

**WHARF RESOURCES (USA) INC.
2010 BASELINE SOIL ASSESSMENT
WHARF AND GOLDEN REWARD
EXPANSION AREAS**

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SOILS

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SOILS

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Introduction

The Wharf and Golden Reward Expansion Areas was evaluated by BKS Environmental Associates, Inc. (BKS) of Gillette, Wyoming in August and October 2010. A total of 600.50 acres were included in the final soil mapping of the Wharf and Golden Reward Expansion Areas. Overall, 32 soil profiles were exposed and two road cuts were described for soil mapping. Soils mapped by BKS Environmental Associates, Inc. are illustrated in the Addendum E Map.

Stripping depths for the Wharf and Golden Reward Expansion Areas were evaluated during mapping. Soil depths within a given mapping unit will vary based on any combination of the five primary soil forming factors, i.e., climate including effective precipitation, organisms, relief or topography, parent material, and time. Subtle differences in any one of the previously mentioned factors will impact development between series and within series designation; however, it may not be as noticeable as when topography is a major factor. The proposed topsoil salvage depths for the Wharf and Golden Reward Expansion Areas are based on field observations of soils profiles found within the project area.

Soils in the Wharf and Golden Reward Expansion Areas are typical for soils formed under a mixed coniferous and deciduous forest occurring on the mountainous hillslopes of the Black Hills. Parent material included colluvium, residuum, and alluvium. Soils were classified taxonomically as Typic Palecryolls, Haplic Glossudalfs, Pachic Hapludolls, Eutric Haplocryalfs, Inceptic Hapludalfs, Glossic Hapludalfs, Typic Hapludalfs, Typic Ustorthents, and Typic Ustifluvents.

All soils have at least some suitable topsoil and/or subsoil except for rock outcrops and rubbleland. The primary limiting factor within the Wharf and Golden Reward Expansion Areas was coarse fragments. Rocks inhibited soil auguring on every hole except for one, where paralithic material was found.

The project boundary was altered after field work was completed. Due to this, the original boundary is considered as the “Expansion Study Area” and the updated boundary is referred to as the “Expansion Area Project Boundary”. Acreages in this report reflect the Expansion Study Area.

Refer to Addendum A for the tables mentioned in the text. Refer to Addendum B for the Soil Mapping Unit Descriptions. Refer to Addendum C for the Soil Series Descriptions. Refer to Addendum D for the photographs. Refer to Addendum E for the map.

Methodology

General

Baseline soils inventories for the Wharf and Golden Reward Expansion Areas consisted of refinement of the current Natural Resources Conservation Service (NRCS) mapping for Lawrence County, South Dakota.

Review of Existing Literature

NRCS mapping within the Wharf and Golden Reward Expansion Areas and historical soils information was reviewed.

Soil Survey

Field mapping was conducted according to techniques and procedures outlined in the National Cooperative Soil Survey. Wyoming Department of Environmental Quality (WDEQ) Land Quality Division (LQD) Guideline 1 (August 1994 Revision) was used as a guide during all phases of the study.

A reconnaissance of the project area was done by field personnel during December 2009. Following the reconnaissance survey, an Order 2 soil survey was conducted during August 2010. In October 2010, Wharf added 28 acres to the expansion area in Section 33. Additional fieldwork was completed for the expansion area on October 6th, 2010. Soil profiles were examined on a widely scattered basis according to physiographic configuration. Information derived from these profiles was used to determine which soils are likely to occur on specific landscape positions. The soil boundaries were delineated on a 1:7,200 topographic base map, for purposes of permit submittal. Refer to Table 1 for permit and proposed disturbance acreages.

Soil Mapping and Description

Laboratory analysis of soil series was not required within the Wharf and Golden Reward Expansion Areas. However, twenty six samples were taken for potential future reference and are stored at the Wharf Mine. Please see Table 1 for project mapping units and associated acreages. All soil profiles were collected with a Giddings truck mounted auger or hand auger to paralthic contact or a maximum depth of 60 inches, whichever was shallower. Most holes were obstructed by rocks, due to the high coarse fragment content of the soils. Sample profiles were described in the field, to the extent possible, by the physical and chemical nature of each profile horizon. Road cuts were viewed, whenever possible, to view a vertical profile. Backhoe pits were not utilized for soil mapping.

Soil mapping verification locations were identified on a base map and global positioning system (GPS) locations were collected with hand-held Garmin GPS units.

Results and Discussion

Soil Survey – General

General topography of the area ranged from valleys to very steep hills and mountainous slopes. The soils occurring on the Wharf and Golden Reward Expansion Areas were generally loamy. The project area contained deep and rocky soils throughout most of the area.

Soil Mapping Unit Interpretation

The primary purpose of the 2010 fieldwork was to characterize the soils within the project areas in terms of topsoil salvage depths and related physical and chemical properties. Refer to Addendum B and C for soil mapping unit descriptions and soil series descriptions, respectively.

Evaluation of Soil Suitability as a Plant Growth Medium

Approximate salvage depths of each map unit series is presented in Table 2 and ranged from 0 to 18 inches. Within the project areas, suitability of soil as a plant growth medium was generally affected by the physical factor of coarse fragments. Chemical limiting factors such as EC and SAR were not considered to be an issue because no salts were noted within the profiles. It is assumed that pH levels were strongly acidic to moderately alkaline. Calcium carbonate was only noted in two profiles within the Winetti soil series.

Topsoil Volume Calculations

Based on the 2010 fieldwork with associated field observations, the recommended topsoil average salvage depth over the Wharf and Golden Reward Expansion Areas was determined to be 5.39 inches. Refer to Table 2, Summary of Approximate Soil Salvage Depths.

Soil Erosion Properties and Impacts

Based on the soil mapping unit descriptions, the hazard for wind and water erosion within project areas varies from negligible to moderate. The potential for wind and water erosion is mainly a factor of surface characteristics of the soil, including texture and organic matter content. Given the loamy texture of the surface horizons throughout the majority of the project, the soils are more susceptible to erosion from water than wind. See Table 3 for a summary of wind and water erosion hazards within the project areas.

References

U.S. Department of Agriculture, Natural Resource Conservation Service. 1979. Soil Survey: Lawrence County, South Dakota.

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U.S. Department of Agriculture. 1975. Soil Taxonomy. U.S. Dept. of Agric. Handbook 436, 754 pp. Government Printing Office.

U.S. Department of Agriculture. 1993. Soil Survey Manual. U.S. Dept. of Agric. Handbook 18, 437 pp. Government Printing Office.

Wyoming Department of Environmental Quality, Land Quality Division. 1994. Guideline 1, Topsoil and Overburden.

ADDENDUM A
TABLES

Table 1: Soil Map Unit Acreages

Map Symbol	Map Unit Description	Permit Acreage	% Total Permit Area
Ci	Citadel silt loam	5.61	0.93
Go	Goldmine loam	176.09	29.32
Gr	Grizzly very gravelly silt loam	118.62	19.75
Hi	Hisega loam	208.45	34.71
RO/R	Rock Outcrop/Rubbleland	30.73	5.12
Sa	Sawdust channery loam	9.15	1.52
Tr	Trebor silt loam	18.01	3.00
Va	Vanocker gravelly silt loam	3.49	0.58
Vi	Virkula silt loam	2.06	0.34
Wi	Winetti gravelly sandy loam	28.29	4.71
Total		600.50	100.00

Table 2: Approximate Soil Salvage Depths

Map Symbol	Map Unit Description	Permit Acreage¹	Salvage Depth² (Inches)	Total Volume of Topsoil³ (Feet)
Ci	Citadel silt loam	5.61	11.00	5.14
Go	Goldmine loam	176.09	5.00	73.37
Gr	Grizzly very gravelly silt loam	118.62	2.00	19.77
Hi	Hisega loam	208.45	8.00	138.97
RO/R	Rock Outcrop/Rubbleland	30.73	0.00	0.00
Sa	Sawdust channery loam	9.15	2.00	1.52
Tr	Trebor silt loam	18.01	13.00	19.51
Va	Vanocker gravelly silt loam	3.49	12.00	3.49
Vi	Virkula silt loam	2.06	18.00	3.10
Wi	Winetti gravelly sandy loam	28.29	2.00	4.72
Average Salvage Depth of Study Area⁴		---	5.39	---
Total		600.50	---	269.59

¹Found in Table 1 of this report

²Found in Addendum B of this report, under Topsoil Suitability

³Calculated by multiplying permit acreage by salvage depth in inches

⁴Calculated as the average of the weighted average salvage depths found in Addendum B

Table 3: Wind and Water Erosion Hazards

Map Unit Symbol	Soil Series	Water Erosion Hazard¹	Wind Erosion Hazard²
Ci	Citadel silt loam	Moderate	Slight
Go	Goldmine loam	Slight	Slight
Gr	Grizzly very gravelly silt loam	Slight	Negligible
Hi	Hisega loam	Slight	Slight
Sa	Sawdust channery loam	Slight	Moderate
Tr	Trebor silt loam	Moderate	Slight
Va	Vanocker gravelly silt loam	Moderate	Slight
Vi	Virkula silt loam	Moderate	Slight
Wi	Winetti gravelly sandy loam	Slight	Slight

¹Based on Kw factor of the A horizon from the NRCS Soil Data Mart
 {<http://soildatamart.nrcs.usda.gov/>}

²Based on Wind Erodibility Group from the NRCS Soil Data Mart
 {<http://soildatamart.nrcs.usda.gov/>}

ADDENDUM B
SOIL MAP UNIT DESCRIPTION

Citadel silt loam¹ – Ci

This map unit consists of very deep, well drained soils formed in residuum and local alluvium from calcareous sandstone, limestone, and soft shale. Slopes range from 2 to 50 percent. The Citadel soil occurs on mountains at elevations between 3,800 and 6,200 feet.

The average annual precipitation ranges from 20 to 30 inches. The mean annual air temperature is approximately 39 to 45 degrees Fahrenheit and the average frost-free season is approximately 60 to 110 days.

Permeability within the Citadel soil is moderately low to moderately high. The available water capacity is high. Effective rooting depth is greater than 60 inches. Surface runoff is medium to very high. The hazard of water erosion is moderate and the hazard of wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 11 inches based on an average of 2010 sample locations. The 11-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Goldmine loam¹ – Go

This map unit consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Slopes range from 3 to 75 percent. The Goldmine soil occurs on mountain hillslopes at elevations between 5,100 and 7,000 feet.

The average annual precipitation ranges from 25 to 30 inches. The mean annual air temperature is approximately 42 to 48 degrees Fahrenheit and the average frost-free season is approximately 60 to 100 days.

Permeability within the Goldmine soil is moderate. The available water capacity is moderate. Effective rooting depth is greater than 60 inches. Surface runoff is high. The hazard of water or wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 5 inches based on an average of 2010 sample locations. The 5-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Grizzly very gravelly silt loam¹ – Gr

This map unit consists of very deep, well drained soils formed in residuum from igneous rocks. Slopes range from 6 to 80 percent. The Grizzly soil occurs on mountains at elevations between 4,400 and 6,400 feet.

The average annual precipitation ranges from 22 to 30 inches. The mean annual air temperature is approximately 39 to 45 degrees Fahrenheit and the average frost-free season is approximately 60 to 100 days.

Permeability within the Grizzly soil is moderately low to moderately high. The available water capacity is moderate. Effective rooting depth is greater than 60 inches. Surface runoff is medium to very rapid. The hazard of water is slight and the hazard of wind erosion is negligible.

Topsoil Suitability

This map unit is a fair source of topsoil to 2 inches based on an average of 2010 sample locations. The 2-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Hisega loam¹ – Hi

This map unit consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks. Slopes range from 15 to 65 percent. The Hisega soil occurs on mountains at elevations between 3,600 and 6,300 feet.

The average annual precipitation ranges from 18 to 27 inches. The mean annual air temperature is approximately 34 to 45 degrees Fahrenheit and the average frost-free season is approximately 60 to 100 days.

Permeability within the Hisega soil is moderate. The available water capacity is low. Effective rooting depth is greater than 60 inches. Surface runoff is medium to very high. The hazard of water or wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 8 inches based on an average of 2010 sample locations. The 8-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Sawdust channery loam¹ – Sa

This map unit consists of very deep, well drained soils formed in residuum and colluvial sediments from calcareous sandstone and limestone. Slopes range from 6 to 80 percent. The Sawdust soil occurs on mountain slopes at elevations between 3600 and 6200 feet.

The average annual precipitation ranges from 18 to 26 inches. The mean annual air temperature is approximately 37 to 45 degrees Fahrenheit and the average frost-free season is approximately 80 to 125 days.

Permeability within the Sawdust soil is moderate. The available water capacity is low. Effective rooting depth is greater than 60 inches. Surface runoff is medium to high. The hazard of water erosion is slight and the hazard of wind erosion is moderate.

Topsoil Suitability

This map unit is a fair source of topsoil to 2 inches based on an average of 2010 sample locations. The 2-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Trebor silt loam¹ – Tr

This map unit consists of moderately deep, well drained soils formed in residuum from limestone. Slopes range from 6 to 60 percent. The Trebor soil occurs on mountains at elevations between 6,200 to 7,200 feet.

The average annual precipitation ranges from 18 to 28 inches. The mean annual air temperature is approximately 32 to 45 degrees Fahrenheit and the average frost-free season is approximately 60 to 100 days.

Permeability within the Trebor soil is moderately slow in the solum and moderate in the underlying material. The available water capacity is low. Effective rooting depth is 20 to 40 inches. The hazard of water is moderate and the hazard of wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 13 inches based on an average of 2010 sample locations. The 13-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Vanocker gravely silt loam¹ – Va

This map unit consists of deep to very deep, well drained soils formed in residuum and colluvium from sedimentary rocks. Slopes range from 2 to 80 percent. The Vanocker soil occurs on gently sloping to very steep ridges and hillslopes in mountains at elevations between 3,600 and 6,200 feet

The average annual precipitation ranges from 20 to 30 inches. The mean annual air temperature is approximately 39 to 45 degrees Fahrenheit and the average frost-free season is approximately 60 to 110 days.

Permeability within the Vanocker soil is moderately low to moderately high. The available water capacity is low. Effective rooting depth is greater than 40 to 80 inches. Surface runoff is medium to very high. The hazard of water erosion is moderate and the hazard of wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 12 inches based on an average of 2010 sample locations. The 12-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Virkula silt loam¹ – Vi

This map unit consists of very deep and deep, well drained soils formed in silty materials weathered from igneous and metamorphic rocks. Slopes range from 2 to 35 percent. The Virkula soil occurs on mountains at elevations between 3600 and 6200 feet.

The average annual precipitation ranges from 18 to 26 inches. The mean annual air temperature is approximately 37 to 45 degrees Fahrenheit and the average frost-free season is approximately 80 to 120 days.

Permeability within the Virkula soil is moderately slow in the solum and moderate or moderately slow in the underlying material. The available water capacity is high. Effective rooting depth is greater than 60 inches. Surface runoff is medium to very high. The hazard of water erosion is moderate and the hazard of wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 18 inches based on an average of 2010 sample locations. The 18-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

Winetti gravelly sandy loam¹ – Wi

This map unit consists of consists of very deep, somewhat excessively drained, moderately rapidly permeable soils that formed in mixed alluvium from sedimentary rocks. Slopes range from 0 to 8 percent. The Winetti soil occurs on long, narrow, gently sloping bottoms or valleys and strongly sloping toeslopes at elevations of 7,100 to 8,000 feet.

The average annual precipitation ranges from 12 to 18 inches. The mean annual air temperature is approximately 42 to 45 degrees Fahrenheit and the average frost-free season is approximately 80 to 100 days.

Permeability within the Winetti soil is moderately rapid. The available water capacity is very low. Effective rooting depth is 8 to 61 inches due to strongly contrasting textural stratification. Surface runoff is medium. The hazard of water or wind erosion is slight.

Topsoil Suitability

This map unit is a fair source of topsoil to 2 inches based on an average of 2010 sample locations. The 2-inch salvage depth was used in Table 2 Approximate Soil Salvage Depths to calculate topsoil salvage volumes for the Goldmine series.

¹Map unit description based on current and 1979 Lawrence County NRCS information.

ADDENDUM C
SOIL SERIES DESCRIPTIONS

Goldmine channery loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 1

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

Oi--0 to 1 inch; relatively undecomposed pine needles, twigs and other wood fragments, aspen leaves and twigs, and grass leaves and stems.

AE--1 to 4 inches; very dark grayish brown (10YR 3/2) channery loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to weak medium and moderate fine subangular blocky; soft, friable, nonsticky and nonplastic; common very fine, fine, medium and coarse roots; about 10 percent angular igneous channers and 5 percent subangular gravel; slightly acid; clear wavy boundary. (10 to 18 cm thick)

E--4 to 10 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E/Bt--10 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay

films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 1 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.
 Mean annual soil temperature: 5 to 8 degrees C
 Mean summer soil temperature: 9 to 12 degrees c
 Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):
 Clay content: 28 to 35 percent
 Sand content: 10 to 25 percent
 Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:
 Hue: 10YR
 Value: 2, 3 or 4 dry
 Chroma: 1 or 2
 Texture: L, CN-L, GR-L
 Clay content: 12 to 22 percent
 Rock fragments: 5 to 25 percent
 Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):
 Hue: 10YR
 Value: 3, 4 or 5 dry
 Chroma: 2
 Texture: CN-L, GR-L, CNV-SIL, L
 Clay content: 12 to 22 percent
 Rock fragments: 10 to 35 percent
 Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is no typical Oe or A horizon present in this profile.

Goldmine gravelly loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 2

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

A--0 to 2 inches; black (10YR 2/1) gravelly loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 10 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

AE--2 to 14 inches; very dark grayish brown (10YR 3/2) channery clay loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to weak medium and moderate fine subangular blocky; soft, friable, nonsticky and nonplastic; common very fine, fine, medium and coarse roots; about 10 percent angular igneous channers and 5 percent subangular gravel; slightly acid; clear wavy boundary. (10 to 18 cm thick)

Bt1--14 to 24 inches; yellowish brown (10YR 5/4) very channery loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--24 to 30 inches; yellowish brown (10YR 5/4) channery loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bt2--30 to 60 inches; yellowish brown (10YR 5/4) channery loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 2 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent

Rock fragments: 10 to 35 percent

Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3
Texture: CN-L, CNV-L, GRV-L, CBV-L
Clay content: 10 to 20 percent
Rock fragments: 20 to 55 percent
Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:
Hue: 10YR
Value: 5 or 6, 6 or 7 dry
Chroma: 3 to 6
Texture: CNV-CL, CNX-CL, CBX-SICL
Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay
Rock fragments: 35 to 90 percent
Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 30 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock
Landform: Gently sloping to steep mountain hillslopes
Slopes: 3 to 75 percent
Elevation: 1575 to 2125 meters
Mean annual air temperature: 6 to 9 degrees F
Mean annual precipitation: 650 to 760 mm
Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).
Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is no typical Oi, Oe, E or E/BT horizons present in this profile.

Goldmine channery loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 3

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

O/A--0 to 2 inches; slightly to moderately decomposed woody residue from pine trees and aspen, and herbaceous plant material mixed with black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E--2 to 16 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

Bt1--16 to 36 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bt2--36 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock

fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral.
(Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 3 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.
Mean annual soil temperature: 5 to 8 degrees C
Mean summer soil temperature: 9 to 12 degrees c
Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):
Clay content: 28 to 35 percent
Sand content: 10 to 25 percent
Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:
Hue: 10YR
Value: 2, 3 or 4 dry
Chroma: 1 or 2
Texture: L, CN-L, GR-L
Clay content: 12 to 22 percent
Rock fragments: 5 to 25 percent
Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):
Hue: 10YR
Value: 3, 4 or 5 dry
Chroma: 2
Texture: CN-L, GR-L, CNV-SIL, L
Clay content: 12 to 22 percent
Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:
Hue: 10YR
Value: 4 to 6, 6 or 7 dry
Chroma: 2 or 3
Texture: CN-L, CNV-L, GRV-L, CBV-L
Clay content: 10 to 20 percent
Rock fragments: 20 to 55 percent
Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 2 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is an O/A in place of the typical Oi, Oe, A and AE horizons. There is no typical E/Bt horizon.

Winetti very gravelly sandy loam

SOIL MAPPING UNIT: Wi

SOIL SAMPLE LOCATION: 4

TYPICAL PEDON: Winetti gravelly sandy loam--woodland. (Colors are for air-dry soil unless otherwise stated.)

The Winetti series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils that formed in mixed alluvium from sedimentary rocks. Slopes range from 0 to 8 percent. The mean annual temperature is 44 degrees F. and the mean annual precipitation is 16 inches.

A--0 to 3 inches; brown (7.5YR 5/2) very gravelly sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine interstitial pores; 60 percent pebbles and cobbles; slightly calcareous; mildly alkaline (pH 7.5); clear smooth boundary. (1 to 6 inches thick)

C1--3 to 8 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose; common fine roots; common fine interstitial pores; 20 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 4 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--8 to 17 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; common medium interstitial pores; 35 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (8 to 15 inches thick)

C3--17 to 24 inches; brown (7.5YR 5/4) and light yellowish brown (10YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak thick platy structure; soft, friable, slightly sticky and nonplastic; common very fine and coarse roots; few fine interstitial and tubular pores; 5 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 8 inches thick)

C4--24 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; loose; few very fine roots; common coarse interstitial pores; 60 percent pebbles and 5 percent cobbles; strongly calcareous; moderately alkaline (pH 8.0).

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 4 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Rock fragments in the particle-size control section average 35 to 50 percent. The mean annual soil temperature is about 44 to 47 degrees F., and the mean summer soil temperature at depths of 20 inches is about 49 to 64 degrees F. The organic matter content appears to decrease irregularly with depth. These soils are noncalcareous to strongly calcareous in the A horizon and moderately calcareous or strongly calcareous in the C horizons.

The A horizon has hue of 5YR to 10YR, value of 5 or 6 dry, 3 or 4 moist and chroma of 2 to 4.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 dry, 4 to 6 moist and chroma of 2 to 6. It is stratified gravelly and very gravelly loamy sand, gravelly and very gravelly sandy loam, sandy loam, loamy sand and gravelly loam.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description): Winetti soils are on long, narrow, gently sloping bottoms or valleys and strongly sloping toeslopes at elevations of 7,100 to 8,000 feet. They formed in mixed alluvium from sandstone, limestone and shale. Slope gradients are 0 to 8 percent. The average annual precipitation is 12 to 18 inches and the freeze-free period ranges from 80 to 100 days. The mean annual temperature is 42 to 45 degrees F., and the average summer temperature is 59 to 64 degrees F.

VARIATION FROM TYPICAL SERIES: There is no variation from the typical series.

Winetti gravelly loam

SOIL MAPPING UNIT: Wi

SOIL SAMPLE LOCATION: 5

TYPICAL PEDON: Winetti gravelly sandy loam--woodland. (Colors are for air-dry soil unless otherwise stated.)

The Winetti series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils that formed in mixed alluvium from sedimentary rocks. Slopes range from 0 to 8 percent. The mean annual temperature is 44 degrees F. and the mean annual precipitation is 16 inches.

A--0 to 4 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine interstitial pores; 25 percent pebbles; mildly alkaline (pH 7.5); clear smooth boundary. (1 to 6 inches thick)

C1--4 to 10 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose; common fine roots; common fine interstitial pores; 20 percent pebbles; noncalcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 4 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--10 to 17 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; common medium interstitial pores; 35 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (8 to 15 inches thick)

C3--17 to 24 inches; brown (7.5YR 5/4) and light yellowish brown (10YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak thick platy structure; soft, friable, slightly sticky and nonplastic; common very fine and coarse roots; few fine interstitial and tubular pores; 5 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 8 inches thick)

C4--24 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; loose; few very fine roots; common coarse interstitial pores; 60 percent pebbles and 5 percent cobbles; strongly calcareous; moderately alkaline (pH 8.0).

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 5 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Rock fragments in the particle-size control section average 35 to 50 percent. The mean annual soil temperature is about 44 to 47 degrees F., and the mean summer soil temperature at depths of 20 inches is about 49 to 64 degrees F. The organic matter content appears to decrease irregularly with depth. These soils are noncalcareous to strongly calcareous in the A horizon and moderately calcareous or strongly calcareous in the C horizons.

The A horizon has hue of 5YR to 10YR, value of 5 or 6 dry, 3 or 4 moist and chroma of 2 to 4.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 dry, 4 to 6 moist and chroma of 2 to 6. It is stratified gravelly and very gravelly loamy sand, gravelly and very gravelly sandy loam, sandy loam, loamy sand and gravelly loam.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description): Winetti soils are on long, narrow, gently sloping bottoms or valleys and strongly sloping toeslopes at elevations of 7,100 to 8,000 feet. They formed in mixed alluvium from sandstone, limestone and shale. Slope gradients are 0 to 8 percent. The average annual precipitation is 12 to 18 inches and the freeze-free period ranges from 80 to 100 days. The mean annual temperature is 42 to 45 degrees F., and the average summer temperature is 59 to 64 degrees F.

VARIATION FROM TYPICAL SERIES: This profile is less calcareous than typical.

Winetti gravelly sandy loam

SOIL MAPPING UNIT: Wi

SOIL SAMPLE LOCATION: 6

TYPICAL PEDON: Winetti gravelly sandy loam--woodland. (Colors are for air-dry soil unless otherwise stated.)

The Winetti series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils that formed in mixed alluvium from sedimentary rocks. Slopes range from 0 to 8 percent. The mean annual temperature is 44 degrees F. and the mean annual precipitation is 16 inches.

A--0 to 3 inches; brown (7.5YR 5/2) gravelly sandy loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine interstitial pores; 25 percent pebbles; mildly alkaline (pH 7.5); clear smooth boundary. (1 to 6 inches thick)

C1--3 to 12 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose; common fine roots; common fine interstitial pores; 20 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 4 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--12 to 17 inches; light yellowish brown (10YR 6/4) very gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, nonsticky and nonplastic; common very fine roots; common medium interstitial pores; 35 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (8 to 15 inches thick)

C3--17 to 24 inches; brown (7.5YR 5/4) and light yellowish brown (10YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak thick platy structure; soft, friable, slightly sticky and nonplastic; common very fine and coarse roots; few fine interstitial and tubular pores; 5 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 8 inches thick)

C4--24 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; loose; few very fine roots; common coarse interstitial pores; 60 percent pebbles and 5 percent cobbles; strongly calcareous; moderately alkaline (pH 8.0).

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 6 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Rock fragments in the particle-size control section average 35 to 50 percent. The mean annual soil temperature is about 44 to 47 degrees F., and the mean summer soil temperature at depths of 20 inches is about 49 to 64 degrees F. The organic matter content appears to decrease irregularly with depth. These soils are noncalcareous to strongly calcareous in the A horizon and moderately calcareous or strongly calcareous in the C horizons.

The A horizon has hue of 5YR to 10YR, value of 5 or 6 dry, 3 or 4 moist and chroma of 2 to 4.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 dry, 4 to 6 moist and chroma of 2 to 6. It is stratified gravelly and very gravelly loamy sand, gravelly and very gravelly sandy loam, sandy loam, loamy sand and gravelly loam.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 3 inches.

GEOGRAPHIC SETTING (according to official series description): Winetti soils are on long, narrow, gently sloping bottoms or valleys and strongly sloping toeslopes at elevations of 7,100 to 8,000 feet. They formed in mixed alluvium from sandstone, limestone and shale. Slope gradients are 0 to 8 percent. The average annual precipitation is 12 to 18 inches and the freeze-free period ranges from 80 to 100 days. The mean annual temperature is 42 to 45 degrees F., and the average summer temperature is 59 to 64 degrees F.

VARIATION FROM TYPICAL SERIES: There is no variation from the typical series.

Goldmine gravelly loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 7

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

A--0-4 inches; black (10YR 2/1) gravelly loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 20 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

AE--4 to 12 inches; very dark grayish brown (10YR 3/2) channery loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to weak medium and moderate fine subangular blocky; soft, friable, nonsticky and nonplastic; common very fine, fine, medium and coarse roots; about 10 percent angular igneous channers and 5 percent subangular gravel; slightly acid; clear wavy boundary. (10 to 18 cm thick)

E--12 to 20 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

E/Bt--20 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly

hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 7 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent

Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:
Hue: 10YR
Value: 4 to 6, 6 or 7 dry
Chroma: 2 or 3
Texture: CN-L, CNV-L, GRV-L, CBV-L
Clay content: 10 to 20 percent
Rock fragments: 20 to 55 percent
Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:
Hue: 10YR
Value: 5 or 6, 6 or 7 dry
Chroma: 3 to 6
Texture: CNV-CL, CNX-CL, CBX-SICL
Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay
Rock fragments: 35 to 90 percent
Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock
Landform: Gently sloping to steep mountain hillslopes
Slopes: 3 to 75 percent
Elevation: 1575 to 2125 meters
Mean annual air temperature: 6 to 9 degrees F
Mean annual precipitation: 650 to 760 mm
Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).
Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is no typical Oi and Oe horizons present in this profile.

Hisega channery loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 8

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

Oi--0 to 2 inch; forest litter and slightly decomposed forest litter. (1 to 3 inches thick)

A--2 to 5 inches; dark grayish brown (10YR 4/2) channery loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--5 to 9 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

C1--9 to 14 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--14 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 8 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume

in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 5 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is no variation from the typical series.

Goldmine loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 9

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

Oi--0 to 1 inch; relatively undecomposed pine needles, twigs and other wood fragments, aspen leaves and twigs, and grass leaves and stems.

A--1 to 5 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E1--5 to 14 inches; dark grayish brown (10YR 4/2) very channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

E2--14 to 15 inches; dark grayish brown (10YR 4/2) very channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E/Bt--15 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 9 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent
Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 5 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is no typical Oe or Ae horizon.

Goldmine channery loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 10

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

O/A--0 to 4 inches; slightly to moderately decomposed woody residue from pine trees and aspen, and herbaceous plant material mixed with black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E--4 to 8 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E/Bt--8 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock

fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 10 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent

Rock fragments: 10 to 35 percent

Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi, Oe and A horizon. There is no typical AE horizon.

Grizzly very gravelly loam

SOIL MAPPING UNIT: Gr

SOIL SAMPLE LOCATION: 11

TYPICAL PEDON: Grizzly very gravelly silt loam, on a southwest facing, convex slope of 50 percent, under a ponderosa pine forest at an elevation of about 1719 meters. (Colors are for moist soil unless otherwise stated.)

The Grizzly series consists of very deep, well drained soils formed in residuum from igneous rocks on mountains. They have moderate or moderately slow saturated hydraulic conductivity. Slopes range from 6 to 80 percent. The mean annual air temperature is about 6 degrees C, and the mean annual precipitation is about 635 mm.

E1--0 to 4 inches; brown (10YR 4/3) very gravelly loam, very pale brown (10YR 7/3), dry; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; 35 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E2--4 to 12 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; common fine roots; 45 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E3--12 to 21 inches; brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and coarse roots; 50 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (Combined thickness of the E horizon is 35 to 60 cm.)

Bt/E--21 to 33 inches; about 60 percent dark yellowish brown (10YR 4/4) very gravelly clay loam, yellowish brown (10YR 5/4) dry (Bt part), and 40 percent brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry (E part); weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; 60 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (25 to 50 cm thick)

Bt--33 to 43 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; 60 percent angular rhyolite fragments; many distinct brown (7.5YR 4/3) clay films on vertical ped faces; slightly acid; gradual wavy boundary. (23 to 90 cm thick)

BC--43 to 52 inches; strong brown (7.5YR 4/6) extremely gravelly clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; 70 percent angular rhyolite fragments; neutral; gradual wavy boundary. (0 to 25 cm thick)

C--52 to 60 inches; light olive brown (2.5Y 5/4) extremely gravelly clay loam, pale yellow (2.5Y 7/4) dry; common fine distinct mottles of yellowish brown (10YR 5/6); massive; very hard, friable, slightly sticky and slightly plastic; 70 percent angular rhyolite fragments; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 11 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Udic SMR

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 10 to 13 degrees C

Depth to glossic horizon: 36 to 61 cm

Particle-size control section:

Clay content (weighted average): 28 to 35 percent

Sand content: 10 to 25 percent fine and coarser sand

E Horizon:

Hue: 7.5YR, 10YR

Value: 4 to 6, 5 to 8 dry

Chroma: 2 or 3

Texture: L, SIL, or FSL (fine earth fraction)

Rock fragments: 20 to 70 percent angular to subangular igneous rock fragments

Reaction: moderately acid to neutral

Bt/E Horizon:

Hue, Value, and chroma have the same range as for their respective parts

Texture: L, SIL, CL, or SICL (fine earth fraction)

Rock fragments: 35 to 70 percent angular or subangular igneous fragments, of which 30 to 70 percent are gravel and 0 to 15 percent are cobble

Reaction: moderately acid to neutral

Bt horizon:

Hue: 7.5YR, 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 3 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 35 to 80 percent angular or subangular igneous rocks, of which 35 to 75 percent are gravel, and 5 to 25 percent are cobble

Reaction: moderately acid to neutral

BC Horizon:

Hue: 7.5YR or 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 4 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

C Horizon:

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4 to 7, 5 to 8 dry

Chroma: 4 to 6

Texture: L, CL, or SICL (fine-earth fraction)

Clay content: 20 to 32 percent

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum or local colluvium over residuum derived from igneous rocks (monzonite, phonolite, rhyolite, rhyolite porphyry, trachyte, and similar igneous materials)

Landform: hillslopes and broad ridges on mountains

Slopes: 6 to 80 percent

Elevation: 1,340 to 1,950 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 558 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 100 days

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon.

Grizzly very gravelly loam

SOIL MAPPING UNIT: Gr

SOIL SAMPLE LOCATION: 12

TYPICAL PEDON: Grizzly very gravelly silt loam, on a southwest facing, convex slope of 50 percent, under a ponderosa pine forest at an elevation of about 1719 meters. (Colors are for moist soil unless otherwise stated.)

The Grizzly series consists of very deep, well drained soils formed in residuum from igneous rocks on mountains. They have moderate or moderately slow saturated hydraulic conductivity. Slopes range from 6 to 80 percent. The mean annual air temperature is about 6 degrees C, and the mean annual precipitation is about 635 mm.

E1--0 to 4 inches; brown (10YR 4/3) very gravelly loam, very pale brown (10YR 7/3), dry; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; 35 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E2--4 to 8 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; common fine roots; 45 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E3--8 to 14 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and coarse roots; 50 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (Combined thickness of the E horizon is 35 to 60 cm.)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bt/E--14 to 33 inches; about 60 percent dark yellowish brown (10YR 4/4) very gravelly clay loam, yellowish brown (10YR 5/4) dry (Bt part), and 40 percent brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry (E part); weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; 60 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (25 to 50 cm thick)

Bt--33 to 43 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; 60 percent angular rhyolite fragments; many distinct brown (7.5YR 4/3) clay films on vertical ped faces; slightly acid; gradual wavy boundary. (23 to 90 cm thick)

BC--43 to 52 inches; strong brown (7.5YR 4/6) extremely gravelly clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; 70 percent angular rhyolite fragments; neutral; gradual wavy boundary. (0 to 25 cm thick)

C--52 to 60 inches; light olive brown (2.5Y 5/4) extremely gravelly clay loam, pale yellow (2.5Y 7/4) dry; common fine distinct mottles of yellowish brown (10YR 5/6); massive; very hard, friable, slightly sticky and slightly plastic; 70 percent angular rhyolite fragments; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 12 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Udic SMR

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 10 to 13 degrees C

Depth to glossic horizon: 36 to 61 cm

Particle-size control section:

Clay content (weighted average): 28 to 35 percent

Sand content: 10 to 25 percent fine and coarser sand

E Horizon:

Hue: 7.5YR, 10YR

Value: 4 to 6, 5 to 8 dry

Chroma: 2 or 3

Texture: L, SIL, or FSL (fine earth fraction)

Rock fragments: 20 to 70 percent angular to subangular igneous rock fragments

Reaction: moderately acid to neutral

Bt/E Horizon:

Hue, Value, and chroma have the same range as for their respective parts

Texture: L, SIL, CL, or SICL (fine earth fraction)

Rock fragments: 35 to 70 percent angular or subangular igneous fragments, of which 30 to 70 percent are gravel and 0 to 15 percent are cobble

Reaction: moderately acid to neutral

Bt horizon:

Hue: 7.5YR, 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 3 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 35 to 80 percent angular or subangular igneous rocks, of which 35 to 75 percent are gravel, and 5 to 25 percent are cobble

Reaction: moderately acid to neutral

BC Horizon:

Hue: 7.5YR or 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 4 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

C Horizon:

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4 to 7, 5 to 8 dry

Chroma: 4 to 6

Texture: L, CL, or SICL (fine-earth fraction)

Clay content: 20 to 32 percent

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum or local colluvium over residuum derived from igneous rocks (monzonite, phonolite, rhyolite, rhyolite porphyry, trachyte, and similar igneous materials)

Landform: hillslopes and broad ridges on mountains

Slopes: 6 to 80 percent

Elevation: 1,340 to 1,950 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 558 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 100 days

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon.

Grizzly very gravelly loam

SOIL MAPPING UNIT: Gr

SOIL SAMPLE LOCATION: 13

TYPICAL PEDON: Grizzly very gravelly silt loam, on a southwest facing, convex slope of 50 percent, under a ponderosa pine forest at an elevation of about 1719 meters. (Colors are for moist soil unless otherwise stated.)

The Grizzly series consists of very deep, well drained soils formed in residuum from igneous rocks on mountains. They have moderate or moderately slow saturated hydraulic conductivity. Slopes range from 6 to 80 percent. The mean annual air temperature is about 6 degrees C, and the mean annual precipitation is about 635 mm.

E1--0 to 4 inches; brown (10YR 4/3) very gravelly loam, very pale brown (10YR 7/3), dry; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; 35 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E2-- 4 to 8 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; common fine roots; 45 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E3--8 to 21 inches; brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and coarse roots; 50 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (Combined thickness of the E horizon is 35 to 60 cm.)

Bt/E--21 to 33 inches; about 60 percent dark yellowish brown (10YR 4/4) very gravelly clay loam, yellowish brown (10YR 5/4) dry (Bt part), and 40 percent brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry (E part); weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; 60 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (25 to 50 cm thick)

Bt--33 to 43 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; 60 percent angular rhyolite fragments; many distinct brown (7.5YR 4/3) clay films on vertical ped faces; slightly acid; gradual wavy boundary. (23 to 90 cm thick)

BC--43 to 52 inches; strong brown (7.5YR 4/6) extremely gravelly clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; 70 percent angular rhyolite fragments; neutral; gradual wavy boundary. (0 to 25 cm thick)

C--52 to 60 inches; light olive brown (2.5Y 5/4) extremely gravelly clay loam, pale yellow (2.5Y 7/4) dry; common fine distinct mottles of yellowish brown (10YR 5/6); massive; very hard, friable, slightly sticky and slightly plastic; 70 percent angular rhyolite fragments; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 13 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Udic SMR

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 10 to 13 degrees C

Depth to glossic horizon: 36 to 61 cm

Particle-size control section:

Clay content (weighted average): 28 to 35 percent

Sand content: 10 to 25 percent fine and coarser sand

E Horizon:

Hue: 7.5YR, 10YR

Value: 4 to 6, 5 to 8 dry

Chroma: 2 or 3

Texture: L, SIL, or FSL (fine earth fraction)

Rock fragments: 20 to 70 percent angular to subangular igneous rock fragments

Reaction: moderately acid to neutral

Bt/E Horizon:

Hue, Value, and chroma have the same range as for their respective parts

Texture: L, SIL, CL, or SICL (fine earth fraction)

Rock fragments: 35 to 70 percent angular or subangular igneous fragments, of which 30 to 70 percent are gravel and 0 to 15 percent are cobble

Reaction: moderately acid to neutral

Bt horizon:

Hue: 7.5YR, 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 3 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 35 to 80 percent angular or subangular igneous rocks, of which 35 to 75 percent are gravel, and 5 to 25 percent are cobble

Reaction: moderately acid to neutral

BC Horizon:

Hue: 7.5YR or 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 4 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

C Horizon:

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4 to 7, 5 to 8 dry

Chroma: 4 to 6

Texture: L, CL, or SICL (fine-earth fraction)

Clay content: 20 to 32 percent

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum or local colluvium over residuum derived from igneous rocks (monzonite, phonolite, rhyolite, rhyolite porphyry, trachyte, and similar igneous materials)

Landform: hillslopes and broad ridges on mountains

Slopes: 6 to 80 percent

Elevation: 1,340 to 1,950 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 558 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 100 days

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon.

Hisega channery loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 14

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

A--0 to 4 inches; dark grayish brown (10YR 4/2) channery loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 20 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--4 to 8 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--8 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 14 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon.

Goldmine loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 15

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

O/A--0 to 3 inches; slightly to moderately decomposed woody residue from pine trees and aspen, and herbaceous plant material mixed with black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E1--3 to 8 inches; very dark grayish brown (10YR 3/2) channery loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to weak medium and moderate fine subangular blocky; soft, friable, nonsticky and nonplastic; common very fine, fine, medium and coarse roots; about 10 percent angular igneous channers and 5 percent subangular gravel; slightly acid; clear wavy boundary. (10 to 18 cm thick)

E2--8 to 12 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E/Bt--12 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 15 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent
Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 3 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi, Oe and A horizon. There is no typical AE horizon.

Goldmine loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 16

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

O/A--0 to 3 inches; slightly to moderately decomposed woody residue from pine trees and aspen, and herbaceous plant material mixed with black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E1--3 to 10 inches; very dark grayish brown (10YR 3/2) channery loam, grayish brown (10YR 5/2) dry; weak fine and medium platy structure parting to weak medium and moderate fine subangular blocky; soft, friable, nonsticky and nonplastic; common very fine, fine, medium and coarse roots; about 10 percent angular igneous channers and 5 percent subangular gravel; slightly acid; clear wavy boundary. (10 to 18 cm thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E2--10 to 20 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

E/Bt--20 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 16 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 9 to 12 degrees c

Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):

Clay content: 28 to 35 percent

Sand content: 10 to 25 percent

Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:

Hue: 10YR

Value: 2, 3 or 4 dry

Chroma: 1 or 2

Texture: L, CN-L, GR-L

Clay content: 12 to 22 percent

Rock fragments: 5 to 25 percent

Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):

Hue: 10YR

Value: 3, 4 or 5 dry

Chroma: 2

Texture: CN-L, GR-L, CNV-SIL, L

Clay content: 12 to 22 percent
Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi, Oe and A horizon. There is no typical AE horizon.

Grizzly very gravelly loam

SOIL MAPPING UNIT: Gr

SOIL SAMPLE LOCATION: 17

TYPICAL PEDON: Grizzly very gravelly silt loam, on a southwest facing, convex slope of 50 percent, under a ponderosa pine forest at an elevation of about 1719 meters. (Colors are for moist soil unless otherwise stated.)

The Grizzly series consists of very deep, well drained soils formed in residuum from igneous rocks on mountains. They have moderate or moderately slow saturated hydraulic conductivity. Slopes range from 6 to 80 percent. The mean annual air temperature is about 6 degrees C, and the mean annual precipitation is about 635 mm.

E1--0 to 3 inches; brown (10YR 4/3) very gravelly loam, very pale brown (10YR 7/3), dry; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; 35 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E2--3 to 10 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; common fine roots; 45 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E3--10 to 21 inches; brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and coarse roots; 50 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (Combined thickness of the E horizon is 35 to 60 cm.)

Bt/E--21 to 33 inches; about 60 percent dark yellowish brown (10YR 4/4) very gravelly clay loam, yellowish brown (10YR 5/4) dry (Bt part), and 40 percent brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry (E part); weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; 60 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (25 to 50 cm thick)

Bt--33 to 43 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; 60 percent angular rhyolite fragments; many distinct brown (7.5YR 4/3) clay films on vertical ped faces; slightly acid; gradual wavy boundary. (23 to 90 cm thick)

BC--43 to 52 inches; strong brown (7.5YR 4/6) extremely gravelly clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; 70 percent angular rhyolite fragments; neutral; gradual wavy boundary. (0 to 25 cm thick)

C--52 to 60 inches; light olive brown (2.5Y 5/4) extremely gravelly clay loam, pale yellow (2.5Y 7/4) dry; common fine distinct mottles of yellowish brown (10YR 5/6); massive; very hard, friable, slightly sticky and slightly plastic; 70 percent angular rhyolite fragments; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 17 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Udic SMR

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 10 to 13 degrees C

Depth to glossic horizon: 36 to 61 cm

Particle-size control section:

Clay content (weighted average): 28 to 35 percent

Sand content: 10 to 25 percent fine and coarser sand

E Horizon:

Hue: 7.5YR, 10YR

Value: 4 to 6, 5 to 8 dry

Chroma: 2 or 3

Texture: L, SIL, or FSL (fine earth fraction)

Rock fragments: 20 to 70 percent angular to subangular igneous rock fragments

Reaction: moderately acid to neutral

Bt/E Horizon:

Hue, Value, and chroma have the same range as for their respective parts

Texture: L, SIL, CL, or SICL (fine earth fraction)

Rock fragments: 35 to 70 percent angular or subangular igneous fragments, of which 30 to 70 percent are gravel and 0 to 15 percent are cobble

Reaction: moderately acid to neutral

Bt horizon:

Hue: 7.5YR, 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 3 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 35 to 80 percent angular or subangular igneous rocks, of which 35 to 75 percent are gravel, and 5 to 25 percent are cobble

Reaction: moderately acid to neutral

BC Horizon:

Hue: 7.5YR or 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 4 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

C Horizon:

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4 to 7, 5 to 8 dry

Chroma: 4 to 6

Texture: L, CL, or SICL (fine-earth fraction)

Clay content: 20 to 32 percent

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum or local colluvium over residuum derived from igneous rocks (monzonite, phonolite, rhyolite, rhyolite porphyry, trachyte, and similar igneous materials)

Landform: hillslopes and broad ridges on mountains

Slopes: 6 to 80 percent

Elevation: 1,340 to 1,950 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 558 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 100 days

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon.

Winetti gravelly loam

SOIL MAPPING UNIT: Wi

SOIL SAMPLE LOCATION: 18

TYPICAL PEDON: Winetti gravelly sandy loam--woodland. (Colors are for air-dry soil unless otherwise stated.)

The Winetti series consists of very deep, somewhat excessively drained, moderately rapidly permeable soils that formed in mixed alluvium from sedimentary rocks. Slopes range from 0 to 8 percent. The mean annual temperature is 44 degrees F. and the mean annual precipitation is 16 inches.

A--0 to 4 inches; brown (7.5YR 5/2) gravelly loam, dark brown (7.5YR 3/2) moist; moderate fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; common fine interstitial pores; 25 percent pebbles; mildly alkaline (pH 7.5); clear smooth boundary. (1 to 6 inches thick)

C1--4 to 16 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, dark yellowish brown (10YR 4/4) moist; massive; loose; common fine roots; common fine interstitial pores; 20 percent pebbles; noncalcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 4 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--16 to 24 inches; brown (7.5YR 5/4) and light yellowish brown (10YR 6/4) sandy loam, dark brown (7.5YR 4/4) moist; weak thick platy structure; soft, friable, slightly sticky and nonplastic; common very fine and coarse roots; few fine interstitial and tubular pores; 5 percent pebbles; strongly calcareous; moderately alkaline (pH 8.0); clear wavy boundary. (0 to 8 inches thick)

C3--24 to 60 inches; yellowish red (5YR 5/6) very gravelly sandy loam, yellowish red (5YR 4/6) moist; massive; loose; few very fine roots; common coarse interstitial pores; 60 percent pebbles and 5 percent cobbles; strongly calcareous; moderately alkaline (pH 8.0).

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 18 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Rock fragments in the particle-size control section average 35 to 50 percent. The mean annual soil temperature is about 44 to 47 degrees F., and the mean summer soil temperature at depths of 20 inches is about 49 to 64 degrees F. The organic matter content appears to decrease irregularly with depth. These soils are noncalcareous to strongly calcareous in the A horizon and moderately calcareous or strongly calcareous in the C horizons.

The A horizon has hue of 5YR to 10YR, value of 5 or 6 dry, 3 or 4 moist and chroma of 2 to 4.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 dry, 4 to 6 moist and chroma of 2 to 6. It is stratified gravelly and very gravelly loamy sand, gravelly and very gravelly sandy loam, sandy loam, loamy sand and gravelly loam.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustifluvents

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 4 inches.

GEOGRAPHIC SETTING (according to official series description): Winetti soils are on long, narrow, gently sloping bottoms or valleys and strongly sloping toeslopes at elevations of 7,100 to 8,000 feet. They formed in mixed alluvium from sandstone, limestone and shale. Slope gradients are 0 to 8 percent. The average annual precipitation is 12 to 18 inches and the freeze-free period ranges from 80 to 100 days. The mean annual temperature is 42 to 45 degrees F., and the average summer temperature is 59 to 64 degrees F.

VARIATION FROM TYPICAL SERIES: This profile is less calcareous than typical.

Goldmine loam

SOIL MAPPING UNIT: Go

SOIL SAMPLE LOCATION: 19

TYPICAL PEDON: Goldmine loam, on a west-northwest facing, linear slope of 24 percent, in a mixed coniferous and deciduous woodland community at an elevation of about 1900 meters (Colors are for moist soil unless otherwise stated)

The Goldmine series consists of very deep, well drained soils that formed in colluvium and residuum derived from igneous rocks. Goldmine soils are on mountain hillslopes. Slopes range from 3 to 75 percent. Mean annual precipitation is about 735 cm and the mean annual temperature is about 7 degrees C.

Oi--0 to 1 inch; slightly to moderately decomposed woody residue from pine trees and aspen, and herbaceous plant material. (Combined thickness of the O horizon is 1 to 5 cm)

A--1 to 2 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium and strong fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine, fine, and medium and common coarse roots; about 5 percent angular igneous rock fragments as channers, gravel, and cobbles; neutral; abrupt smooth boundary. (7 to 15 cm thick)

E--2 to 10 inches; dark grayish brown (10YR 4/2) channery loam, light gray (10YR 7/2) moist; moderate medium platy structure parting to moderate fine and medium subangular blocky; soft, friable, nonsticky and nonplastic; common very fine and few fine, medium and coarse roots; about 20 percent angular igneous channers and 10 percent subangular gravel; slightly acid; gradual wavy boundary. (20 to 51 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E/Bt--10 to 29 inches; about 70 percent dark grayish brown (10YR 4/2) very channery loam (E), light gray (10YR 7/2) dry, and 30 percent dark yellowish brown (10YR 4/4) very channery clay loam (Bt), light yellowish brown (10YR 6/4) dry; moderate fine and medium subangular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few fine and medium roots; about 30 percent faint yellowish brown (10YR 5/6) clay films on ped faces and rock fragments (Bt part); about 35 percent angular igneous channers and 5 percent flagstones; slightly acid; gradual wavy boundary. (0 to 33 cm thick)

Bt1--29 to 37 inches; yellowish brown (10YR 5/4) very channery clay loam, light yellowish brown (10YR 6/4) dry; weak coarse and moderate medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 20 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; few medium and fine roots; about 60 percent angular igneous rock

fragments, of which 40 percent are channers, 10 percent cobbles, and 10 percent are flagstones; slightly acid; gradual irregular boundary.

Bt2--37 to 60 inches; yellowish brown (10YR 5/4) extremely channery clay loam, light yellowish brown (10YR 6/4) dry; weak fine and medium subangular blocky structure; slightly hard, firm, moderately sticky and slightly plastic; few medium and fine roots; about 50 percent faint dark yellowish brown (10YR 4/6) clay films on ped faces and 15 percent faint dark yellowish brown (10YR 4/6) clay films on rock fragments; about 85 percent igneous rock fragments, of which 65 percent are angular channers and 20 percent are flagstones; neutral. (Combined Bt horizons greater than 50 cm thick)

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 19 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: The soil moisture control section is typic udic.
Mean annual soil temperature: 5 to 8 degrees C
Mean summer soil temperature: 9 to 12 degrees c
Depth to lithic contact: greater than 152 cm to hard igneous bedrock

Particle-size control section (weighted average):
Clay content: 28 to 35 percent
Sand content: 10 to 25 percent
Rock fragments: 35 to 90 percent igneous rocks; 30 to 65 percent of which are angular channers, 5 to 15 percent subangular gravel, 0 to 40 percent angular cobbles, and 0 to 20 percent angular flagstones.

A horizon:
Hue: 10YR
Value: 2, 3 or 4 dry
Chroma: 1 or 2
Texture: L, CN-L, GR-L
Clay content: 12 to 22 percent
Rock fragments: 5 to 25 percent
Reaction: Neutral or slightly acid

AE horizon (EA in some pedons):
Hue: 10YR
Value: 3, 4 or 5 dry
Chroma: 2
Texture: CN-L, GR-L, CNV-SIL, L
Clay content: 12 to 22 percent
Rock fragments: 10 to 35 percent
Reaction: Neutral or slightly acid

E horizon:

Hue: 10YR

Value: 4 to 6, 6 or 7 dry

Chroma: 2 or 3

Texture: CN-L, CNV-L, GRV-L, CBV-L

Clay content: 10 to 20 percent

Rock fragments: 20 to 55 percent

Reaction: Neutral to medium acid

The E/Bt horizon (Bt/E in some pedons) has combined properties of the E and Bt horizons. It typically consists of about 60 percent E horizon material and 40 percent Bt horizon material.

Bt horizon:

Hue: 10YR

Value: 5 or 6, 6 or 7 dry

Chroma: 3 to 6

Texture: CNV-CL, CNX-CL, CBX-SICL

Clay content: 28 to 35 percent weighted average; upper part of horizon may have 35 to 40 clay

Rock fragments: 35 to 90 percent

Reaction: Neutral or slightly acid

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive Typic Palecryolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 2 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: Colluvium or residuum derived from Tertiary-aged igneous rock

Landform: Gently sloping to steep mountain hillslopes

Slopes: 3 to 75 percent

Elevation: 1575 to 2125 meters

Mean annual air temperature: 6 to 9 degrees F

Mean annual precipitation: 650 to 760 mm

Precipitation pattern: In most years, about half the annual precipitation occurs as snow or rain during the period March through June. The driest period normally is from late summer (September) through early winter (January).

Frost-free period: 60 to 100 days.

VARIATION FROM TYPICAL SERIES: There are no typical Oe or AE horizons in the profile.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 20

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

A--0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--4 to 19 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--19 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 20 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon found in this profile.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 21

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

A--0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

A/B--6 to 12 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

Bt--12 to 24 inches; brown (10YR 5/3) channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 20 percent by volume fragments of schist; neutral; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C--24 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 21 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 24 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon. There is an A/B horizon in place of the typical Bw horizon and a Bt horizon in place of the typical C horizon.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 22

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

A--0 to 3 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--3 to 9 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--9 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 22 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 9 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon found in this profile.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 23

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

O/A--0 to 6 inch; forest litter and slightly decomposed forest litter mixed with dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--6 to 14 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--14 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 23 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 14 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi and A horizons.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 24

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

O/A--0 to 4 inch; forest litter and slightly decomposed forest litter mixed with dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--4 to 12 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--12 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 24 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 12 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi and A horizons.

Trebor loam

SOIL MAPPING UNIT: Tr

SOIL SAMPLE LOCATION: 25

TYPICAL PEDON: Trebor silt loam - on a 13 percent convex northwest-facing slope under a ponderosa pine forest at 6,700 feet. (Colors are for dry soil unless otherwise stated.)

The Trebor series consists of moderately deep, well drained soils formed in residuum from limestone. They have moderately slow permeability in the solum and moderate permeability in the underlying material. Slopes range from 6 to 60 percent. Mean annual temperature is about 38 degrees F, and mean annual precipitation is about 24 inches.

A--0 to 3 inches; pinkish gray (7.5YR 7/2) loam, dark brown (7.5YR 4/2) moist; weak medium and thick platy structure; slightly hard, friable; many fine roots; slightly acid; abrupt wavy boundary. (1 to 4 inches thick)

Bw--3 to 10 inches; reddish brown (5YR 5/3) channery clay loam, reddish brown (5YR 4/3) moist; faces of peds dark reddish brown (5YR 3/3) moist; weak coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; common fine and coarse roots; common fine pores; 20 percent by volume fragments of limestone; neutral; gradual wavy boundary. (4 to 8 inches thick)

BC--10 to 14 inches; reddish brown (5YR 5/3) and very pale brown (10YR 7/4) channery loam, reddish brown (5YR 4/3) and yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and coarse roots; 20 percent by volume fragments of limestone; no effervescence; slightly alkaline; gradual wavy boundary. (3 to 7 inches thick)

C--14 to 28 inches; yellow (10YR 8/6) channery silty clay loam, brownish yellow (10YR 6/6) moist; weak medium and coarse subangular blocky structure; hard, friable; few fine and coarse roots; 20 percent by volume fragments of limestone; no effervescence; moderately alkaline; gradual wavy boundary.

R--30 to 60 inches; non-calcaerous weathered grey shale.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 25 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to the base of the argillic horizon is 5 to 10 inches. Coarse fragments range from 5 to 60 percent by volume in the solum and from 35 to 80 percent by volume in the C horizon. The control section averages

from 18 to 35 percent clay and 35 to 60 percent by volume of coarse fragments. Depths to carbonates ranges from 5 to 14 inches. Depth to bedrock ranges from 20 to 40 inches.

The E horizon has hue of 7.5YR or 10YR, value of 4 to 7 and 3 to 5 moist, and chroma of 2 or 3. It is loam, silt loam, channery loam, channery silt loam, flaggy loam, or flaggy silt loam. It is moderately or slightly acid. Some pedons have an A horizon of 1 inch or less in thickness.

The Bt horizon has hue of 5YR to 10YR, value of 4 to 6 and 3 or 4 moist, and chroma of 3 or 4. It is clay loam, silty clay loam, silty clay or clay and contains up to 60 percent channers and flagstones. It averages between 35 and 50 percent clay. It is slightly acid or neutral.

Some pedons have a thin BE horizon.

The BC horizon has hue of 5YR to 10YR, value of 5 to 8 and 4 to 6 moist, and chroma of 2 to 6. It is silt loam, silty clay loam, or clay loam and contains up to 60 percent channers and flagstones. It is neutral or slightly alkaline.

Some pedons have a Bk horizon with colors and texture of the BC horizon. It is slightly or moderately alkaline.

The C horizon has hue of 10YR or 7.5YR, value of 6 to 8 and 4 to 6 moist, and chroma of 2 to 6. It is silt loam, loam, or clay loam and contains up to 80 percent channers and flagstones. It is slightly or moderately alkaline.

TAXONOMIC CLASS: Loamy-skeletal, carbonatic Eutric Haplocryalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 14 inches.

GEOGRAPHIC SETTING (according to official series description): Trebor soils are moderately sloping to very steep on mountains at elevations of 6200 to 7200 feet. Slope gradients ranges from 6 to 60 percent. These soils formed in residuum from limestone. Mean annual temperature ranges from 32 degrees to 45 degrees F, and mean annual precipitation ranges from 18 to 28 inches.

VARIATION FROM TYPICAL SERIES: This profile is less calcareous than typical. This profile has shale instead of the typical limestone paralithic material.

ROCK OUTCROP/RUBBLELAND

SOIL MAPPING UNIT: RO/R

SOIL SAMPLE LOCATION: 26

DESCRIPTION OF ROCK OUTCROP:

Setting

Landform: Mountainsides

Landform position (two-dimensional): Backslope, shoulder, summit

Down-slope shape: Convex

Across-slope shape: Convex, linear

Properties and Qualities

Slope: 40 to 500 percent

Surface area covered with stones and boulders: 4.0 percent

Depth to restrictive feature: 0 to 1 inches to Lithic bedrock

Drainage class: Excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately high (0.00 to 0.21 in/hr)

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate maximum: 1 percent

Gypsum maximum: 1 percent

Sodium adsorption ratio maximum: 0.5

Available water capacity: Very low (about 0.0 inches)

Interpretive Groups

Land capability (non irrigated): 8s

Ecological site: Non-site

Other vegetative classification: Not suited

Typical Profile

0 to 80 inches: bedrock

Grizzly very gravelly loam

SOIL MAPPING UNIT: Gr

SOIL SAMPLE LOCATION: 27

TYPICAL PEDON: Grizzly very gravelly silt loam, on a southwest facing, convex slope of 50 percent, under a ponderosa pine forest at an elevation of about 1719 meters. (Colors are for moist soil unless otherwise stated.)

The Grizzly series consists of very deep, well drained soils formed in residuum from igneous rocks on mountains. They have moderate or moderately slow saturated hydraulic conductivity. Slopes range from 6 to 80 percent. The mean annual air temperature is about 6 degrees C, and the mean annual precipitation is about 635 mm.

Oi--0 to 1 inch; forest litter and slightly decomposed forest litter. (0 to 5 cm thick)

E1--1 to 10 inches; brown (10YR 4/3) very gravelly loam, very pale brown (10YR 7/3), dry; weak very fine and fine granular structure; soft, very friable, nonsticky and nonplastic; common fine roots; 35 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

E2--10 to 14 inches; brown (10YR 5/3) very gravelly loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure parting to weak very fine and fine granular; soft, very friable, nonsticky and nonplastic; common fine roots; 45 percent angular rhyolite fragments; few worm casts; moderately acid; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

E3--10 to 21 inches; brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry; weak medium and thick platy structure; slightly hard, very friable, nonsticky and nonplastic; common fine and coarse roots; 50 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (Combined thickness of the E horizon is 35 to 60 cm.)

Bt/E--21 to 33 inches; about 60 percent dark yellowish brown (10YR 4/4) very gravelly clay loam, yellowish brown (10YR 5/4) dry (Bt part), and 40 percent brown (10YR 5/3) very gravelly silt loam, very pale brown (10YR 8/3) dry (E part); weak medium and coarse subangular blocky structure; slightly hard, friable, sticky and plastic; common fine roots; 60 percent angular rhyolite fragments; moderately acid; gradual wavy boundary. (25 to 50 cm thick)

Bt--33 to 43 inches; strong brown (7.5YR 4/6) very gravelly clay loam, strong brown (7.5YR 5/6) dry; moderate medium and coarse angular blocky structure; very hard, firm, sticky and plastic; few fine roots; 60 percent angular rhyolite fragments; many distinct brown (7.5YR 4/3) clay films on vertical ped faces; slightly acid; gradual wavy boundary. (23 to 90 cm thick)

BC--43 to 52 inches; strong brown (7.5YR 4/6) extremely gravelly clay loam, strong brown (7.5YR 5/6) dry; weak medium and coarse subangular blocky structure; very hard, friable, sticky and plastic; 70 percent angular rhyolite fragments; neutral; gradual wavy boundary. (0 to 25 cm thick)

C--52 to 60 inches; light olive brown (2.5Y 5/4) extremely gravelly clay loam, pale yellow (2.5Y 7/4) dry; common fine distinct mottles of yellowish brown (10YR 5/6); massive; very hard, friable, slightly sticky and slightly plastic; 70 percent angular rhyolite fragments; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 27 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Udic SMR

Mean annual soil temperature: 5 to 8 degrees C

Mean summer soil temperature: 10 to 13 degrees C

Depth to glossic horizon: 36 to 61 cm

Particle-size control section:

Clay content (weighted average): 28 to 35 percent

Sand content: 10 to 25 percent fine and coarser sand

E Horizon:

Hue: 7.5YR, 10YR

Value: 4 to 6, 5 to 8 dry

Chroma: 2 or 3

Texture: L, SIL, or FSL (fine earth fraction)

Rock fragments: 20 to 70 percent angular to subangular igneous rock fragments

Reaction: moderately acid to neutral

Bt/E Horizon:

Hue, Value, and chroma have the same range as for their respective parts

Texture: L, SIL, CL, or SICL (fine earth fraction)

Rock fragments: 35 to 70 percent angular or subangular igneous fragments, of which 30 to 70 percent are gravel and 0 to 15 percent are cobble

Reaction: moderately acid to neutral

Bt horizon:

Hue: 7.5YR, 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 3 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 35 to 80 percent angular or subangular igneous rocks, of which 35 to 75 percent are gravel, and 5 to 25 percent are cobble

Reaction: moderately acid to neutral

BC Horizon:

Hue: 7.5YR or 10YR

Value: 3 or 4, 4 to 6 dry

Chroma: 4 to 6

Texture: CL or SICL (fine earth fraction)

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

C Horizon:

Hue: 7.5YR, 10YR, or 2.5Y

Value: 4 to 7, 5 to 8 dry

Chroma: 4 to 6

Texture: L, CL, or SICL (fine-earth fraction)

Clay content: 20 to 32 percent

Rock fragments: 40 to 85 percent angular or subangular igneous rocks, of which 30 to 65 percent are channers or gravel, 5 to 30 percent cobble, and 0 to 10 percent stones

Reaction: slightly acid to slightly alkaline

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Haplic Glossudalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum or local colluvium over residuum derived from igneous rocks (monzonite, phonolite, rhyolite, rhyolite porphyry, trachyte, and similar igneous materials)

Landform: hillslopes and broad ridges on mountains

Slopes: 6 to 80 percent

Elevation: 1,340 to 1,950 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 558 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 100 days

VARIATION FROM TYPICAL SERIES: There is no variation from the typical series.

Hisega loam

SOIL MAPPING UNIT: Hi

SOIL SAMPLE LOCATION: 28

TYPICAL PEDON: Hisega loam - on a 30 percent convex south-facing slope under a ponderosa pine forest at 5800 feet. (Colors are for dry soil unless otherwise stated.)

The Hisega series consists of deep and very deep, well drained soils formed in residuum from micaceous metamorphic rocks on mountains. They have moderate permeability. Slopes range from 15 to 65 percent. Mean annual temperature is about 40 degrees F, and the annual precipitation is about 24 inches.

O/A--0 to 4 inch; forest litter and slightly decomposed forest litter mixed with dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; soft, very friable; many fine and medium roots; 10 percent by volume fragments of schist; neutral; clear wavy boundary. (1 to 7 inches thick)

Bw--4 to 8 inches; brown (10YR 4/3) channery loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium subangular blocky structure; soft, friable; many fine and medium roots; 20 percent by volume fragments of schist; slightly acid; clear wavy boundary. (9 to 20 inches thick)

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C1--8 to 30 inches; brown (10YR 5/3) very channery loam, very dark grayish brown (10YR 3/2) moist; massive; soft, very friable; many coarse and medium roots; 50 percent by volume fragments of schist; neutral; gradual wavy boundary.

C2--30 to 60 inches; grayish brown (2.5Y 5/2) extremely flaggy loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable; common medium roots along fractures and cleavage planes of the bedrock; 80 percent by volume fragments of schist oriented toward the northwest at about 65 degrees; neutral.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 28 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to consolidated bedrock typically is below 60 inches but ranges from 40 inches. Depth to fractured bedrock containing soil material and with evidence of rock structure typically is between depths of 20 and 40 inches. Content of coarse fragments of rock range from 10 to 50 percent by volume in the solum and 50 to 80 percent by volume in the C horizon. The mollic epipedon is 16 to 24 inches thick. Dark colors extend to 60 inches or more in some pedon but the organic carbon is

less than 0.6 percent. The control section averages 8 to 15 percent clay. Free carbonates are below a depth of 40 inches in some pedons. The solum is slightly acid or neutral.

The A horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 3 to 5 and 2 to 4 moist; and chroma of 1 to 3. It is loam or silt loam with 10 to 30 percent by volume channers.

The Bw horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5 moist; and chroma of 2 to 4. It is loam or silt loam with 15 to 50 percent by volume channers.

The C horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 6 and 3 to 5; and chroma of 2 to 4. It is loam or silt loam with 50 to 80 percent by volume channers or flagstones. It ranges from slightly acid to slightly alkaline.

TAXONOMIC CLASS: Loamy-skeletal, micaceous, frigid Pachic Hapludolls

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 0 inches.

GEOGRAPHIC SETTING (according to official series description): Hisega soils are steep on mountains at elevations of 3600 to 6300 feet. Slope gradients range from 15 to 65 percent. These soils formed in residuum derived from micaceous metamorphic rocks. Mean annual air temperature ranges from 34 to 45 degrees F, and mean annual precipitation ranges from 18 to 27 inches.

VARIATION FROM TYPICAL SERIES: There is an O/A horizon in place of the typical Oi and A horizons.

ROCK OUTCROP/RUBBLELAND

SOIL MAPPING UNIT: RO/R

SOIL SAMPLE LOCATION: 29

DESCRIPTION OF ROCK OUTCROP:

Setting

Landform: Mountainsides

Landform position (two-dimensional): Backslope, shoulder, summit

Down-slope shape: Convex

Across-slope shape: Convex, linear

Properties and Qualities

Slope: 40 to 500 percent

Surface area covered with stones and boulders: 4.0 percent

Depth to restrictive feature: 0 to 1 inches to Lithic bedrock

Drainage class: Excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Very low or moderately high (0.00 to 0.21 in/hr)

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate maximum: 1 percent

Gypsum maximum: 1 percent

Sodium adsorption ratio maximum: 0.5

Available water capacity: Very low (about 0.0 inches)

Interpretive Groups

Land capability (non irrigated): 8s

Ecological site: Non-site

Other vegetative classification: Not suited

Typical Profile

0 to 80 inches: bedrock

VIRKULA loam

SOIL MAPPING UNIT: Vi

SOIL SAMPLE LOCATION: 30

TYPICAL PEDON: Virkula silt loam - on a 25 percent concave west-facing slope under a ponderosa pine forest at 5,260 feet. (Colors are for dry soil unless otherwise stated.)

The Virkula series consists of very deep and deep, well drained soils formed in silty materials weathered from igneous and metamorphic rocks on mountains. They have moderately slow permeability in the solum and moderate or moderately slow permeability in the underlying material. Slopes range from 2 to 35 percent. Mean annual soil temperature is about 40 degrees F, and the annual precipitation is about 22 inches.

A--0 to 2 inch; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable; common fine and medium roots; strongly acid; abrupt smooth boundary.

BA--2 to 8 inches; very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; weak thin and medium platy structure; slightly hard, very friable; common fine and coarse roots; many pores; strongly acid; clear smooth boundary.

Bt--8 to 18 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable; common fine and coarse roots; common fine pores; strongly acid; clear wavy boundary.

C--18 to 20 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; strong coarse prismatic structure parting to strong fine and medium blocky; very hard, firm, sticky and plastic; few roots; few fine and coarse roots; common fine pores; shiny films on faces of peds; strongly acid; clear wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bt2--20 to 36 inches; pale brown (10YR 6/3) clay loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate subangular blocky; very hard, firm, sticky and plastic; few coarse roots; common fine pores; shiny films on faces of peds; moderately acid; clear wavy boundary.

BC--36 to 60 inches pale brown (10YR 6/3) gravelly clay loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky; very hard, firm, slightly sticky and plastic; 15 percent by volume fragments of igneous rock; moderately acid.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 30 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Content of coarse fragments as pebbles and channers of rock ranges from 0 to 15 percent in the solum and ranges up to 60 percent at depths below 40 inches. Depth to consolidated bedrock typically is greater than 60 inches but ranges from 40 to 60 inches or more. The soil is leached of carbonates throughout. Worm working is common in the upper 4 inches of the profile. The sand fraction is dominantly very fine sand in the B/E and Bt horizons.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 and 2 or 3 moist, and chroma of 1 or 2. It is a loam or silt loam and contains up to 15 percent pebbles and channers less than 3 inches. It ranges from strongly acid to slightly acid.

The E horizon has hue of 7.5YR to 2.5Y, value of 5 to 8 and 4 to 7 moist, and chroma of 2 or 3. It is a silt loam, loam or very fine sandy loam and contains up to 10 percent pebbles and channers less than 3 inches. It ranges from strongly acid to slightly acid.

The B/E horizon has colors of the B2t and E horizons.

The Bt horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 5 to 7 and 4 to 6 moist; and chroma of 2 to 4. It is clay loam, loam, silt loam, or silty clay loam. The Bt horizon averages 20 to 35 percent clay and contains up to 10 percent pebbles and channers less than 3 inches. It ranges from strongly acid to slightly acid.

The BC horizon has hue of 7.5YR, 10YR, or 2.5Y; value of 4 to 7 and 4 to 6 moist; and chroma of 3 to 5. It typically is clay loam, silty clay loam, loam or silt loam and contains up to 35 percent pebbles and channers. It ranges from strongly acid to slightly acid.

The C horizon, if present, has hue of 7.5YR, 10YR, or 2.5Y; value of 5 to 8 and 4 to 7; and chroma of 3 to 6. It is silty clay loam, clay loam or loam, and contains 10 to 60 percent pebbles and channers. It ranges from moderately acid to neutral.

TAXONOMIC CLASS: Fine-silty, mixed, superactive, frigid Glossic Hapludalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 18 inches.

GEOGRAPHIC SETTING (according to official series description): Virkula soils are on gently sloping to steep mountains at elevations of 3600 and 6200 feet. Slope gradients range from 2 to 35 percent. These soils formed in silty materials weathered from igneous and metamorphic rocks. Mean annual temperature ranges from 37 to 45 degrees F, and the mean annual precipitation ranges from 18 to 26 inches.

VARIATION FROM TYPICAL SERIES: There are no typical Oi or E horizons. There is a BA horizon in place of the B/E horizon. The texture is slightly sandier than typical from 18 to 20 inches. The C horizon is farther up the profile than typical.

TREBOR silt loam

SOIL MAPPING UNIT: Tr

SOIL SAMPLE LOCATION: 31

TYPICAL PEDON: Trebor silt loam - on a 13 percent convex northwest-facing slope under a ponderosa pine forest at 6,700 feet. (Colors are for dry soil unless otherwise stated.)

The Trebor series consists of moderately deep, well drained soils formed in residuum from limestone. They have moderately slow permeability in the solum and moderate permeability in the underlying material. Slopes range from 6 to 60 percent. Mean annual temperature is about 38 degrees F, and mean annual precipitation is about 24 inches.

A--0 to 2 inches; pinkish gray (7.5YR 7/2) silt loam, dark brown (7.5YR 4/2) moist; weak medium and thick platy structure; slightly hard, friable; many fine roots; slightly acid; abrupt wavy boundary.

C--2 to 6 inches; reddish brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; faces of peds dark reddish brown (5YR 3/3) moist; weak coarse prismatic structure parting to moderate fine and medium blocky; very hard, firm, sticky and plastic; common fine and coarse roots; common fine pores; 20 percent by volume fragments of limestone; neutral; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

BC--6 to 10 inches; reddish brown (5YR 5/3) and very pale brown (10YR 7/4) channery silt loam, reddish brown (5YR 4/3) and yellowish brown (10YR 5/4) moist; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine and coarse roots; 20 percent by volume fragments of limestone; slight effervescence; slightly alkaline; gradual wavy boundary.

C--10 to 30 inches; yellow (10YR 8/6) very channery silt loam, brownish yellow (10YR 6/6) moist; weak medium and coarse subangular blocky structure; hard, friable; few fine and coarse roots; 45 percent by volume fragments of limestone; strong effervescence; moderately alkaline; gradual wavy boundary.

R--30 to 60 inches; fractured limestone.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 31 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): Depth to the base of the argillic horizon is 5 to 10 inches. Coarse fragments range from 5 to 60 percent by volume

in the solum and from 35 to 80 percent by volume in the C horizon. The control section averages from 18 to 35 percent clay and 35 to 60 percent by volume of coarse fragments. Depths to carbonates ranges from 5 to 14 inches. Depth to bedrock ranges from 20 to 40 inches.

The E horizon has hue of 7.5YR or 10YR, value of 4 to 7 and 3 to 5 moist, and chroma of 2 or 3. It is loam, silt loam, channery loam, channery silt loam, flaggy loam, or flaggy silt loam. It is moderately or slightly acid. Some pedons have an A horizon of 1 inch or less in thickness.

The Bt horizon has hue of 5YR to 10YR, value of 4 to 6 and 3 or 4 moist, and chroma of 3 or 4. It is clay loam, silty clay loam, silty clay or clay and contains up to 60 percent channers and flagstones. It averages between 35 and 50 percent clay. It is slightly acid or neutral.

Some pedons have a thin BE horizon.

The BC horizon has hue of 5YR to 10YR, value of 5 to 8 and 4 to 6 moist, and chroma of 2 to 6. It is silt loam, silty clay loam, or clay loam and contains up to 60 percent channers and flagstones. It is neutral or slightly alkaline.

Some pedons have a Bk horizon with colors and texture of the BC horizon. It is slightly or moderately alkaline.

The C horizon has hue of 10YR or 7.5YR, value of 6 to 8 and 4 to 6 moist, and chroma of 2 to 6. It is silt loam, loam, or clay loam and contains up to 80 percent channers and flagstones. It is slightly or moderately alkaline.

TAXONOMIC CLASS: Loamy-skeletal, carbonatic Eutric Haplocryalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 12 inches.

GEOGRAPHIC SETTING (according to official series description): Trebor soils are moderately sloping to very steep on mountains at elevations of 6200 to 7200 feet. Slope gradients ranges from 6 to 60 percent. These soils formed in residuum from limestone. Mean annual temperature ranges from 32 degrees to 45 degrees F, and mean annual precipitation ranges from 18 to 28 inches.

VARIATION FROM TYPICAL SERIES: There are no typical Oi and E horizons. The C horizon is farther up the profile than typical.

VANOCKER loam

SOIL MAPPING UNIT: Va

SOIL SAMPLE LOCATION: 32

TYPICAL PEDON: Vanocker gravelly silt loam, on a west-facing, linear slope of 38 percent under ponderosa pine forest at an elevation of 1,432 meters. (Colors are for dry soil unless otherwise stated.)

The Vanocker series consists of deep to very deep, well drained soils formed in residuum and colluvium from sedimentary rocks. Vanocker soils are on gently sloping to very steep ridges and hillslopes in mountains. They have moderately low and moderately high saturated hydraulic conductivity. Slopes range from 2 to 80 percent. The mean annual precipitation is about 585 mm, and the mean annual temperature is about 6.0 degrees C.

A--0 to 3 inches; black (10YR 2/1) and very dark grayish brown (10YR 3/2) loam, very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) dry; weak very fine granular structure; soft, very friable, slightly sticky and slightly plastic; many fine, medium, and coarse roots; 30 percent by volume subangular limestone gravel; neutral; abrupt wavy boundary.

AB--3 to 12 inches; brown (10YR 4/3) loam, brown (10YR 5/3) dry; moderate fine subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; many fine, medium and coarse roots; many faint continuous clay films on faces of peds; 40 percent by volume subangular limestone gravel; disseminated calcium carbonate throughout; very slightly effervescent; slightly alkaline; clear wavy boundary.

Bt--12 to 14 inches; brown (10YR 4/3) clay loam, brown (10YR 5/3) dry; moderate medium and fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common coarse, medium, and fine roots; 55 percent by volume subangular limestone gravel; slightly alkaline; clear wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bk1--14 to 41 inches; brown (10YR 5/3) very gravelly loam, light gray (10YR 7/2) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and coarse roots; 55 percent by volume subangular limestone gravel; few (3 percent) fine threads of calcium carbonate in soil matrix and medium and coarse calcium carbonate coatings on the bottom of rock fragments; strongly effervescent; moderately alkaline; gradual wavy boundary.

Bk2--41 to 60 inches; brown (10YR 4/3) extremely gravelly silt loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; few medium and coarse roots; 65 percent by volume subangular limestone gravel;

few (3 percent) fine threads of calcium carbonate in matrix and continuous calcium carbonate coatings on faces of peds; violent effervescence; moderately alkaline.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 32 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Typic-udic soil moisture regime.

Depth to secondary calcium carbonate: 10 to 38 cm

Particle-size control section (weighted average):

Clay content: 18 to 35 percent

Sand content: typically 5 to 15 percent fine and coarser sand; ranges to 35 percent in some pedons

Rock fragments: 35 to 80 percent subangular or subrounded limestone and/or calcareous sandstone fragments that typically increase with depth

A horizon:

Hue: 7.5YR or 10YR

Value: 3 to 6, 2 to 4 moist

Chroma: 2 or 3

Texture: L, SIL, FSL, VFSL (fine-earth fraction)

Clay content: 8 to 27 percent

Rock fragments: 5 to 35 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, and 0 to 5 percent cobble

Reaction: moderately acid to neutral

An E horizon is present in place of the A in a few pedons; it has properties similar to the A except that moist and dry colors are one value lighter.

Bt horizon:

Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y

Value: 5 to 7, 4 to 6 moist

Chroma: 2 to 4

Texture: CL or SICL; SCL where parent material is derived from sandstone (fine-earth fraction)

Clay content: 25 to 35 percent

Rock fragments: 30 to 45 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, and 0 to 15 percent cobble

Calcium carbonate equivalent: 0 to 10 percent

Reaction: moderately acid to slightly alkaline

Btk horizon:

Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y

Value: 5 to 7, 4 to 6 moist

Chroma: 2 to 6

Texture: L, SIL, CL, SICL; SCL where parent material is derived from sandstone(fine-earth fraction)

Clay content: 20 to 35 percent

Rock fragments: 30 to 45 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, and 0 to 15 percent cobble

Calcium carbonate equivalent: 10 to 20 percent

Reaction: slightly alkaline

Bk horizon:

Hue: 2.5YR, 5YR, 7.5YR, 10YR, or 2.5Y

Value: 5 to 8, 4 to 7 moist

Chroma: 2 to 6

Texture: L, CL, SIL, or SICL; SL, FSL, or SCL where parent material is derived from sandstone (fine-earth fraction)

Clay content: 15 to 35 percent

Rock fragments: 20 to 55 percent total volume of non-flat subangular or subrounded gravel, or flat subangular or subrounded channers, 5 to 30 percent cobble, and/or 0 to 20 percent flagstones

Calcium carbonate equivalent: 15 to 40 percent

Reaction: slightly alkaline or moderately alkaline

Some pedons contain a C horizon

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, frigid Inceptic Hapludalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 12 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: colluvium and/or residuum derived primarily from limestone and/or calcareous sandstone

Landform: ridges, ridge shoulders, and hillslopes of mountains

Slopes: 2 to 80 percent

Elevation: 1,097 to 1,890 meters

Mean annual temperature: 4 to 7.2 degrees C)

Mean annual precipitation: 508 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 110 days

VARIATION FROM TYPICAL SERIES: There is no typical Oi horizon. There is an additional AB horizon. There are less coarse fragments than typical.

SAWDUST loam

SOIL MAPPING UNIT: Sa

SOIL SAMPLE LOCATION: 33

TYPICAL PEDON: Sawdust channery loam - on a south-facing slope of 34 percent under sparse pine and native grass at 5460 feet elevation. (Colors are for dry soil unless otherwise stated.)

The Sawdust series consists of very deep, well drained soils formed in residuum and colluvial sediments from calcareous sandstone and limestone on mountain slopes. Permeability is moderate. Slopes range from 6 to 80 percent. Mean annual precipitation is about 18 inches, and mean annual air temperature is about 40 degrees F.

A--0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; 30 percent coarse fragments; slightly alkaline; gradual wavy boundary.

C1--4 to 8 inches; pale brown (10YR 6/3) gravelly loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, friable; 50 percent coarse fragments; moderately alkaline; gradual wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

C2--8 to 15 inches; light yellowish brown (10YR 6/4) very channery loam, dark yellowish brown (10YR 4/4) moist; massive; soft, friable; 60 percent coarse fragments; many partially weathered limestone pebbles; strong effervescence; moderately alkaline; gradual wavy boundary.

C3--15 to 26 inches; very pale brown (10YR 7/4) extremely channery loam, light yellowish brown (10YR 6/4) moist; massive; soft, friable; 70 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

C3--26 to 60 inches; yellow (10YR 7/6) extremely channery sandy loam, brownish yellow (10YR 6/6) moist; massive; soft, friable; 85 percent coarse fragments; strong effervescence; moderately alkaline.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 33 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description): The Sawdust soils typically have carbonates to the surface but some pedons are leached to a depth of 4 inches. The depth to bedrock is more than 40 inches. Rock fragments which are dominantly pebbles and channers range from 5 to 45 percent by volume in the upper 10 inches. They range from 35 to 90

percent by volume in the control section and are dominantly channers and flagstones. Some pedons have a thin O horizon.

The A horizon has 7.5YR or 10YR hue, value of 3 to 6 dry and 2 to 4 moist, and chroma of 1 to 3. It typically is gravelly loam, gravelly silt loam or channery loam, but is loam or silt loam, channery silt loam, very channery loam, very gravelly loam or very gravelly silt loam in some pedons. It is neutral or slightly alkaline. When the A horizon is thicker than 6 inches, the lower part has value of 5 or 6 dry and 4 moist.

The AC horizon has 5 YR, 7.5YR, or 10YR hue; value of 5 to 7 dry and 4 or 5 moist; and chroma of 2 to 5. It is loam or silt loam and contains up to 50 percent coarse fragments of rock. It is slightly or moderately alkaline.

The C horizon has 2.5YR through 10YR hue, value of 5 to 8 dry and 4 to 7 moist, and chroma of 3 to 6. It is sandy loam, silt loam, silty clay loam, loam or clay loam and contains 35 to 90 percent coarse fragments. It is slightly or moderately alkaline.

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, calcareous, frigid Typic Ustorthents

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 2 inches.

GEOGRAPHIC SETTING (according to official series description): The Sawdust soils are on moderately sloping to very steep mountain side slopes at elevations of 3600 to 6200 feet. Slope gradients range from 6 to 80 percent. These soils formed in colluvial or residuum weathered from calcareous limestone or sandstone. Mean annual temperature ranges from 37 to 45 degrees F. Mean annual precipitation ranges from 18 to 26 inches.

VARIATION FROM TYPICAL SERIES: There is no typical AC horizon. This profile is less calcareous than typical.

CITADEL loam

SOIL MAPPING UNIT: Ci

SOIL SAMPLE LOCATION: 34

TYPICAL PEDON: Citadel silt loam, on a northeast facing, linear slope of 4 percent, under ponderosa pine forest at an elevation of about 1470 meters. (Colors are for dry soil unless otherwise stated.)

The Citadel series consists of very deep, well drained soils formed in residuum and local alluvium from calcareous sandstone, limestone, and soft shale on mountains. They have moderately slow or slow saturated hydraulic conductivity. Slopes range from 2 to 50 percent. Mean annual air temperature is about 5 degrees C, and the mean annual precipitation is about 610 mm.

A--0 to 4 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate very fine and fine granular structure; slightly hard, very friable, nonsticky and nonplastic; common very fine, few fine and medium roots; common fine irregular pores; strongly acid; abrupt smooth boundary.

Bt1--4 to 8 inches; brown (10YR 5/3) silt loam, pale brown (10YR 6/3) dry; moderate medium and fine platy structure parting to weak medium and coarse subangular blocky; moderately hard, very friable, nonsticky and nonplastic; common very fine, few fine, medium and coarse, roots; few very fine tubular pores throughout; common (3 percent) black (10YR 2/1) medium worm casts throughout; moderately acid; abrupt wavy boundary.

Bt2--8 to 11 inches; brown (7.5YR 4/3) silt loam, brown (7.5YR 5/3) dry; strong fine and medium angular blocky structure; moderately hard, firm, slightly sticky and moderately plastic; common very fine, few fine, medium and coarse roots; few fine and very fine tubular pores throughout; many (75 percent) faint brown (7.5YR 4/3) continuous clay films on vertical faces of peds, and common (10 percent) distinct very dark gray (7.5YR 3/1) organoargillans on vertical faces of peds; slightly acid; clear wavy boundary.

--Hit rock in drilling, the rest of the profile is taken from the NRCS soil series description--

Bt3--11 to 22 inches; brown (7.5YR 4/3) silty clay, brown (7.5YR 5/3) dry; strong medium prismatic structure parting to strong fine and medium angular blocky; hard, very firm, moderately sticky and very plastic; few very fine, fine, medium, and coarse roots; common very fine tubular pores throughout; many (75 percent) faint brown (7.5YR 4/3) continuous clay films on vertical faces of peds, and common (10 percent) distinct very dark gray (7.5YR 3/1) organoargillans on vertical faces of peds; slightly acid; gradual wavy boundary.

Bt4--22 to 30 inches; brown (10YR 4/3) silty clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to strong medium subangular blocky; hard, firm, moderately sticky and moderately plastic; few very fine, fine, medium and coarse roots; common very fine

tubular pores throughout; 3 percent subrounded limestone and calcareous sandstone gravel; common (20 percent) distinct brown (7.5YR 4/3) continuous clay films on vertical faces of peds, and common (10 percent) prominent very dark gray (7.5YR 3/1) organoargillans on vertical faces of peds; neutral; clear wavy boundary.

Btk1--30 to 35 inches (30 to 34.5 inches); olive brown (2.5Y 4/3) clay loam, brown (10YR 5/3) dry; moderate medium and coarse subangular blocky structure; very hard, firm, slightly sticky and moderately plastic; 3 percent subrounded limestone and calcareous sandstone gravel, 1 percent cobble; common (30 percent) distinct brown (7.5YR 4/3) continuous clay films on vertical faces of peds, and few (5 percent) prominent very dark gray (7.5YR 3/1) organoargillans on vertical faces of peds; common very fine tubular pores throughout; few coarse, medium, fine, and very fine roots; matrix is noneffervescent, but has common fine distinct white (10YR 8/1), very weakly cemented spherical masses and threads of calcium carbonate; slightly alkaline; clear wavy boundary.

Btk2--35 to 50 inches; light olive brown (2.5Y 5/3) silt loam, pale brown (10YR 6/3) dry; weak medium prismatic parting to moderate medium and coarse subangular blocky; very hard, firm, slightly sticky and moderately plastic; few coarse, medium, fine, and very fine roots; common very fine tubular pores throughout; 1 percent subrounded limestone gravel and 1 percent cobble; common (30 percent) distinct yellowish brown (10YR 5/4) continuous clay films on vertical faces of peds; many medium and coarse distinct very pale brown (10YR 8/2) very weakly cemented irregular threads of calcium carbonate in matrix, lining pores, and around rock fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

Bk--50 to 60 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (10YR 6/4) dry; moderate medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few fine and very fine roots; common very fine dendritic-tubular pores throughout; 6 percent rock fragments, of which 2 percent are subrounded limestone gravel, 3 percent cobble, and 1 percent stones; few (10 percent) distinct yellowish brown (10YR 5/4) continuous clay films on vertical faces of peds; many medium and coarse distinct very pale brown (10YR 8/2), very weakly cemented irregular threads of calcium carbonate in matrix, lining pores, and around rock fragments; strong effervescence; moderately alkaline.

TYPE LOCATION: Lawrence County, South Dakota; refer to waypoint 34 on the map included in this report.

RANGE IN CHARACTERISTICS (according to official series description):

Soil moisture: Typic-udic soil moisture regime.
Mean annual soil temperature: 4 to 8 degrees C
Mean summer soil temperature: 10 to 14 degrees C

Particle-size control section (weighted average):
Clay content: 35 to 45 percent
Sand content: 5 to 15 percent fine and coarser sand

A horizon:

Hue: 5YR, 7.5YR, or 10YR
Value: 4 or 5 dry, 2 or 3 moist
Chroma: 1 or 2
Texture: L, SIL, FSL, VFSL
Clay content: 10 to 25 percent
Reaction: strongly acid to neutral

E horizon:

Hue: 5YR, 7.5YR, or 10YR
Value: 5 to 7 dry, 4 or 5 moist
Chroma: 2 or 3
Texture: L, SIL, FSL, VFSL
Clay content: 10 to 20 percent
Reaction: strongly acid to neutral

The Bt/E horizon has the combined properties of the Bt and E horizons.

Bt horizon:

Hue: 5YR, 7.5YR, 10YR, or 2.5Y
Value: 4 to 6 dry, 4 or 5 moist
Chroma: 3 to 6
Texture: CL, C, SICL, SIC
Clay content: 35 to 45 percent
Rock fragments: 0 to 20 percent limestone and/or calcareous sandstone gravel
Reaction: strongly acid to neutral (pH 5.1 to 7.3)

Btk horizon:

Hue: 5YR, 7.5YR, 10YR, or 2.5Y
Value: 4 to 6 dry, 4 or 5 moist
Chroma: 3 to 6
Texture: SIL, CL, SICL
Clay content: 25 to 40 percent
Rock fragments: 0 to 20 percent limestone and/or calcareous sandstone gravel
Reaction: slightly alkaline or moderately alkaline (pH 7.4 to 8.4)

Bk horizon:

Hue: 5YR, 7.5YR, 10YR, or 2.5Y
Value: 4 to 7 dry, 4 or 5 moist
Chroma: 3 to 6
Texture: L, CL, SIL, or SICL
Clay content: 20 to 35 percent
Rock fragments: 0 to 35 percent angular and subangular limestone and/or calcareous sandstone fragments. Reaction: slightly alkaline or moderately alkaline

A C horizon is present in some pedons. Where present, the C horizon can have 5 to 60 percent angular and subangular limestone and/or calcareous sandstone fragments.

TAXONOMIC CLASS: Fine, smectitic, frigid Typic Hapludalfs

SUITABILITY FOR TOPSOIL (according to WDEQ Guideline 1, 1994): Estimated salvage depth is 11 inches.

GEOGRAPHIC SETTING (according to official series description):

Parent material: residuum, local alluvium, or colluvium derived from limestone, calcareous sandstone, or soft shale

Landform: ridges, ridge shoulders, and hillslopes of mountains

Slopes: 2 to 50 percent

Elevation: 1,158 to 1,890 meters

Mean annual temperature: 4 to 7 degrees C

Mean annual precipitation: 508 to 762 mm

Precipitation pattern: over one-half the mean annual precipitation falls as snow and rain during the period March through July

Frost-free season: 60 to 110 days

VARIATION FROM TYPICAL SERIES: There are no typical Oi, E or Bt/E horizons.

ADDENDUM D
PHOTOGRAPHS



Photo 1: Profile view of Sample Point 1



Photo 2: General view of Sample Point 1



Photo 3: Profile view of Sample Point 2



Photo 4: General view of Sample Point 2



Photo5: Profile view of Sample Point 3



Photo 6: Profile view of Sample Point 4

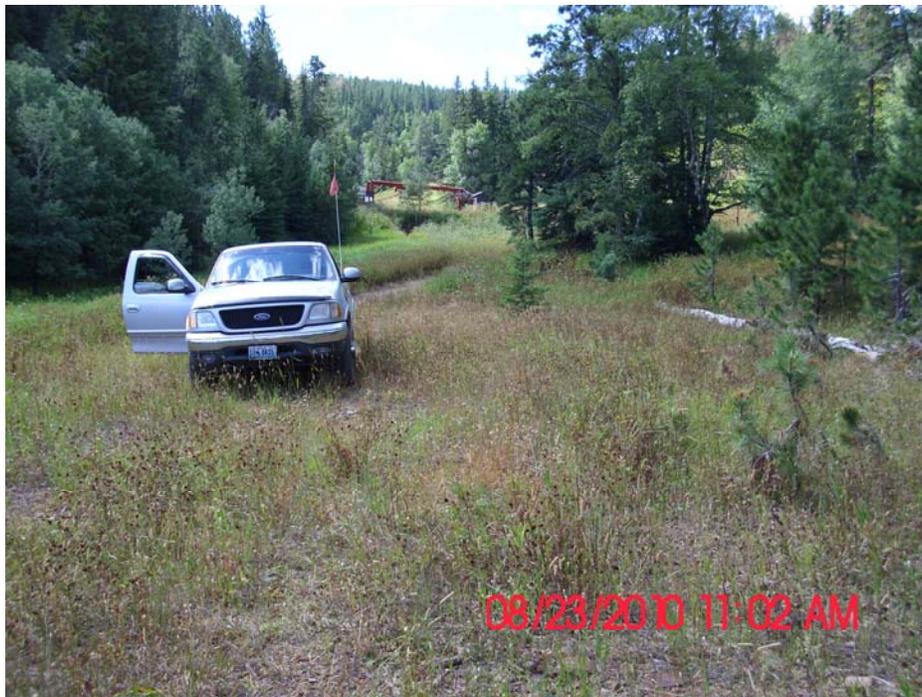


Photo 7: General view of Sample Point 4



Photo 8: Profile view of Sample Point 5



Photo 9: General view of Sample Point 5



Photo 10: Profile view of Sample Point 6



Photo 11: General view of Sample Point 6



Photo 12: Profile view of Sample Point 7

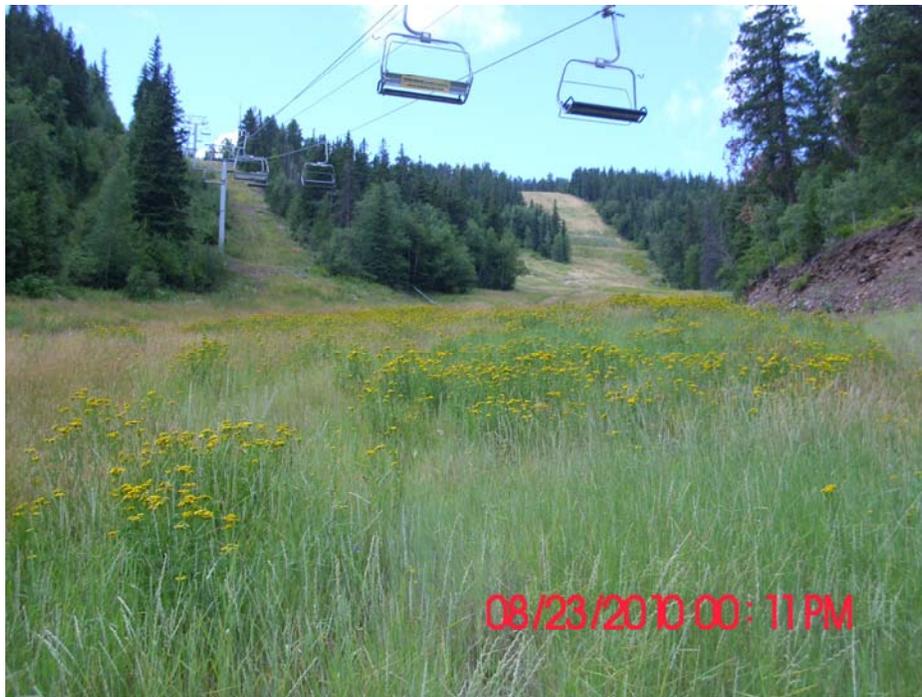


Photo 13: General view of Sample Point 7



Photo 14: Profile view of Sample Point 8



Photo 15: General view of Sample Point 8



Photo 16: Profile view of Sample Point 9



Photo 17: General view of Sample Point 9



Photo 18: Profile view of Sample Point 10



Photo 19: General view of Sample Point 10



Photo 20: Profile view of Sample Point 11

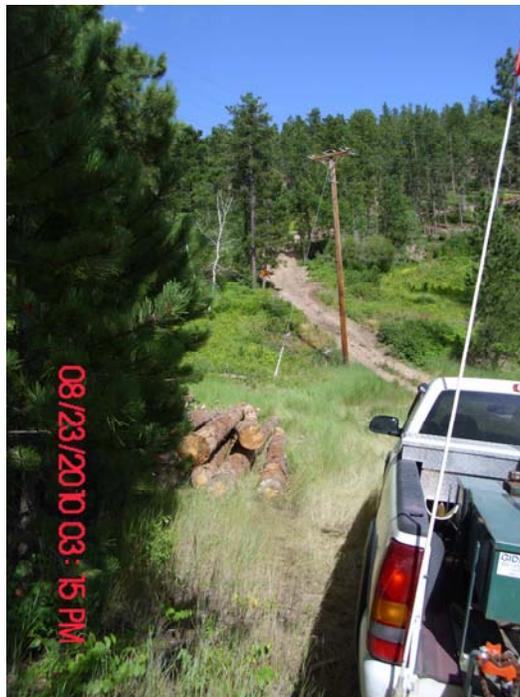


Photo 21: General view of Sample Point 11



Photo 22: Profile view of Sample Point 12



Photo 23: General view of Sample Point 12



Photo 24: Profile view of Sample Point 13



Photo 25: General view of Sample Point 13



Photo 26: Profile view of Sample Point 14



Photo 27: General view of Sample Point 14



Photo 28: Profile view of Sample Point 15



Photo 29: General view of Sample Point 15



Photo 30: Profile view of Sample Point 16



Photo 31: General view of Sample Point 16



Photo 32: Profile view of Sample Point 17



Photo 33: General view of Sample Point 17



Photo 34: Profile view of Sample Point 18



Photo 35: General view of Sample Point 18



Photo 36: Profile view of Sample Point 19



Photo 37: General view of Sample Point 19



Photo 38: Profile view of Sample Point 20



Photo 39: General view of Sample Point 20



Photo 40: Profile view of Sample Point 21



Photo 41: General view of Sample Point 21



Photo 42: Profile view of Sample Point 22



Photo 43: General view of Sample Point 22



Photo 44: Profile view of Sample Point 23



Photo 45: General view of Sample Point 23



Photo 46: Profile view of Sample Point 24

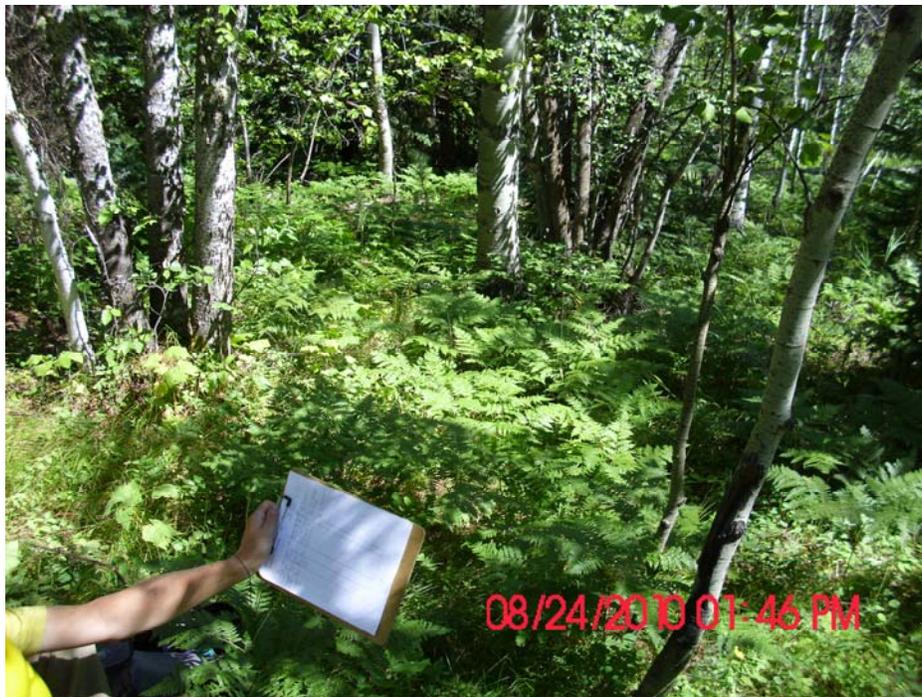


Photo 47: General view of Sample Point 24



Photo 48: Profile view of Sample Point 25



Photo 49: General view of Sample Point 25



Photo 50: Profile view of Sample Point 26



Photo 51: General view of Sample Point 26



Photo 52: Profile view of Sample Point 27



Photo 53: General view of Sample Point 27



Photo 54: Profile view of Sample Point 28



Photo 55: General view of Sample Point 28



Photo 56: Profile view of Sample Point 29



Photo 57: Profile view of Sample Point 30



Photo 58: General view of Sample Point 30



Photo 59: Profile view of Sample Point 31



Photo 60: General view of Sample Point 31



Photo 61: Profile view of Sample Point 32



Photo 62: General view of Sample Point 32



Photo 63: Profile view of Sample Point 33



Photo 64: General view of Sample Point 33



Photo 65: Profile view of Sample Point 34



Photo 66: General view of Sample Point 34

ADDENDUM E
MAP

