

¹ Soils are classified using Soil Taxonomy (USDA-SCS, 1975) but are not correlated to existing series used by the SCS.

APPENDIX D-7.C (Part 2)

SOIL MAP LEGEND

Map Unit Symbol	Name	Percent Slope
1ac	moderately deep, calcareous, moderately developed, channery, fine-textured soils over very channery, black, gypsiferous shale	3-25
1-3ab	moderately deep, calcareous, moderately developed channery, fine-textured soils over very channery, black, gypsiferous shale -- deep to very deep, fine over loamy-skeletal alluvial soils complex	2-10
2bc	shallow, calcareous, gravelly clayey and loamy, undeveloped soils over interbedded sandstones and shales	8-15
3ab	deep to very deep, fine over loamy-skeletal alluvial soils	2-10
4ac	shallow, clayey, gypsiferous, residual soils over shale	3-25
S4ac	very shallow, clayey, gypsiferous, residual soils over shale -- shale outcrop complex	3-25
4-3ab	shallow, clayey, gypsiferous residual soils over shales -- deep to very deep, fine over loamy-skeletal alluvial soils complex	2-10
DL	Disturbed land	

APPENDIX D-7.C (Part 3)

LABORATORY ANALYSIS

PIT 102T

Soil Series; Pedon No., (Map unit)	Horizon Depth (in.)	pH	Conductivity mmhos/cm	Saturation %	Calcium Carbonate Reaction (% Lime)	% Sand	% Silt	% Clay	% VF Sand	Soil Textural Class	Ca meg/l	Mg meg/l	Na meg/l	SAR	Se ppm	Boron ppm
102T-1	0-5	7.6	1.81	52.2	e	26	30	44	-	C	11.8	2.0	6.82	2.6	-	0.1
S-1;	5-12	7.4	16.2	53.4	(1.5)	26	24	50	-	C	83.5	10.6	97.0	14.1	-	0.3
1ac, 1-3ab	12-19	7.2	12.3	50.3	(1.1)	22	26	52	-	C	88.0	9.89	40.0	5.72	-	0.1
	19-35	5.9	2.98	54.3	eo	24	22	54	-	SL	26.1	3.21	7.42	1.94	-	0.4
102T-2	0-7	6.6	3.31	28.7	e	74	10	16	-	SL	26.6	7.21	7.22	1.76	-	-
S-2;	7-16	7.1	3.57	32.0	e	50	32	18	-	L	32.7	5.43	4.21	0.96	-	-
2bc	16-21	7.4	10.0	30.1	eo	48	32	20	-	L	27.8	34.4	68.5	12.3	-	-
102T-3	0-5	7.2	4.39	50.2	eo	24	30	46	-	C	25.6	3.45	16.6	4.36	-	-
S-3;	5-13	7.0	2.98	49.0	eo	24	32	44	-	C	16.5	1.72	10.7	3.54	-	-
(-3ab,	13-25	6.5	4.08	52.7	eo	24	32	44	-	C	36.9	5.06	5.33	1.16	-	- 3ab,
4-3ab	25-34	6.8	3.62	47.2	eo	24	32	44	-	C	30.1	4.72	6.82	1.63	-	-
	34-59	6.8	4.22	37.4	eo	52	24	24	-	SCL	24.9	3.69	17.8	4.70	-	-
102T-4	0-2	7.6	5.66	77.7	eo	24	22	54	-	C	24.0	5.12	30.0	7.86	-	0.1
S-4	2-7	7.7	9.39	247	eo	34	6	60	-	C	22.4	8.13	75.5	19.3	-	-
4ac,	7-10	7.8	9.31	264	eo	28	24	48	-	C	20.2	7.35	82.5	22.2	-	-
4-3ab	10-18	8.0	8.84	374	eo	14	20	66	-	C	14.7	6.45	74.5	22.9	-	-
S-1	*	5.9	9.92	62.2	(0.8)	20	26	54	--	C	28.3	8.45	74.5	17.4	--	--

(DL)

*Composite grab sample from existing soil stockpile.

PIT 108T

SITE DESCRIPTION

Approximately 50 acres were mapped for the area to be affected by pit 108T, Sections 24 and 25, T43N, R95W, Hot Springs County, Wyoming. The elevation ranges between 4,520 and 4,600 feet.

The soils are dominantly loess and residuum from interbedded sandstone and shale. The soils range from very shallow, undeveloped soils over sandstone or shale to deep, loamy, moderately developed soils occurring on the ridges.

Soil 108T-3 is the deepest soil available in the area providing about 30 inches of topsoil. Other shallow soils provide topsoil material in thicknesses ranging from 4 to 8+ inches.



TABLE D-7.1-6

PIT 108T

DETAILED SOIL SERIES CHARACTERISTICS

Soil Series ^a Profile No.; (Map Unit)	Depth (Inches)	Drainage Class	Slopes (%)	Parent Material and Landform	Native Vegetation	Permeability	A.W.C. ^a (in./in.)	Effective Rooting Depth (Inches)
108T-1	moder- ately deep (20-40)	well	5-15	loess and resi- duum from inter- bedded sandstone and shale on ridge crests and sideslopes	bluebunch wheatgrass, big sage, phlox and lichens	moderate	.09-.19	to bedrock (20 to 40)
108T-2	very shallow to shal- low (5-20)	well	3-12	loess and resi- duum from inter- bedded sandstone and shale on ridge crests and sideslopes	bluebunch wheatgrass, big sage, and lichens	moderate	.11 - .14	to bedrock (20 to 40)
108T-3	deep (40-60)	well	3-8	loess and resi- duum from sand- stone and shale on rolling ridges	big sage, bluebunch wheatgrass, needle and thread grass	moderate	.11 - .21	40
108T-4	very shallow to shallow (5-20)	moder- ately well	8	residuum from interbedded sandstone and shale on rol- ling ridges	big sage, bluebunch wheatgrass	moderate	.13 - .17	40

^a Soils were not correlated with soil series as used by the SCS.

^b A wide range is given since these soils are stratified and textures range from CN-SL to SC.

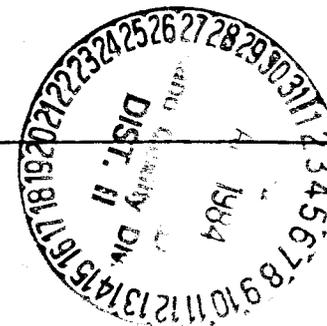


TABLE D-7.1-6 (Cont.)

PIT 108T

PROFILE CHARACTERISTICS: FIELD ANALYSIS

Soil Series; Pedon No; (Map Unit)	Horizon	Depth (Inches)	Boundary	Color		Consistency			Structure			Coarse Fragments (Percent)
				Dry	Moist	Dry	Moist	Wet	Grade	Type	Size	
108T-1; (1ac)	A1	0-4	a,s	pale brn./dk.gr.brn.		so	vfr	ss,ps	1	gr	f	60
	IIB2t	4-15	a,s	brn.dk.brn./yel.brn.		sh	fi	s,p	2	sbk	f&m	0
	IIC1ca	15-24	ND	pale brn./brn.		so	fr	s,p	2	sbk	f&m	10
	R	24+	---	hard bedrock		--	--	---	-	---	---	--
108T-2; (2ab, 2R0ac)	A1	0-2	d	pale brn./brn.		so	vfr	ss,ps	1	gr	vf	10
	C1ca	2-8	a,w	brn./dk.brn.		sh	vfr	ss,ps	1	sbk-gr	f	25
	R	8+	---	hard, sandstone bedrock		--	---	---	-	--	--	--
108T-3; (3ab)	A11	0-1.5	c,s	pale brn./brn.		lo	vfr	ss,ps	1	gr-sg	vf	2
	A12	1.5-8	g,s	pale brn./brn.		so	vfr	ss,ps	1	gr	f	-
	B2t	8-13	g,s	brn./brn.		so	vfr	s,p	2	sbk	m&f	-
	B3tca	13-44	g,s	brn./yel.brn.		so-sh	vfr	s,p	2	sbk	m	-
	C1cacs	44-51	ND	brn./brn.		so-sh	vfr	s,p	-	ND	--	-
	C2	51-63+	ND	brn.dk.brn./yel.brn.		so	vfr	ss,p	-	ND	--	2
108T-4; (4ab,e4ab, 4ac)	A2	0-3	a,s	lt.gr./gr.brn.		lo	vfr	ss,ps	1	gr	f	50
	C1	3-7	a,s	gr./dk.gr.brn.		so	vfr	s,p	m	--	--	30
	R	7+	---	hard, gray sandstone, easily broken		---	---	---	-	--	--	--

ND= not described

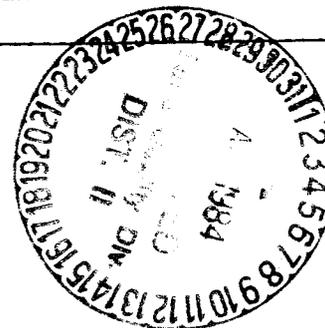
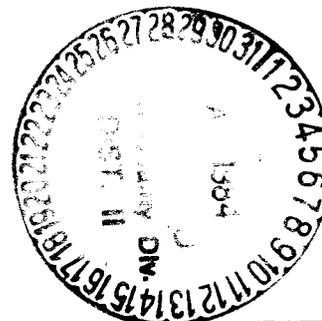


TABLE D-7.2-6

PIT 108T

SOIL MAP UNIT CHARACTERISTICS

Map Unit Symbol	Name	Soil Series (Inclusions)	Percent of Map Unit	Erosion Factors		Capability Subclass	Range Site ^a	Land Use
				K	WEG			
1ac	moderately deep, calcareous, channery, fine textured, moderately developed soils	108T-1	85	.23	4	7c	clayey	wildlife habitat grazing
		(other soils)	15					
2 ab	very shallow to shallow, calcareous, stony, loamy, undeveloped soils	108T-2	90	.18	3-4	7c	shallow loamy	wildlife habitat, grazing
		(other soils)	10					
2-ROab	very shallow to shallow, calcareous, stony, loamy, undeveloped soils -- rock outcrop complex	108T-2	50	.18	3-4	7c	shallow loamy	wildlife habitat, grazing
		RO	40					
		(other soils)	10					
3ab	deep to very deep, calcareous, loamy, moderately developed eolian deposited soils.	108T-3	95	.18	3-4	7c	loamy	wildlife habitat, grazing
4ab	shallow, calcareous, fine-textured, undeveloped soils	108T-4	85	.20	5	7c	shallow clayey	wildlife habitat, grazing
		(other soils)	15					

^a Range sites have not been correlated with site-specific vegetation data or with the SCS. Range sites used are from 10-14" precipitation zone, basins and foothills east, (USDA-SCS, WY, Nov. 1977. Technical Guide, Section II E).

TABLE D-7.3-6

PIT 108T

EVALUATION OF TOPSOIL SUITABILITY BY TYPICAL SOIL PEDON

Major Soils Profile No. (Map Unit)	Horizon	Depth (inches)	pH	EC	Saturation Percentage	SAR	Texture	Coarse Fragments	Consistency	Boron	Overall Rating	Restrictive Features
108T-1	A1	0-4	g	g	g	g	p	g-f	g	--	f-p	clayey
	IIB2t	4-15	g	g	p	p	p	g	f	--	p	clayey, sodic
	IIC1ca	15-24	g	f	f	p	f	g	g	--	f-p	sodic
108T-2	A1	0-2	g	g	g	g	g	g	g	--	g	----
	C1ca	2-8	g	g	g	g	g	g	g-f	--	g-f	dry consistence
108T-3	A11, A12	0-8	g	g	g	g	g	g	g	--	g	
	B2t	8-13	g	g	g	g	f	g	g	--	g-f	
	B31tca	13-28	g	g	g	f	f	g	g-f	--	f-p	sodic
	B32tca	28-44	g	f	g	u	f	g	g-f	--	f-u	sodic
	C1cacs	44-51	g	p	g	u	f	g	g	--	p-u	saline, sodic
C2	51-63+	g	u	g	u	f	g	g	--	u	saline, sodic	
108T-4	A2	0-3	g	g	g	g	g	g	g	--	g	----
	C1	3-7	g	g	g	g	f	g	g	--	g-f	finest

g = good, f = fair, p = poor, u = unsuitable

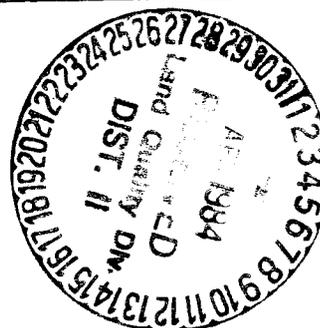


TABLE D-7.4-6

PIT 108T

DEPTH OF SUITABLE TOPSOIL MATERIAL BY SOIL MAP UNIT



Map Unit Symbol	Component Soils	Percent of Map Unit	Depth (Inches)	Topsoil Suitability Rating	Recommended Depth of Suitable Material (Principal restrictive features of suitable material)
1ac	108T-1	85	0-24	f-p	4 in. (clayey and sodic below)
2ab	108T-2	90	0-8	g-f	8+ in. (salvage to bedrock)
2-ROab	108T-2	50	0-8	g-f	8+in. (salvage to bedrock)
	RO	40		--	--
3ab	108T-3	95	0-13	g-f	30 in. (sodicity and salinity increase below 28 in.)
			3-28	f-u	
			28-63+	p-u	
4ab	108T-4	85	0-7	g-f	7+ in. (salvage to bedrock)
e4ab	108T-4	80	0-7	g-f	7+ in. (salvage to bedrock)
4ac	108T-4	85	0-7	g-f	7+ in. (salvage to bedrock)
	RO	85	--	---	--

-- Information not available or does not apply.

APPENDIX D-7.D (Part 1)

CLASSIFICATION OF PIT 108T SOILS

Soil	Family	Subgroup ¹
108T-1	loamy, mixed (calcareous)	Ustollic Haplargids
108T-2	fine-loamy, mixed (calcareous)	Lithic Ustic Torriorthents
108T-3	fine-loamy, mixed (calcareous)	Ustic Haplargids
108T-4	fine, montmorillonitic (calcareous), shallow	Ustic Torriorthents

¹ Soils are classified using Soil Taxonomy (USDA-SCS, 1975) but are not correlated to existing series used by the SCS.



APPENDIX D-7.D (Part 2)

SOIL MAP LEGEND

Map Unit Symbol	Name	Percent Slope
1ac	moderately deep, calcareous, channery, fine-textured, moderately developed soils.	5-20
2ab	very shallow to shallow, calcareous, stony, loamy, undeveloped soils	3-12
2-R0ac	very shallow to shallow, calcareous, stony, loamy, undeveloped soils - rock outcrop complex	3-15
3ab	deep to very deep, calcareous, loamy, moderately developed eolian deposited soils	3-8
4ab	shallow, calcareous, fine-textured, undeveloped soils	3-12
e4ab	shallow, calcareous, fine-textured, undeveloped soils, eroded	3-12
4ac	shallow, calcareous, fine-textured, undeveloped soils (not eroded)	3-20



APPENDIX D-7.D (Part 3)

LABORATORY ANALYSIS

PIT 108T

Soil Series; Pedon No., (Map unit)	Horizon Depth (in.)	pH	Con- d. tion mmhos/cm	Satura- tion %	Calcium Carbonate Reaction (% Lime)	% Sand	% Silt	% Clay	% VF	Soil Textural Class	Ca meg/l	Mg meg/l	Na meg/l	SAR	Se ppm	Boron ppm
108T-1	0-4	7.0	2.51	21.8	eo	66	24	10	-	SL	9.01	4.45	10.7	4.12	-	-
S-1;	4-15	7.7	1.93	87.6	e	30	10	50	-	C	2.35	1.02	14.4	11.1	-	-
(1ac)	15-24	7.4	7.96	79.1	e	38	28	34	-	CL	29.0	8.42	60.0	13.9	-	-
108T-2	0-2	7.0	2.63	39.6	eo	62	26	12	-	SL	25.1	5.15	4.32	1.11	-	-
S-2;	2-8	7.5	0.92	52.9	e	46	32	22	-	L	7.35	1.43	1.52	0.73	-	-
(2ab,2-R0ac)																
108T-3	0-8	7.2	0.80	43.4	e	32	26	16	26	SL	5.01	1.65	0.92	0.5	-	-
S-3;	8-13	7.8	0.83	44.4	e	15	34	30	21	CL	2.32	0.81	4.52	3.61	-	-
(3ab)	13-28	8.3	1.93	54.5	e	18	32	30	20	CL	2.11	1.36	16.4	12.5	-	-
	28-44	8.1	5.28	52.5	es	18	32	30	20	CL	6.23	4.44	48.5	21.0	-	-
	44-51	8.0	13.0	41.9	es	42	30	28	--	CL	26.9	21.2	103	28.9	-	-
	51-63	8.1	16.9	43.7	e	40	32	28	--	CL	29.1	31.3	159	28.9	-	-
108T-4	0-3	7.6	1.91	39.0	es	45	24	27	4	SCL	16.5	1.52	3.52	1.17	-	0.1
(4ab,e4ab, 4ac)	3-7	7.5	1.02	47.6	e	40	28	32	-	CL	5.48	0.69	4.22	2.40	-	0.1

APPENDIX D-7.E (Part 1)

CRITERIA FOR EVALUATION OF TOPSOIL SUITABILITY¹

Parameter	Suitable			Unsuitable	Restrictive Feature
	Good	Fair	Poor		
pH	6.0 - 8.4	5.5 - 6.0 8.4 - 8.8	5.0 - 5.5 8.8 - 9.0	5.0 9.0	Acid Alkaline
EC (Conductivity) mmhos/cm	0 - 4	4 - 8 8 may prove difficult to revegetate	8 - 16	16	Salty
Saturation Percentage	25 - 80		80 25		Clayey Droughty
SAR	6	6 - 10	10 - 15 10 - 12 ²	15	Sodium
Boron		less than 5.0 ppm		greater than 5.0 ppm	
Calcium Carbonate	0 - 15%	15 - 30%	Over 30%		Limy
Texture ³	sl, l, sil, scl, vfsl, fsl	cl, sicl, sc, ls, lfs	c, sic, s		Clayey ² Sandy
Coarse Frag. 3-10 in. (% Vol.) 10 in.	0 - 15 0 - 3	15 - 25 3 - 7	25 - 35 7 - 10	35 10	Cobbly Stony
Moist Consistency ³ Dry Consistency	vfr, fr lo, so	lo sh, h, fi	- vh, eh, vfi, efi		Loose Hard

1 From Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, Table I-2, January 1981.

2 For fine-textured soils (clay 40%).

3 Abbreviations are in Appendix.

APPENDIX D-7.E (Part 2)

KEY TO SOIL DESCRIPTION ABBREVIATIONS

COLOR (modified from Low, 1977) and MISC.

black.....blk.	medium.....med.
brown.....brn.	olive.....ol.
brownish gray.....brn. gr., etc.	pink.....pink
calcareous.....calc.	red.....red
coarse.....crse.	slightly.....sl.
dark.....dk.	variegated.....varig.
gray.....gr.	very.....v.
green.....grn.	white.....wh.
light.....lt.	yellow.....yel.

MOTTLING

Abundance:

few (<2% of surface).....f
common (2-20% of surface).....c
many (>20% of surface).....m

Size:

fine (<5mm).....1
medium (5-15mm).....2
coarse (>15mm).....3

Contrast: (Variations of hue and chroma of matrix and mottles):

faint (closely related).....f
distinct (1-2 hues and several units in chroma and value).....d
prominent (several units in hue, value, and chroma).....p

TEXTURE

Modifier:

BY Bouldery	CRC Coarse cherty	PT Peaty
BYV Very bouldery	CRV Very cherty	SH Shale
BYX Extremely bouldery	FL Flaggy	SHV Very shaly
180 Cobbly	FLV Very flaggy	SR Stratified
CBA Angular cobbly	GR Gravelly	ST Stony
CBV Very cobbly	GRC Coarse gravelly	STV Very stony
CN Channery	GRF Fine gravelly	STX Extremely stony
CNV Very channery	GRV Very gravelly	SY Slaty
CR Cherty	MK Mucky	SYV Very slaty

Texture of terms used in lieu of texture:

COS	Coarse sand	SI	Silt	HM	Hemic Material
S	Sand	SCL	Sandy clay loam	HV	Heavy
FS	Fine sand	CL	Clay loam	ICE	Ice/frozen soil
VFS	Very fine sand	SICL	Silty clay loam	IND	Indurated
LCOS	Loamy coarse sand	SC	Sandy clay	LT	Light
LS	Loamy sand	SIC	Silty clay	MARL	Marl
LFS	Loamy fine sand	C	clay	MPT	Mucky-peat
LVFS	Loamy very fine sand	CE	Coprogenous earth	MUCK	Muck
COSL	Coarse sandy loam	CEM	Cemented	PEAT	Peat
SL	Sandy loam	CIND	Cinders	SG	Sand & Gravel
FSL	Fine sandy loam	DE	Diatomaceous earth	SP	Sapric material
VFSL	Very fine sandy loam	FB	Fibric material	UWB	Unweathered bedrock
L	Loam	FRAG	Fragmental mat'l	VAR	Variable
SIL	Silt loam	G	Gravel	WB	Weathered bedrock
		GYP	Gypsiferous mat'l		

STRUCTURE

Grade

Form or Type:

Structureless.....0	Platy.....pl	Subangular blocky....sbk
Weak.....1	Prismatic.....pr	Granular.....gr
Moderate.....2	Columnar.....cpr	Crumb.....cr
Strong.....3	Blocky.....bk	Single grain.....sg
	Angular blocky...abk	Massive.....m

Size (differs with kind of structure as follows):

Size Class	Diameter of granules	Thickness of plates	Diameter of blocks	Diameter of prisms
vf - very fine or Very thin*	¼ 1 mm	¼ 1 mm	¼ 5 mm	¼ 10 mm
f - fine or thin*	1-2 mm	1-2 mm	5-10 mm	10-20 mm
m - medium	2-5 mm	2-5 mm	10-20 mm	20-50 mm
c - coarse or thick*	5-10 mm	5-10 mm	20-50 mm	50-100 mm
vc - very coarse or very thick*	½ 10 mm	½ 10 mm	½ 50 mm	½ 100 mm

* Read "thin" and "thick" for platy instead of "fine" and "coarse".

CONSISTENCE

Wet Soil:

nonsticky.....so
 slightly sticky...ss
 sticky.....s
 very sticky.....vs
 nonplastic.....po
 slightly plastic..ps
 plastic.....p
 very plastic.....vp

Moist Soil:

loose.....l
 very friable.....vfr
 friable.....fr
 firm.....fi
 very firm.....vfi
 extremely firm....efi

Dry Soil:

loose.....l
 soft.....s
 slightly hard.....sh
 hard.....h
 very hard.....vh
 extremely hard....eh
Cementation:
 weakly cemented....cw
 strongly cemented..cs
 indurated.....ci

REACTION

(Use pH figures)

Effervescence with HCl:

none.....eo
 slight.....e
 strong.....es
 violent.....ev

BOUNDARY

Distinctness:

abrupt (1" thick).....a
 clear (1"-2 1/2").....c
 gradual (2 1/2"-5").....g
 diffuse (5" thick).....d

TOPOGRAPHY:

smooth (nearly a plane).....s
 wavy (pockets, width 1/2 depth).....w
 irregular (pockets, depth 1/2 width).i
 broken (discontinuous).....b

ROOTS

Abundance of Roots
 (by number and size)

Code	Class	Very fine (1/4 1 mm)	Fine (1-2 mm)	Medium (2-5 mm)	Coarse (1/2 5 mm)
Average number per square decimeter					
1	Few	1/4 10	1/4 10	1/4 1	1/4 1
2	Common	10 - 100	10 - 100	1-10	1-5
3	Many	1/2 100	1/2 100	1/2 10	1/2 5

Size:

very fine (1 mm in diameter).....vf
 fine (1-2 mm in diameter).....f
 medium (2-5 mm in diameter).....m
 coarse (5 mm in diameter).....co

SOIL PORES

Abundance of pores by number and size

Code	Class	Very fine (0.1-0.5 mm)	Fine (0.5-2 mm)	Medium (2-5 mm)	Coarse (5-10 mm)
Average number per square decimeter					
1	Few	$\frac{1}{4}$ 25	$\frac{1}{4}$ 10	$\frac{1}{4}$ 1	$\frac{1}{4}$ 1
2	Common	25-100	10-50	1-5	1-2.5
3	Many	$\frac{1}{2}$ 200	$\frac{1}{2}$ 50	$\frac{1}{2}$ 5	$\frac{1}{2}$ 2.5

Continuity:

discontinuous.....dis
 constricted.....cons
 continuous.....cont

Shape:

vesicular.....v
 irregular or
 interstitial.....i
 tubular.....t

CLAY FILMS

Frequency (% of ped

faces and/or pores
 containing clay films):

very few (5%).....v1
 few (5-25%).....1
 common (25-50%).....2
 many (50-90%).....3
 continuous (90%).....4

Thickness:

thin.....n
 moderately thick.....mk
 thick.....k

Morphology:

On faces of peds.....pf
 Line tubular or
 interstitial pores..po
 Oriented clay occurs
 as bridges holding
 mineral grains together....br
 Colloid strains on
 mineral grains.....co

Topsoil and Subsoil Handling

Wyo-Ben will save all available soil for reclamation during the initial stripping part of mining as indicated by soil mapping of the proposed disturbance areas and Table D-7.7. Soils will be saved by one of two methods. Soils will be stockpiled with topsoil and subsoil being salvaged separately and signed to distinguish the two qualities. Alternatively, soils may be spread directly on a previously backfilled and contoured phase of mining, behind the current phase, when a new phase of mining is being opened (spreading soils live).

TABLE D-7.7 PROJECTED TOPSOIL AND SUBSOIL STOCKPILE VOLUMES AND AVERAGE SOIL REPLACEMENT DEPTHS.

PIT No.	Total Affected Acres	Stockpile Volume ^f Topsoil B.C.Y.	Stockpile Volume Subsoil B.C.Y.	Average TS/SS Replacement Depth in Inches	Total TS/SS to be removed in cubic yards
75T	18.8	5,700 yd ³	10,800yd ³	6"/ 15"	15,165 yd ³ / 28,774 yd ³
98T	16.0	4,400 yd ³	12,300yd ³	6"/ 17"	12,907 yd ³ / 36,570 yd ³
102T	20.8	10,700 yd ³	35,000yd ³	6"/ 20"	16,780 yd ³ / 55,930 yd ³
73T/104T	32.8	11,740 yd ³	44,600yd ³	6"/ 23"	26,460 yd ³ / 101,425 yd ³
108T	106.2	35,800 yd ³	18,100yd ³	6"/ 3"	85,670 yd ³ / 42,834 yd ³

^f Volumes include top and subsoils from projected stockpile areas.

GLOSSARY

- alluvium - Soil material, such as sand, silt, or clay that has been deposited by streams or running water, such as sheetwash.
- argillic horizon - A mineral soil horizon that is characterized by the accumulation of layer-lattice silicate clays from horizons above. The argillic horizon usually has coatings of oriented clay on the surface pores or peds or bridging sand grains.
- available water - The portion of water in a soil that can be absorbed by plant roots. The amount of water released by the soil when the water content is decreased from field capacity to wilting point.
- bedrock - The solid rock underlying soils and the regolith in depths ranging from zero (where exposed by erosion) to several hundred feet.
- capability subclass - As used by the SCS, is a rating of the suitability of the land for most kinds of farming. The numerical class is based on the degree of limitations of the soils, risk of damage through use, and their response to treatment. A lower number indicates soils with less limitations. The subclass, indicated by a letter symbol, classifies the limitation.
- calcareous soil - Soil containing sufficient free calcium carbonate or calcium-magnesium carbonate to effervesce visibly when treated with cold dilute hydrochloric acid.
- channers - Thin, flat fragments of limestone, sandstone, or schist up to 6 inches in major diameter. (In this study, most channers are less than 3 inches in diameter.)
- channery - Soil with up to 35 percent or more by volume of channer-size coarse fragments.
- classification, soil - The systematic arrangement of soils into groups or categories on the basis of their characteristics. USDA soil classification system (soil taxonomy) was adopted for use in publications by the National Cooperative Soil Survey.
- clay - 1) A soil separate consisting of particles $\frac{1}{4}$ 0.002 mm in equivalent diameter. 2) A textural class; 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- clay films - Coatings of clay on the surfaces of soil peds and mineral grains and in soil pores. (Also called clay skins).
- clayey - Containing large amounts of clay or having properties similar to those of clay.
- coarse fragments - Rock or mineral particles $\frac{1}{2}$ 2.0 mm in diameter.

cobble - Rocks between 7.5 and 25 cm in diameter (3 and 10 inches). See coarse fragments.

complex - Mapping unit where patterns of the major soil are so intricate within the landscape that they cannot be mapped separately at the field scale.

depth, soil - The term and their meanings used to describe depth of the soil over bedrock or over a restricting layer are: deep, more than 40 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

drainage, natural - The relative rapidity and extent of the removal of water from on and within the soil under natural conditions. Terms commonly used to describe drainage are:

Excessively drained - Water is removed from the soil rapidly, the soils are typically sandy and porous.

Well drained - Water is removed from the soil readily but not rapidly. There is no evidence of wetness above a depth of 40 inches.

Moderately well drained - Water is removed from the soil somewhat slowly so that the soil is wet for short, but significant, periods of time.

Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all the time. Wetness is apparent between a depth of 20 and 40 inches.

Poorly drained - Water is removed from the soil so slowly that the water table is at or on the surface most of the time. Wetness is apparent within 20 inches of the surface.

Very poorly drained - Water is removed from the soil so slowly that the water table is at or on the surface most of the time. These soils are generally in low areas or depressions.

erosion - The group of processes whereby earth or rock material is loosened or dissolved and removed from any part of the earth's surface.

erosion class - There are four classes used to distinguish the degrees of present erosion condition.

Class 1: few rills, few places in which A has evidence of accelerated erosion (up to 25 percent of A has been removed).

Class 2: surface has been eroded such that tillage reaches into the sub-soil; shallow gullies may be present; 25 to 75 percent of A is eroded.

Class 3: erosion of practically all of the A horizon and part of B; shallow gullies are common, deep gullies are few.

Class 4: an intricate pattern of moderately deep and deep gullies is observed.

fine texture - Consisting of or containing large quantities of the fine fractions, particularly of silt and clay. (Includes all clay loams and clays; that is, clay loam, sandy clay loam, silty clay loam, sandy clay, silty clay, and clay textural classes).

gravelly soil - A soil in which 20 to 50 percent of material by volume consists of fragments between 2 mm (1/8 inch) and 3 inches in diameter. A very gravelly soil is one in which 50 to 90 percent of material by volume is coarse fragments the size of gravel.

ground water - That portion of the water below the surface of the ground whose pressure is greater than atmospheric.

gully erosion - The erosion process whereby water accumulates in narrow channels and over short periods removes the soil from this narrow area to considerable depths, ranging from 0.56 meter to as much as 25 to 30 meters.

horizon, soil - A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes.

lithic contact - A boundary between soil and continuous coherent, underlying material. The underlying material must be sufficiently coherent to make hand digging with a spade impractical. If mineral, it must have a hardness of 3 or more (Mohs scale), and gravel size chunks that can be broken out do not disperse with 15 hours shaking in water or sodium hexametaphosphate solution.

loamy - Intermediate in texture and properties between fine-textured and coarse-textured soil. Includes all textural classes with the words "loam" or "loamy" as part of the class name, such as clay loam or loamy sand.

mesic - A soil temperature regime that has mean annual soil temperatures of 8° C or more but less than 15° C, and more than 5° C difference between mean summer and mean winter soil temperatures at 50 cm. Isomesic is the same except the summer and winter temperatures differ by less than 5° C.

mottling, soil - Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage.

paralithic contact - Similar to a lithic contact except that the mineral material below the contact has a hardness of less than 3 (Mohs scale), and gravel size chunks that can be broken out will partially disperse within 15 hours shaking in water or sodium hexametaphosphate solution.

parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.

particle size - The effective diameter of a particle measured by sedimentation, sieving or micrometric methods.

permeability, soil - That quality of the soil that enables it to transmit water or air. Terms used to describe permeability in inches per hour are: very slow, less than 0.06 inch; slow, 0.06 to 0.2 inch; moderately slow,

0.2 to 0.6 inch; moderate, 0.6 to 2.0 inches; moderately rapid, 2.0 to 6.0 inches; rapid, 6.0 to 20 inches; and very rapid, more than 20 inches.

pH, soil - The negative logarithm of the hydrogen-ion activity of a soil. The degree of acidity (alkalinity) of a soil as determined by means of a glass, quinhydrone, or other suitable electrode or indicator at a specified moisture content or soil-water ratio, and expressed in terms of the pH scale.

physiographic - Pertaining to the study of the genesis and evolution of land forms.

profile, soil - A vertical section of the soil through all its horizons and extending into the parent material.

rock land - Areas containing frequent rock outcrops and shallow soils. Rock outcrops usually occupy from 25 to 90 percent of the area. A miscellaneous land type.

skeletal - A soil on which rock fragments 2 mm or larger in diameter make up 35 percent or more by volume.

slope, soil - In this report, slope is expressed in general descriptive terms. Each term refers to the range of slope expressed in percent (number of feet of vertical rise or fall in 100 feet horizontal distance). Slope terms are given both single and complex slopes as follows:

<u>Simple Slopes</u>	<u>Complex Slopes</u>	<u>Percent Slope</u>
Nearly flat		Less than 1%
Nearly level	Gently undulating	1 to 2 percent
Gently sloping	Undulating	2 to 5 percent
Sloping	Gently rolling	5 to 15 percent
Moderately steep	Rolling	15 to 30 percent
Steep		30 to 40 percent
Very Steep		40 percent plus

sodium adsorption ratio (SAR) - A relation between soluble sodium and soluble divalent cations which can be used to predict the exchangeable-sodium percentage of soil equilibrated with a given solution. It is defined as follow:

$$SAR = \frac{\text{sodium, mmoles/liter}}{(\text{calcium} + \text{magnesium}) (\text{mmoles/liter})^{1/2}}$$

soil - 1) The consolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. 2) The unconsolidated mineral matter on the surface of the earth that has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and microorganisms, and topography, all acting over a period of time and producing a product -- soil -- that differs from the material from which it is derived in many physical, chemical, biological and morphological properties and characteristics.

soil complex - A mapping unit used in detailed soil surveys where two or more defined taxonomic units are so intimately intermixed geographically that it is undesirable or impractical, because of the scale being used, to separate them. A more intimate mixing of smaller areas of individual taxonomic units than that described under soil association.

soil horizon - A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical and biological properties or characteristics such as color, structure, texture, consistency, kinds and numbers of organisms present, degree of acidity or alkalinity, etc.

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