

# NORTH DAK RESEARCH REPORT

## CHARACTERIZATION OF COAL OVERBURDEN AND STRIP-MINE SPOILS IN NORTH DAKOTA

F. W. Schroer

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line 29—Williams (7) should read, Williams (12)	
line 32—Diagnosis and Improvement of Saline and Alkali Soils (6) should read, Diagnosis and Improvement of Saline and Alkali Soils (11)	
line 38—Handbook #60 (6) should read, Handbook #60 (11)	
line 43—Adsorbed $NS_4$ should read, Adsorbed $NH_4$	
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line 4—Agronomy No. 9 Part 2, p. 1172 (1) should read, Agronomy No. 9 Part 2, p. 1172 (2).	
line 6—Brasher, and others (2) should read, Brasher and others (3)	
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# Characterization of Coal Overburden and Strip-Mine Spoils in North Dakota

Fred. W. Schroer

## INTRODUCTION

Lignite mining has been a continuing activity in North Dakota since before statehood. USDI, Bureau of Mines estimates of "strippable" coal reserves in the state range from about four billion (6) to more than seven billion tons (1). This coal reserve occurs in about 28,000 square miles of western North Dakota in the Tongue River, Sentinel Butte and Ludlow formations of the Fort Union Group (9).

Production has increased from 35,000 tons in 1884 to 6.3 million tons in 1972 (5). At present the mines are all surface type (strip) mines that produce rows of steep-sided spoil banks of the coal overburdens. Cut widths of 125 feet and depths of 70 to 100 feet to coal are common with present equipment. The 6.3 million tons mined in 1972 produced about 420 acres of spoil banks. As of January, 1974, North Dakota Geological Survey estimated that there were about 9,500 acres of coal mine spoil bank in North Dakota<sup>1</sup>.

Projections based on tonnage trends in years 1965 to 1971 forecast annual production of about 45 million tons by year 1990 (7). This tonnage will disturb about 3,000 acres annually. More recent projections that anticipate larger energy requirements for gasification plants are as high as 80 million tons to create 5,000 acres of spoil bank per year (7).

At present there is little information on the chemical and physical properties of overburdens from depths greater than 5 feet. Soil characterization analyses with profile descriptions have been made by North Dakota State University and USDA Soil Conservation Service on many of the soils that occur extensively in the potential coal producing areas of the state. These analyses are confined to the upper 5 feet of overburdens.

A limited number of samples of the deeper overburdens have been analyzed by North Dakota Geological Survey, the Cooperative Extension Service, and USDA Agricultural Research Service. Many of these samples were fine textured and high in exchangeable sodium (7).

There is a need for more extensive analyses of the overburdens to determine the range in properties that occurs within and between present and potential mine areas. Such information is needed for development of improved methods and regulations for strip mine reclamation.

---

<sup>1</sup> Carlson, C.G., personal communication.

## PROCEDURE

### **Characterization of soils that occur extensively in potential strip mine areas.**

Characterization of soils (pedons) for the purpose of soil mapping and classification is a continuing program of the North Dakota Agricultural Experiment Station. Pedons are described by observation of soil in place on pit walls. Samples taken from representative layers (horizons) including the parent materials are then analyzed in the laboratory for elements of significance to agriculture and to classification of the soils. In potential strip mine areas soil characterization provides a record of the base line resource prior to mining.

Twenty soils were described and sampled under this project in cooperation with Soil Conservation Service personnel in Mercer, Dunn and Bowman counties. A total of 77 samples were analyzed for about 40 chemical and physical determinations. These soils represent a wide range of soils and soil properties that will be encountered in the strip mine areas of North Dakota.

### **Deep sampling in unmined areas.**

In cooperation with the major coal producers in the state, samples were obtained to a depth of currently mined or mineable coal or deeper using drill equipment owned or leased by the coal mine operator. Samples were recovered by pneumatic circulation and collected in a wire-mesh, kitchen utensil-type strainer. Some loss of fine sand and possibly crystallized salts may have occurred when the materials were very dry. Recovery seemed satisfactory when materials were slightly moist, which was the usual condition. Sampling of Fort Union sediments was satisfactory except for loose sands where loss of finer fractions occurred. Sampling interval was 5 feet, or 10 feet at depths below 100 feet where materials were homogenous.





Samples could not be recovered from glacial till by pneumatic circulation because of "balling" of the cuttings. A "water-mist" method that involved the air stream was used here. Samples were taken by both dry pneumatic and water-mist methods at seven locations, from sites a few feet apart, to determine the effect of added water on sample salinity, ionic composition of extracts and SAR (sodium adsorption ratio).

Circulation was often lost at depths greater than about 100 feet by both dry pneumatic and water-mist methods. In these cases the operators used prepared gel-type circulating mud and no usable samples were obtained.

North Dakota Geological Survey personnel cooperated in collecting most of the pneumatic and water-mist samples and took subsamples for identification of the formation.

Core samples (1.5 inches diameter) were taken to 5 to 10 feet at most deep sample sites to obtain unmixed soil horizon samples for soil series (pedon) identification.

Deep drill core segments 2 or 4 inches in diameter were analyzed from drill holes in Dunn county. Segments were selected by geologists from the North Dakota Geological Survey or Paul Weir Company to represent the formations occurring at the various sites. About 1/8 inch of surface material was removed from the cores to reduce contamination from drilling water.

Channel samples from high wall sections at several mines were analyzed. The majority of these were taken by geologists from the North Dakota Geological Survey who collected sub-samples for identification of the formations.

The numbers of sites, samples and names of cooperating mines or agencies are shown in Table 1.

**Table 1. Deep samplings to currently mined (or mineable) coal or deeper.**

<u>Cooperating mine or agency</u>	<u>Drill Holes</u>	<u>Samples</u>
North American Coal Company,		
Indian Head Mine, Sec. 36	17	224
Underwood Area and Falkirk Mine	31	484
Knife River Coal Company,		
Beulah South Mine	5	49
Consolidation Coal Company,		
Glenharold Mine	5	79
Renner Cove and north Hazen areas (DS),		
Water mist vs dry pneumatic	5	216
Montana Tech. for USGS,		
Areas north of Zap and Beulah	10	137
Baukol-Noonan Incorporated, Center,		
Water mist vs dry pneumatic	3	111
	<u>High Walls</u>	
Knife River Coal Co., Gascoyne	1	6
Baukol-Noonan Incorporated, Center	2	20
Husky Industries, Dickinson	3	41
North American Coal Company		
Indian Head, Sec. 36	24	161
	<u>Cored Holes</u>	
Natural Gas Pipeline Co., Dunn County	16	162
Total holes and high walls	122	
Total samples		1690

**Sampling in reclaimed fields.**

In 1973 and 1974 several reclaimed fields were sampled by foot increments to a depth of 5 feet with a Giddings core sampler. Five to 10 random sites were sampled in each of the fields. Reclamation was done prior to present PSC regulations regarding "top dressing". Fields that received measurable amounts of topsoil as top dressing are so indicated in the data tables.

The cooperating mines, numbers of reclaimed fields sampled and numbers of samples analyzed are shown in Table 2.

**Table 2. Numbers of Reclaimed fields and samples.**

<u>Mine</u>	<u>Fields</u>	<u>Sites</u>	<u>Samples</u>
North American; Indian Head	2	20	100
Baukol-Noonan, Center	1	10	50
Knife River, Beulah south	2	19	95
Knife River, Gascoyne	2	9	45
<hr/>			
Totals	7	58	290

**Overburden samples analyzed for other projects.**

Several hundred samples were analyzed in support of reclamation research carried on mainly at Indian Head and Falkirk Mines under Old West Regional Commission and EPA projects. Data from these analyses will be reported in the respective project reports.

**Laboratory analyses of samples.**

Analyses for soil characterization were by standard methods used by the Soil Conservation Service and NDSU Soils Laboratories. Laboratory procedures were as stated in USDA Agricultural Handbook #60 (11), and in Agronomy No. 9, Methods of Soil Analysis (2). Some exceptions to these procedures (3, 12) and notes on terminology used in the data tables are included in the Appendix.

RESULTS AND DISCUSSION

**Characterization of soils.**

The following narrative description for Chama silt loam is an example of the site and soil profile descriptions recorded for soil profile characterizations.

Soil Type: Chama silt loam

Sample No.: SU75ND25-11 (FIPS)

Date: October 7, 1975

Sampled By: F. Schroer, D. D. Patterson, M. R. Wright, L. E. Edland, and S. R. Base

Area: About 1 1/2 miles south of Werner, Dunn County, North Dakota

Location: 525 feet north and 213 feet east of the W 1/4 corner Sec. 31, T. 145 N., R. 92 W.

Classification: Fine-silty, mixed Typic Haploborolls

Vegetation: Prairie junegrass, western wheatgrass, and green needlegrass

Parent Material: Residuum from siltstone

Physiography: Sedimentary upland

Relief: Simple smooth

Drainage: Well

Slope: 1 percent

Ground Water: Deep

Permeability: Moderate

Erosion: Slight

Pedon Description: Chama silt loam (Colors are for dry soil unless otherwise stated).

A1 0 to 4 inches; dark grayish brown (10YR 4/2) silt loam; very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky, slightly plastic; many very fine roots; clear wavy boundary.

B2 4 to 10 inches; brown (10YR 4/3) silt loam; dark brown (10YR 3/3) moist weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky, slightly plastic; common very fine roots; many very fine tubular pores; clear wavy boundary.

C1ca 10 to 35 inches; light gray (2.5Y 7/2) silt loam; brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; sticky, plastic; common very fine roots; many very fine and fine tubular pores; violent effervescence; abrupt wavy boundary.

11C2r 35 to 62 inches; light brownish gray (2.5Y 6/2) soft weathered siltstone that parts to silt loam; dark grayish brown (2.5Y 4/2) moist; moderate medium platy structure; sticky, plastic; common very fine roots; many very fine tubular pores; few small salt crystals at 39 to 62 inches; strong effervescence; common medium irregular shaped soft masses of lime; abrupt wavy boundary.

11C3r 62 to 110 inches; soft weathered siltstone that crushes to silt loam; light olive brown (2.5Y 5/6) moist; massive; nonsticky, nonplastic; few very fine tubular pores.

Analytical data in Table 3, from samples taken at the Chama site, indicate the kinds of chemical and physical information obtained for the 20 soils. Field descriptions and laboratory data for the other 19 soils are on file at SCS or NDSU Soils Department offices.

**Table 3. Chemical and physical data for Chama silt loam.**

SOIL SURVEY LABORATORY: NORTH DAKOTA STATE UNIVERSITY, FARGO, NORTH DAKOTA

SOIL TYPE: Chama silt loam LOCATION: 525' N, 213' E of W ¼ corner of Sec. 31-145-92

SOIL NUMBERS: SU75ND-25-11 LABORATORY NUMBERS: 825-829 DATE: Dec. 10/75

Depth (in)	Horizon	Size Class and Particle Diameter (mm)											Textural Class
		very coarse sand 2- 1	coarse sand 1- 0.5	medium sand 0.5- 0.25	fine sand 0.25- 0.10	very fine sand 0.10- 0.05	total sand 2- 0.05	silt 0.05- 0.002	clay <0.002	>2	0.020- 0.002	0.020- 0.050	
0-4	A1						33.5	45.9	20.6		17.5	28.4	1
4-10	B2						39.1	38.1	22.8		15.5	22.6	1
10-35	Clca						9.8	66.2	24.1		36.2	30.0	sil
35-62	IIC2r						3.6	61.8	34.6		40.8	21.0	sicl
62-110	IIC3r						25.4	60.0	14.6		21.9	38.1	sil
Depth (in)	pH (paste)	CO <sub>2</sub> Clay (%)	Organic Carbon (%)	N (%)	C/N (%)	Gypsum (meq/ 100g)	CaCO <sub>3</sub> Equiv- alent (%)	Bulk Density <sup>a</sup>		Water Content <sup>b</sup>			COLE <sup>c</sup>
								oven dry (g/cc)	1/3 bar (g/cc)	1/10 bar (%)	1/3 bar (%)	15 bar (%)	
0-4	6.6		2.91	0.254	11.5		---	1.25	1.17		33.5	13.1	.02
4-10	7.3		1.47	0.138	10.7		---	1.40	1.33		21.1	10.4	.02
10-35	8.5	3.8	0.81				25.8	1.45	1.36		23.1	9.5	.02
35-62	8.7	1.3	0.50				13.5	1.63	1.45		25.5	14.3	.04
62-110	8.3		0.32				---					7.9	
Depth (in)	Saturation Extract Soluble Ions								ECE 25°C (mmhos/ cm)	SAR	Water At Sat'n (%)		
	Ca	Mg	Na	K	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>					
0-4	2.4	1.1	0.1	0.7		2.6	0.1	1.6	0.38	0.1	49		
4-10	3.1	1.2	0.1	0.5		3.7	0.1	1.1	0.41	0.1	38		
10-35	1.6	4.0	3.2	0.2		2.9	0.4	5.7	0.84	1.9	45		
35-62	23.5	127.0	74.0	0.5		1.4	4.5	219.1	11.50	8.5	55		
62-110	6.5	71.0	59.0	0.5		1.5	4.4	131.1	8.30	9.5	43		
Depth (in)	CEC (meq/ 100g)	Exchangeable Cations <sup>d,e</sup>					Exchange- able Na (%)	<sup>a</sup> 1/3 bar: saran coating <sup>b</sup> 15 bar: loose samples <sup>c</sup> Saran coating <sup>d</sup> Exchangeable cations: BaCl <sub>2</sub> TEA extracted minus saturation extract soluble cations <sup>e</sup> Exchangeable hydrogen: BaCl <sub>2</sub> TEA procedure ---Zero or negligible amount					
		Ca	Mg	H	Na	K							
0-4	25.8	16.0	3.6	3.5	0.1	1.3	0.2						
4-10	22.6	15.6	3.5	2.0	0.1	0.8	0.3						
10-35	15.5	12.0	8.8	---	0.4	0.3	2.7						
35-62	28.3	7.7	18.2	---	4.5	0.3	16.0						
62-110	13.1	1.7	10.0	0.3	2.1	0.2	16.3						

Table 4 shows the soil series sampled and some selected properties derived from the analytical data that are of interest in evaluating soils as reclamation materials. These series (pedons) illustrate the range in soil material that occurs in the coal-bearing areas of Mercer, Oliver and Dunn counties.

**Table 4. Selected properties and interpretations of soils sampled.**

Soil series	Classification: Textural family	Slope (%)	Available water capacity (inches/5 ft.)	Permeability (least permeable layer)	Depth of suitable plant growth material (inches)	Depth of soil material best suited for top dressing (inches)
Amor	fine-loamy	4	12	moderate	60	13
Arnegard	fine-loamy	4	8	moderate	>168	33
Chama	fine-silty	1	11	moderate	35	10
Daglum	fine	3	11	very slow	7	4
Farland	fine-silty	1	10	moderately slow	70	17
Flaxton	fine-loamy	2	8	moderately slow	>60	16
Grail	fine	1	7	slow	48	26
Harriet	fine-silty	1	7	slow	0	0
Krem	sandy/loamy	2	10	moderately slow	>60	0
Lefor	fine-loamy	5	7	moderate	54	10
Lihen	sandy	2	8	rapid	>60	17
Livona	fine-loamy	2	9	moderately slow	>60	9
Parshall	coarse-loamy	1	8	moderately rapid	>129	15
Straw	fine-loamy	1	8	moderate	>60	52
Tally	coarse-loamy	7	8	moderately rapid	>162	11
Vebar	coarse-loamy	7	7	moderately rapid	>108	24
Werner (like)	loamy	20	5 <sup>1</sup>	moderate	15	5
Williams	fine-loamy	1	7	moderately-slow	>108	16

<sup>1</sup>For 2.5-foot depth

Depth of suitable plant growth material is based on current North Dakota Public Service Commission (PSC) standards (5). Permeability classes are SCS estimates for these textural families. Available water in inches per 5-foot profile was calculated from water at 1/3 bar less 15 bar data.

#### Chemical and physical properties of overburden.

Most of the North Dakota lignite deposits occur in the Sentinel Butte and Tongue River formations of the Fort Union Group of tertiary deposits. The Tongue River and Sentinel Butte formations have been described by Carlson (4) as interbedded sand, silt, clay, shale, limestone and lignite. From such materials we should expect to find coal overburden that may change abruptly in chemical and physical properties with a small change in depth. Where soils are formed directly in the Fort Union sediments there will be a corresponding range in soil properties. Where glacial till and outwash overlie the Fort Union we have additional possibilities for variation in the coal overburdens.

Chemical and physical data for the overburden samples are reported in Appendix, Tables III through VII, and XIV through XVII.

Figures 1, 2, 3 and 4 show graphically, with depth, some properties of overburden that are significant in reclamation.

Salinity of saturation (water) extracts is shown as electrical conductivity of the extracts (ECE, mmhos). Conductivity values above 4 millimhos are considered to restrict plant growth and only very salt tolerant species survive at values above 15 millimhos. A maximum of 4 millimhos has been set by the PSC for reclamation material suitable for plant growth (5).

The sodium adsorption ratio (SAR), which closely approximates exchangeable sodium percentage, indicates the tendency of soil material to develop poor physical condition when the material is exposed to sun and rain. SAR values above 10 or exchangeable sodium percentages above 12 are taken as maxima for suitable growth material. At high SAR values, soil colloids disperse, the surface seals and infiltration of water is reduced to near zero. Dispersive effects are more severe as clay content increases and organic matter decreases. Texture (or relative proportion of sand, silt and clay) is indicated by the textural class abbreviation in box charts at the right of the figures.

A key to textural class abbreviations is:

- |                                       |                        |
|---------------------------------------|------------------------|
| s, fs - sand, fine sand               | sil - silt loam        |
| ls, lfs - loamy sand, loamy fine sand | sicl - silty clay loam |
| fsl, sl - fine sandy loam, sandy loam | sic - silty clay       |
| l - loam                              | c - clay               |

pH is also shown on the figures. The materials are mostly moderately alkaline in reaction with pH values around 8. Lower pH values (5 to 6) may occur in or close to the coal seam.

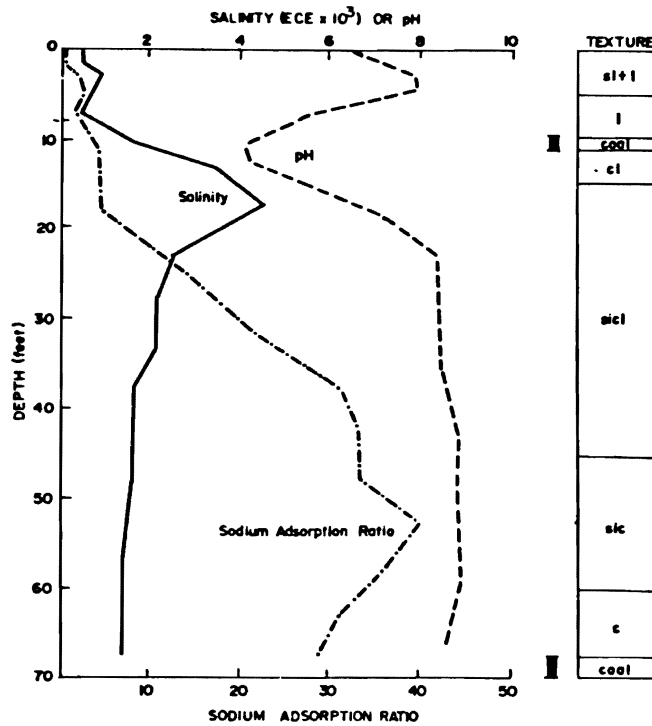


Figure 1. ECE, SAR, Texture and pH of Overburden in Mercer County. Flaxton soil area.

The soil at the Figure 1 data site is Flaxton fine sandy loam, developed in aeolian sandy loam deposited over glacial till which overlies a thin coal seam at 10 feet. The coal and material below it are of Fort Union age. Suitable plant growth material occurs to about 25 feet at the site. Below this depth, high SAR makes the material unsuitable for plant growth.

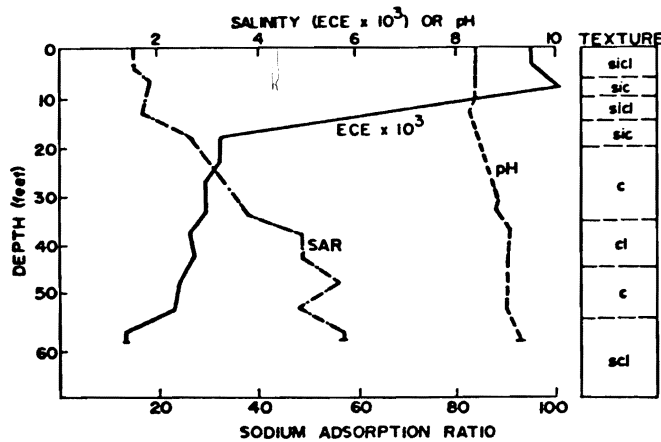


Figure 2. ECE, SAR, Texture and pH of Overburden in Mercer County. Rhoades soil area.

The overburden characterized by Figure 2 is from a drill hole in a Rhoades soil area. The Rhoades soil is high in sodium and moderately fine-textured. There is no suitable plant growth material at this site because of high salinity (ECE values of 4 to 9.5 in the upper 20 feet), and SAR in excess of 15 to the coal at about 60 feet. This situation usually occurs in soil associations where Rhoades and Daglum are part of the mapping unit.

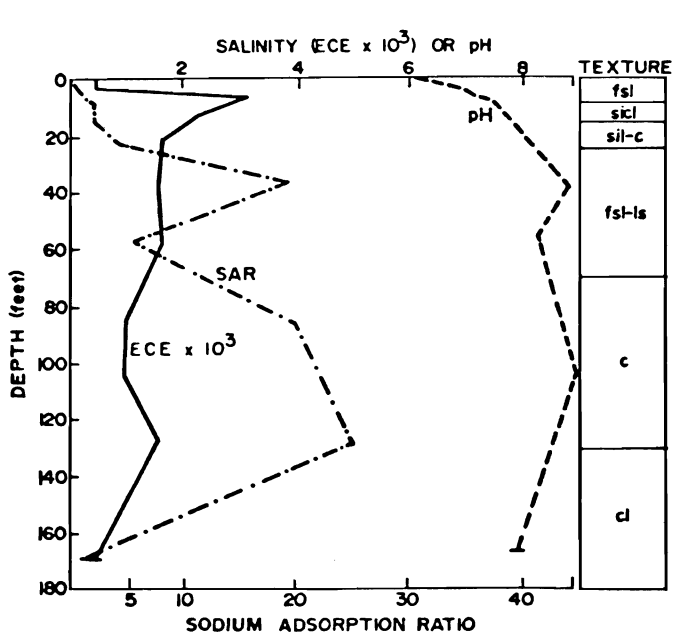


Figure 3. ECE, SAR, Texture and pH in a Telfer soil area in Dunn County.

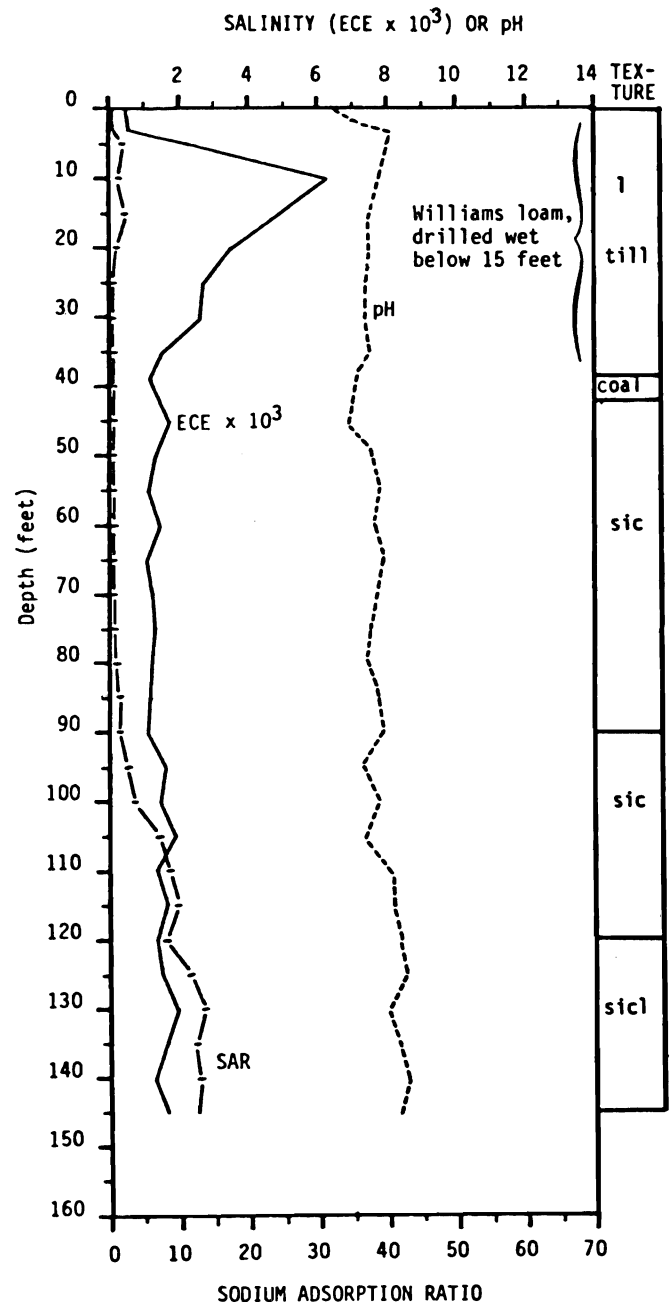


Figure 4. ECE, SAR, Texture and pH of overburden in a Williams soil area in McLean County.

About 30 feet of suitable plant growth material, low in salinity and sodium, occurs at the Figure 3 data site. Some of the fine sandy loam to loamy sand in the 30-70 foot section is also suitable. Soil blowing and low water-holding capacity will be problems in reclamation of the sandy loam to loamy sand material. Poor stability of the banks during mining operations is also a problem in coarser-textured material. The high SAR clay to clay loam below 70 feet is unsuitable plant growth material.

About 40 feet of glacial till overlies soft, Fort Union bedrock at the Figure 4 data site. The glacial till is suitable plant growth material, except for the 10 to 15 foot depth where salinity (ECE) is over 4 millimhos. Sodium (SAR) values are low, even in the Fort Union silty clay from 40 to 110 feet. The Fort Union silty clay at this location is suitable chemically as plant growth material, but because of its fine texture, it is difficult to spread and pack without voids. It is, therefore, less desirable as reclamation material than glacial till.

All of the nine drill holes sampled in glacial till had similar material except for one site in an area of Niobel soils. At this site the SAR and ECE were too high in the upper 10 feet for suitable plant growth material.

Figures 1 through 4 illustrate some of the variation in overburden from Fort Union and glacial deposited materials. Because of their variability, in thickness, depth and area, on-site sampling will be needed at future mine sites to assess overburden properties.

### Analyses of reshaped mine spoil.

Analytical data for reshaped spoil samples are shown in Appendix Tables VIII through XIII. Figures 5, 6 and 7 show ECE, SAR and pH data from the 0 to 60 inch depth in reshaped spoilbank areas at three mine sites. The data are averages of from five to 10 cores per area. Dominant textures are indicated on the figures.

The areas were selected to show different "soil" properties and associated problems and do not necessarily represent an entire mine. All spoilbanks were reshaped prior to the present regulations governing additions of "top dressing".

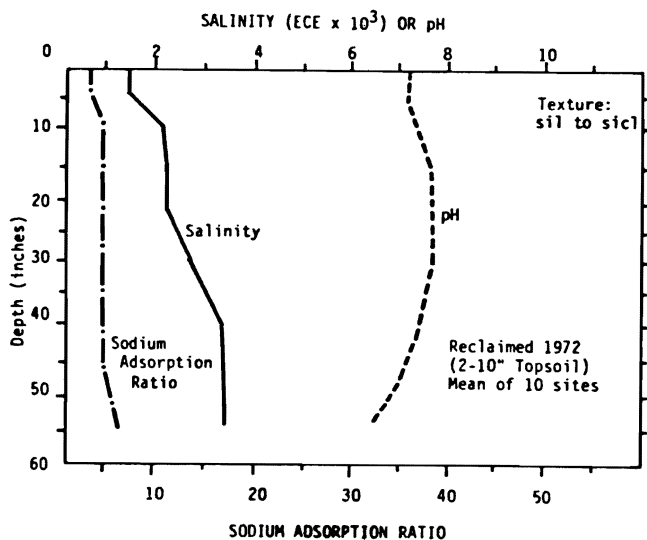


Figure 5. Properties of Reshaped Spoil.

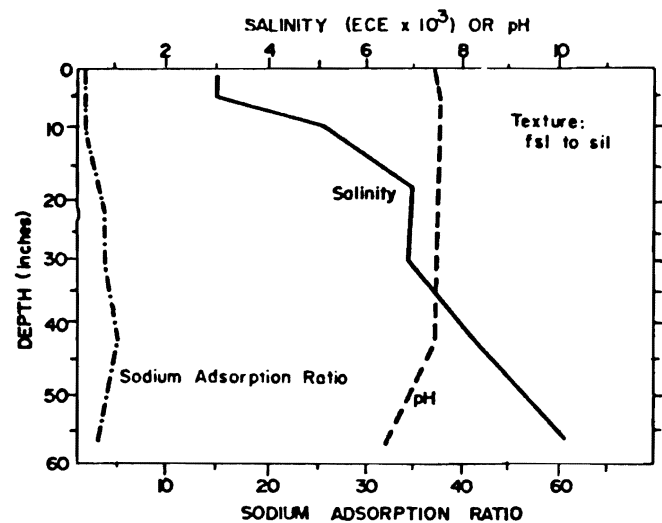


Figure 6. Properties of Reshaped Spoil.

The data in Figure 5 are from an area of reshaped silt loam to silty clay loam spoil with moderate permeability. The material is nearly neutral in reaction,  $pH7 \pm 0.5$ . The ECE is less than 4 millimhos and SAR is less than 7 so the material is suitable for plant growth.

Thin lenses or pieces of unweathered sandstone and siltstone were found in the cores. Bulk densities (Appendix, Table XIII) ranged from 1.0 to 1.5 grams per cubic centimeter. These densities are no greater than those of the original soils.

Two to 10 inches of "topsoil" (A and B horizons mixed) had been spread on the surface. A fair stand of grasses, oats and alfalfa was present. Reclamation appears to be successful on this field.

The reshaped spoil material represented by data shown in Figure 6 is fine sandy loam to silt loam of moderate permeability. It is slightly alkaline (pH about 7.5) through most of the 60 inch depth. The SAR is less than 5 so dispersion should not be a problem. Excess salinity is a problem as indicated by ECE values of more than 4 millimhos at about 9 inches, increasing to 10 millimhos at 60 inches. Leaching of salts and/or improved drainage will be needed to obtain good productivity of all but salt tolerant crops. Because of excess salinity, the material below 10 inches is not suitable for plant growth.

Numerous thin layers of oxidized coal and some pieces of siltstone and sandstone were in the cores. Bulk densities (Appendix, Table X) ranged from 0.5, in coal layers to 1.5 where hard pieces occurred. The average density of 1.1 is less than that of the original soil.



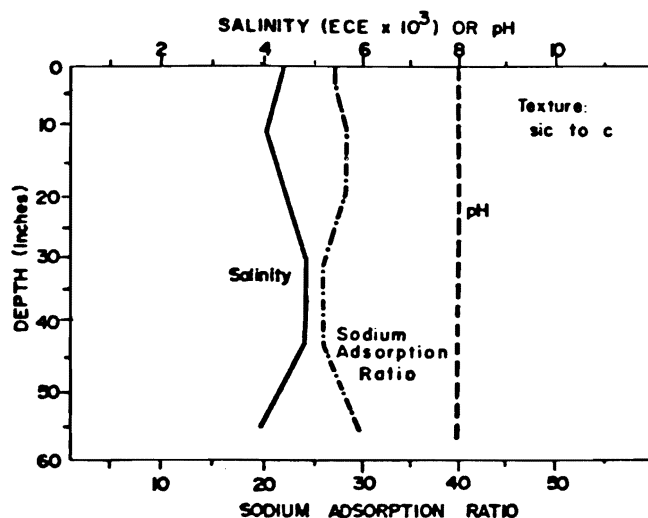


Figure 7. Properties of Reshaped Spoil.

Figure 7 shows properties of reshaped spoil where moderately saline, high sodium, silty clay to clay is the dominant characteristic. The material is all moderately alkaline (pH 8), ECE values are 4 to 5 and SAR is more than 25. Because of the high sodium, the surfaces soon disperse and become impervious to water. All of this material is unsuitable for plant growth. Reclamation of such areas is impossible without a covering of suitable plant growth material. No "topsoil" had been spread at this site and only a few kochia weeds were growing. Bulk densities (Appendix Table X) averaged 1.3.

Variability between sites is high for ECE and SAR in reshaped spoils. RSD values of 30 to 50% are common. K by soil test is high in most reshaped spoils. N ( $\text{NO}_3$ ) and P test low in most areas. One area of moderately fine sodic spoils had high N ( $\text{NO}_3$ ).

Extractable  $\text{NH}_4$  values of 30 to 50 lb/Ac/6" is common in the silty clay loam textured sodic Fort Union spoil materials.

## SUMMARY

Twenty soil series (pedons) were described, sampled, and analyzed. They represent a wide range in soil chemical and physical properties present in potential coal mine areas of North Dakota. Fifteen of the soils had more than 5 feet of suitable plant growth material by North Dakota Public Service Commission standards. The Harriet soils have no suitable plant growth material because they are saline and sodic soils. The Daglum soils had only 7 inches of surface material suitable for plant growth. Materials below 7 inches are high in sodium and very slowly permeable. All soils but four had 10 or more inches of material best suited for top dressing.

Several hundred samples of coal overburdens to mined seams or deeper were analyzed for chemical and physical properties of significance to mined land reclamation. Properties varied widely with depth and across the surface within and between mine areas. Variations are associated with the stratified (layered) nature of the geologic materials that constitute the overburdens. Four figures show graphically, with depth, the salinity, sodium status (SAR), pH, and texture of the materials from four drill sites selected to show the typical range in properties of the overburdens. Materials range from loamy sand to silty clay in texture and most are alkaline in reaction (pH greater than 7). One site in Rhoades soil has no suitable growth material because of excess salinity and sodium in combination with clayey textures. Another site in Williams soil has many feet of suitable growth material.

Because of the variability in overburdens, depth and area wise, on site sampling will be needed at future mine sites to assess overburden properties significant to reclamation.

Reshaped spoils were sampled and analyzed to 5 foot depths at four mine sites. Properties from three sites are shown graphically, with depth. They illustrate the mix of materials presented for revegetation of the mined land. Reshaping of these sites was done prior to the present regulations governing "top dressing." The resulting properties of the mixes could have been predicted from a prior knowledge of the overburden materials and the geologic formations at the various sites.

Kinds and amounts of top dressing materials can be predicted from a highly detailed on site soil map. Properties of the deeper overburdens are predictable from the soil survey in many areas such as sodic (natric) soils, sandy soils in bedrock sands, and soils in glacial tills of considerable depth.

## REFERENCES

1. Ball, C.G. 1966. An economic appraisal of lignite reserves in North Dakota. USDI, Bur. of Mines Info. Cir. 8304.
2. Black, C.A., ed. Agronomy No. 9, Part 2. Methods of Soil Analyses.
3. Brasher, B.R. and others. 1976. Use of saran resin to coat natural soil clods for bulk density and moisture retention measurements. Soil Sci. 101:108.
4. Carlson, C.G. 1973. Geology of Mercer and Oliver counties, North Dakota.
5. North Dakota Public Service Commission. 1975. Rules and regulations for reclamation of surface mined lands.
6. Pollard, B., J.B. Smith, and C.C. Knox. 1971. Strippable coal reserves of North Dakota. USDI, Bur. of Mines, Prelim. Rep. 182.
7. Sandoval, F.M., J.J. Bond, J.F. Power and W.O. Willis. Lignite mine spoils in the Northern Great Plains. Mimeo, for presentation at Symposium, Mined Land Reclamation. Pittsburgh, Penn., Mar. 7-8, 1973.
8. Schroer, F.W. Chemical and physical characterization of coal overburden. North Dakota Farm Research, Vol. 34, No. 1, pp. 5-11.
9. Ting, F.C., ed. N. Dak. Geol. Survey, Misc. Series No. 50, 1972.
10. USDA Agricultural Handbook #18. 1951. Soil Survey Manual.
11. USDA Agricultural Handbook #60. 1954. Diagnosis and Improvement of Saline and Alkali Soils.
12. Williams, D.E. 1948. A rapid manometric method for the determination of carbonate in soils. Soil Sci. Soc. Amer. Proc. 13:127.



## APPENDIX

### Laboratory Methods

#### Sample preparation:

Overburden samples were air dried and crushed in a jaw crusher or low speed (1725 rpm) hammer mill, to pass a 2 mm sieve.

Soil pedon samples were crushed in a mortar to pass a 2 mm sieve. Subsamples were further ground to approximately 80 mesh for total N and organic carbon.

#### Observations and procedures by headings reported in Data Tables III through XVII:

**Material:** Some very generalized notes on type of material are recorded in this column. The abbreviated terms used to describe the dominant materials are as follows: till—glacial material, usually unsorted; FU or BR—Fort Union beds undifferentiated; sh—clayey shale usually gray; ss—sandstone; sis—siltstone; ls—limestone; OW—glacial outwash gravelly to silty; A or B or C or Cca—material assumed to be from these soil horizons; mx or mix—material of several kinds none dominant; lig—lignite.

**Texture:** Texture was determined manually on all samples, and was checked on selected samples by pipette analyses as outlined in USDA Agricultural Handbook #60 (6). Results are reported as per cent sand, silt and clay.

Manual textures are reported in the data tables in abbreviated form as follows: s—sand; fs—fine sand; ms—medium sand; lfs—loamy fine sand; ls—loamy sand; lcos—loamy coarse sand; vfsi—very fine sandy loam; fsl—fine sandy loam; sl—sandy loam; cosl—coarse sandy loam; l—loam; cl—clay loam; si—silt; sil—silt loam; sicl—silty clay loam; sic—silty clay; c—clay; g—gravel 2 to 19 mm; gcl—gravelly clay loam

**Color:** Color was determined on freshly broken surfaces of uncrushed sample by Munsell charts and is reported in the data tables by Munsell notation. It was hoped that color, especially hue and chroma, might give some clue as to sodium status or texture.

**Consistence:** Consistence was determined manually on uncrushed material. Dry consistences as listed in data tables are: s—soft; h—hard; vh—very hard; eh—extremely hard (can't break in the hand). Moist consistences listed are: l—loose; fr—friable; fi—firm; vfi—very firm; efi—extremely firm. These consistence terms are defined in Agricultural Handbook #18. Soil Survey Manual (5).

**Bulk density:** Bulk density (BD) as reported was determined by weighing known lengths of the air dry soil cores taken with the Giddings sampler.

**Effervescence with HCl (or Lime Qual.):** This test was made using 2N HCl on the crushed samples. Data are reported as follows: e—trace; e—slight; es—strong; ev—violent.

**Calcium carbonate equivalent:** Calcium carbonate equivalent was determined by the method of Williams (7). Results are in CaCO<sub>3</sub> equivalent per cent of air dry sample.

**Saturated pastes and saturation extract analyses:** Procedures followed for determinations in this section are essentially as stated in USDA Handbook 60, Diagnosis and Improvement of Saline and Alkali Soils (6). Air dry crushed samples were used to make the saturated pastes by adding soil to known volumes of de-ionized water and stirring mechanically to the desired consistence. pH was determined on a portion of the saturated paste. Ca and Mg were determined by versenate procedure, or by atomic absorption with 0.5% Lanthanum chloride added. Na was determined by flame emission, or by atomic absorption. K was determined by flame emission. Anions were determined as in the Handbook #60 procedure. SO<sub>4</sub> is by difference; cations minus other anions.

Sodium adsorption ratio (SAR) was calculated as stated in Handbook #60 (6).

**Soil test data:** N, P and K were determined by methods currently used at the NDSU soil testing laboratory. Nitrate N was determined with the NO<sub>3</sub> ion electrode in a stirred water extract.

P was extracted with 0.5N NaHCO<sub>3</sub> and determined colormetrically.

K was extracted with 0.5N NaHCO<sub>3</sub> and determined by flame emission.

**Adsorbed NS<sub>4</sub>:** Adsorbed N as NH<sub>4</sub> was determined on selected samples using an ammonium ion electrode in normal NaCl extracts.

Additional methods used for soil (pedon) characterization.

Organic carbon: Organic carbon was determined by furnace combustion.

Total Nitrogen: Total nitrogen (N%) was determined by the semi-micro Kjeldahl procedure of Bremner in Agronomy No. 9 Part 2, p. 1172 (1).

Bulk density, 1/3 bar water content, and COLE: These were determined by the Saran coating method of Brasher, and others (2).

Exchangeable cations: Exchangeable cations were determined by the Barium chloride - Triethanolamine method (Agronomy No. 9, page 910), minus water soluble cations. The Ca, Mg, Na and K were determined in the BaCl<sub>2</sub> - TEA extract by atomic absorption.

Table III.  
Lab Data - Consolidation Coal Co.  
Deep Borings

NDSU - Soils Lab - Sept. 1973  
F. Schroer, Darrell Vanderbusch

Sample	Depth (ft.)	Tex.	Color (dry)	Sat'n. %	pH (paste)	ECE <sub>25</sub> <sup>0</sup> (mmhos/cm)	Soil Test Data												
							Saturation		Extract		Solution Ions (meq./litre)				CaCO <sub>3</sub> Equiv., %	lbs/A/6"	lbs/A		
							CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	SAR		N(NO <sub>3</sub> )	P	K
Con. #1	0-2.5	l	4/2	43	7.5	0.42		2.6	0.4	1.9	2.4	1.5	0.9	0.1	0.7	0	<5	7	185
So. 1/2,	2.5-5	cl	6/2	42	8.3	0.71		3.1	0.6	3.6	0.9	1.8	4.5	0.1	3.8	15.4	7	8	250
20-144-84	5-7	cl	6/2	49	8.2	2.6		2.4	2.4	23.4	2.5	10.4	15.1	0.2	6.0	11.8	7	8	410
Temvik	10-15	cl	6/2	42	7.8	6.4		1.2	3.0	84.8	24.4	36.0	28.0	0.6	5.1	11.5	40	8	450
loam.	15-20	cl	6/2	53	7.7	5.5		1.2	2.0	72.4	25.2	25.8	24.0	0.6	4.8	9.5	69	9	590
	20-25	cl	6/2	52	7.7	5.2		1.0	1.6	69.1	25.2	24.0	21.8	0.7	4.4	10.2	65	9	620
	25-30	c	6/2	85	7.8	4.8		1.3	0.8	62.4	24.4	22.2	17.2	0.7	3.6	5.0	90	6	510
	30-35	coal	4/1	49	4.7	6.9			1.5		25.6	32.0	38.4	0.8	7.2	0	99	75	390
	35-40	c	6/1	93	7.8	2.0		3.6	0.3	16.0	2.3	2.0	15.1	0.5	10.3	6.4	5	7	425
	40-45	c	6/1	108	8.3	1.9		4.7	-	14.2	1.9	1.4	15.1	0.5	11.8	14.7	<5	8	460
	45-47	c	6/1	125	8.3	1.9		3.6	-	12.6	1.3	0.9	13.5	0.5	13.2	5.2	<5	7	470
	47-52	coal	(NS)	-	-	-		-	-	-	-	-	-	-	-	-	-	-	-
	52-57	sil	6/1	105	8.5	1.8	0.6	4.8	-	11.4	0.4	0.2	15.4	0.2	28.5	4.5	<5	5	430
	57-62	sil	6/1	145	9.0	1.3	1.3	4.3	0.3	5.7	0.1	0.2	11.2	0.1	29.5	9.2	<5	8	400
	62-70	sic1	6/1	130	8.9	1.3	1.1	5.3	0.3	5.8	0.2	0.2	12.0	0.1	27.3	13.2	<5	32	420
	71-77	coal	(NS)	-	-	-		-	-	-	-	-	-	-	-	-	<5	9	460
Con. #2	0-3	sil	4/2	52	7.0	0.83		6.4	0.2	2.7	4.9	2.8	1.0	0.6	0.5	0	<5	7	280
28-144-84	3-5	l	6/2	36	8.2	0.59		3.4	0.5	2.2	0.8	1.9	3.3	0.1	2.8	18.0	5	6	400
Temvik	5-10	cl	6/2	45	7.9	4.7		1.8	3.2	60.8	15.7	33.4	16.4	0.3	3.3	12.8	37	8	400
silt	10-15	cl	6/2	42	7.8	4.8		1.4	4.8	59.7	21.5	27.0	17.0	0.4	3.5	14.5	100	14	430
loam	15-20	l	6/2	39	7.6	4.7		0.9	2.4	62.3	27.1	22.0	16.0	0.5	3.2	10.8	180	75	500
	20-23	cl	6/1	63	5.3	5.1		2.6	2.8	66.9	29.8	25.0	16.8	0.7	3.2	0.7	7500	160+	400
	23-28	coal	2/1	94	4	8.0					30.5	41.8	52.6	0.8			150	27	400
	28-34	cl	6/1.4	66	6.1	6.0		12.5	1.0	68.1	18.5	19.5	43.0	0.6	9.9	5.8	50	8	380
	34-38	sic1	6/2	85	7.5	3.0		6.9	0.6	23.4	2.2	3.2	25.2	0.3	15.4	8.6	38	12	365
	38-43	l	6/1.4	110	7.8	2.1		5.3	0.4	14.7	0.8	1.2	18.2	0.2	18.2	9.8	17	122	360
	43-47	sic1	6/2	124	8.1	1.6		4.2	0.4	11.1	0.5	0.5	14.5	0.2	20.7	10.2	10	8	435
	47-49	sil	6/1	148	8.4	1.6		7.0	0.2	7.6	0.2	0.4	14.0	0.2	25.9	11.8	18	17	450
	49-50	sic	6/1	130	8.1	2.1		6.9	-	12.7	0.6	0.6	18.0	0.4	23.4	15.3			
	50-58	coal	(NS)	-	-	-		-	-	-	-	-	-	-	-	-			

Table III.  
Lab Data - Consolidation Coal Co.  
Deep Borings

NDSU - Soils Lab - Sept. 1973  
F. Schroer, Darrell Vanderbusch

Sample	Depth (ft.)	Tex.	Color (dry)	Sat'n. %	pH (paste)	ECE <sub>25</sub> <sup>0</sup> (mmhos/cm)	Saturation, Extract Solution Ions (meq./litre)								CaCO <sub>3</sub> Equiv., %	Soil Test Data			
							CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K		SAR	lbs/A/6" N(NO <sub>3</sub> )	lbs/A P	lbs/A K
Con. #3	0-1.5	l	4/2	51	7.0	0.80		4.9	0.4	3.4	5.0	2.5	0.9	0.3	0.5	0	<5	7	355
N 1/2	1.5-5	cl	6/2	45	8.3	0.64		3.5	0.8	2.5	0.8	2.3	3.6	0.1	2.9	16.8	<5	8	350
N 1/2	5-10	cl	6/2	51	7.9	5.8		1.7	3.4	75.7	19.0	36.5	25.0	0.3	4.8	11.8	3	5	395
29-144-84	10-15	sicl	6/3	74	7.9	3.6		1.3	2.6	41.0	10.5	14.5	19.5	0.4	5.5	8.9	38	9	-
	15-20	sic	6/2	84	7.8	4.5		1.2	1.8	57.1	21.0	18.0	20.5	0.6	4.7	4.7	120	20	460
	15-24	coal	2/1	74	3.8	8.5					29.0	38.5	57.5	0.8			460	160+	-
	24-30	sic	6/2	86	6.0	5.9		14.2	1.8	62.8	21.5	18.5	38.0	0.8	8.5	7.4	195	48	480
	30-35	sic	6/3	105	7.8	3.2		3.0	0.3	31.0	4.2	6.0	23.6	0.5	10.5	11.1	121	9	400
	35-40	sicl	6/2	81	8.1	2.6		1.9	0.5	22.9	1.8	3.0	20.2	0.3	13.2	8.9	80	4	365
	40-45	sil	6/3	92	8.1	2.6		1.9	0.2	23.0	1.8	2.8	20.2	0.3	13.4	9.5	60	5	415
	45-50	sicl	6/2	110	8.2	3.6	0.6	2.7	14.2	23.1	2.0	2.8	22.0	13.2	14.3	10.1	32	3	430
	50-55	sic	6/1	121	8.3	2.2	0.6	2.7	0.2	18.2	1.4	2.0	17.2	0.5	13.2	12.0	9	11	495
	55-59	coal	3/1	62	6.0	7.1		11.0	1.0	81.8	23.5	18.5	51.0	0.8			22	125	385
	H-66-72	sicl	6/1	101	8.8	1.2	0.8	4.4	0.4	7.7	0.2	0.2	12.0	0.1	27.3	10.0	<5	7	360
	H-72-80	sil	6.3/1	113	9.0	1.3	1.2	3.3	0.4	8.9	0.1	0.9	11.5	0.1	16.4	9.6	9	5	-
Con. #4	0-2.5	cl	4/2	46	7.4	0.72		4.8	0.4	2.5	2.0	2.1	3.5	0.1	2.5	0	17	5	280
NW33-	2.5-5	cl	6/2	63	8.5	1.0		3.5	0.2	6.2	0.3	0.7	8.9	-	12.7	15.6	6	8	465
144-84	5-10	sc	6/2	58	8.4	0.57	0.6	3.2	0.4	2.8	0.3	0.8	5.8	0.1	7.8	10.5	5	4	440
Temvik	10-15	c	6/2	83	8.5	1.3	0.8	2.1	0.6	9.3	0.5	1.4	10.7	0.2	11.0	11.2	13	8	430
silt	15-20	sic	6/2		8.1	2.2	-	1.3	0.4	22.3	3.2	3.8	16.6	0.4	8.9	8.7	25	7	490
loam,	21-24	coal	2/2	77	4.3	5.7					18.5	20.5	77.5	0.8	17.5		285	160+	460
2%	24-29	sic	6/1	125	7.6	3.2		2.6	0.1	32.1	2.8	2.8	28.8	0.4	17.3	6.4	360	9	510
	29-33	sic	6/2	156	8.4	2.2	0.2	2.1	0.4	20.7	0.8	0.8	21.4	0.2	24.0	9.3	92	6	475
	33-36	sic	6/1	133	8.4	2.8	0.6	3.3	0.3	24.1	0.8	0.8	25.6	0.5	28.8	11.0	90	5	540
	36-39	sic	6/2	130	8.5	2.2	0.8	2.4	0.4	17.9	0.6	0.4	20.2	0.3	28.9	11.1	33	5	415
	39-42	sic	6/1	130	8.4	2.6	0.8	4.1	-	20.6	0.6	0.4	24.0	0.5	34.3	10.5	26	8	480
	42-47	coal	2/1	68	6.8	5.5		7.1	1.0	52.2	1.5	1.0	57.5	0.3	51.3		27	4	180
	47-52	sic	6/1	129	8.5	1.1	0.7	4.4	-	10.8	0.2	0.9	14.6	0.2	19.7	5.2	7	6	370
	52-57	sic	6/1	144	8.8	1.1	1.4	4.6	0.3	4.5	0.1	0.5	10.1	0.1	18.7	10.3	10	13	380
	57-62	sic	6/1	120	8.8	1.2	2.0	5.1	0.3	5.3	0.1	0.5	12.0	0.1	22.2	10.1	6	8	350
	62-67	c	6/1	144	8.6	1.2	1.5	5.3	0.2	5.6	0.1	0.9	11.5	0.1	16.4	11.7	8	8	390
	67-72	sic	6/1	147	8.4	1.2	1.6	6.2	-	6.7	0.2	1.7	12.4	0.2	12.8	14.7	11	9	400
	72-82	coal	2/1	69	6.9	4.5		30.5	0.6	25.6	1.5	1.0	54.0	0.2	48.2		16	5	180

Table III.  
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Deep Borings

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Sample	Depth (ft.)	Tex.	Color (dry)	Sat'n. %	pH (paste)	ECE <sub>25</sub> <sup>0</sup> (mmhos/cm)	Saturation Extract Solution Ions (meq./litre)								SAR	CaCO <sub>3</sub> Equiv., %	Soil Test Data		
							CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K			lbs/A/6" N(NO <sub>3</sub> )	lbs/A P	lbs/A K
Con. #5	0-2	l	4/2	49	7.2	1.1		5.3	2.6	2.3	4.5	2.4	1.0	2.3	0.5	0	<10	7	355
32-144-86	2-5	cl	6/2	66	8.4	4.0	0.4	2.6	1.4	39.3	1.5	5.0	37.0	0.2	20.6	16.4	<10	9	360
Temvik-	5-10	sic	6/2	128	8.5	5.7	-	1.1	1.6	85.7	7.5	18.5	62.0	0.4	17.2	14.7	28	7	430
Williams	10-13	c	6/2	174	8.5	5.1	-	1.6	1.6	56.2	2.5	8.5	48.0	0.4	20.9	8.5	180	12	470
loam.	13-16	c	6/1	125	7.2	8.5		3.8	1.6	104.3	10.0	27.0	72.0	0.7	16.7	1.0	270	53	620
	16-18	coal	3/2	63	4.0	15.3			2.4		22.0	69.0	141.0	0.6			7500	28	360
	18-22	si	5/2	48	4.5	8.5		0.1	0.8	111.5	16.0	20.0	76.0	0.4	17.9	0	160	95	335
	22-24	coal	2/1	97	4.1	11.3					12.0	18.0	124.0	0.7			7500	160	380
	24-29	sic	6/2	104	7.4	5.7		3.2	0.4	64.5	6.0	6.0	55.5	0.6	22.8	4.9	71	14	450
	29-34	c	6/2	139	8.1	3.4	0.2	2.4	0.4	32.3	1.2	1.4	32.4	0.3	28.4	7.4	55	7	470
	34-37	sicl	6/2	132	8.5	2.7	0.2	3.3	0.3	22.9	0.6	0.6	25.2	0.3	32.7	14.6	31	7	400
	37-42	sic	6/1	144	8.8	2.4	0.8	4.7	0.5	15.3	0.6	0.2	20.2	0.3	32.1	12.5	38	10	415
	42-47	sic	6/1	133	8.6	1.9	1.0	6.6	0.6	11.3	0.4	-	18.8	0.3	42.7	12.9	14	11	410
	47-52	sic	6/1	145	8.8	1.5	2.6	7.5	0.2	4.4	0.1	-	14.4	0.2	65.5	12.9	13	12	430
	52-57	c	6/1	130	8.6	1.5	1.6	9.1	0.2	5.4	0.1	-	15.8	0.2	71.8	14.3	42	13	450
	57-64	c	6/1	125	8.7	1.6	1.4	8.1	-	6.4	0.1	0.1	15.5	0.2	50.0	10.3	10	9	495
	64-68	coal	2/2	68	7.0	4.0		29.7		21.0	1.0	0.5	49.0	0.2	-		24	8	230
	68-73	c	6/1	117	8.6	1.8	1.1	6.8	-	9.9	0.2	-	17.4	0.2	56.1	3.9	<10	10	500
	73-78	coal	2/1	64	7.0	4.0		24.2	0.6	25.4	1.0	0.5	48.5	0.2			26	9	230



Table III (Cont'd)

North Dakota State University Soils Lab, April 1975

Deep Borings Consolidation Coal Company

Particle Size Analyses

Sample	Depth (ft.)	Size Class and Particle Diameter (mm) - %								Texture
		vcos 2-1	cos 1-.5	ms -.25	fs -.1	vfs -.05	total sand 2-.05	silt -.002	clay .002	
Con #1	0-2.5	0.6	0.9	1.1	5.3	25.1	33.4	48.2	18.2	loam
SO 1/2,	2.5-5	4.4	2.2	3.3	8.7	14.3	33.7	40.1	26.2	loam
20-144-84	15-20	6.6	3.2	4.8	14.4	10.6	39.8	34.2	26.0	loam
Temvik loam	40-45						1.0	61.2	37.8	silty clay loam
	52-57	2.2	1.0	0.2	0.7	12.6	17.0	57.2	25.8	silt loam
	57-62	0.8	0.2	0.1	1.0	53.8	55.5	28.7	15.8	very fine sandy loam
Con #2	0-3	1.1	1.4	1.9	5.2	18.2	28.1	52.7	19.2	silt loam
28-144-84	3-5	5.8	4.9	6.0	14.5	13.2	43.5	32.1	24.4	loam
Temvik	15-20	11.1	3.3	4.3	12.8	10.7	41.4	33.5	25.1	loam
silt loam	38-43	0.5	0.2	0.2	0.1	40.7	42.3	37.3	20.4	loam
	47-49	0.4	0.2	0.1	0.6	9.6	11.0	64.5	24.5	silt loam
Con #3	0-1.5	1.4	2.5	4.2	11.8	14.6	34.4	41.2	24.4	loam
N 1/2, N 1/2	5-10	5.9	3.0	4.1	12.1	10.4	35.6	37.3	27.1	loam-clay loam
29-144-84	15-20						0.7	45.8	53.5	silty clay
	35-40	0.1	0.1	0.2	1.2	40.1	41.8	39.8	18.4	loam
	50-55	0.5	0.1	0	0.1	5.1	7.2	64.5	28.3	silty clay loam
	H66-72	0.1	0.1	0.1	5.1	46.1	51.2	31.3	17.5	very fine sandy loam
Con #4	0-2.5	1.6	0.8	1.9	6.6	24.2	30.6	48.4	21.0	loam
NW 33-144-84	2.5-5	3.2	2.3	4.1	14.2	11.6	34.9	35.7	29.4	clay loam
Temvik	10-15	2.1	0.5	0.5	2.0	2.3	7.4	62.3	30.3	silty clay loam
silt loam,	29-33						0.1	58.8	41.1	silty clay
2%	52-57	0	0	0	0.6	35.9	36.7	46.1	17.2	loam
Con #5	0-2	0.4	0.8	1.5	6.7	17.0	26.7	53.6	19.7	silt loam
32-144-86	2-5	1.9	1.9	3.2	10.9	13.4	32.0	42.7	25.3	loam
Temvik-	10-13						1.1	40.4	58.5	clay
Williams	42-47	0	0	0	0.1	12.1	11.7	63.9	24.4	silt loam
loam	57-64						0.9	58.1	41.0	silty clay
	68-73						0.6	50.0	49.4	silty clay

Table IV  
 Lab Data: Knife River Coal Company, Beulah South,  
 Deep Borings

Sampled October 1973  
 NDSU, Soils Department

Sample	Depth (ft.)	Mat'l.	Color (dry)	Tex <sup>1/</sup>	Con. (dry)	Lime (qual.)	pH (paste)	ECE25 mmhos	Saturation					Extract Soluble Ions (meq./litre)					Sat'n. %	CaCO3 (Eq.%)	Soil Test Data			
									CO3	HC03	Cl	S04	Ca	Mg	Na	K	SAR	1bs/A-6"			1bs/A			
										(NH4)	(NO3)	P	K											
K12 (NE11-143-88)	10-15	till	10YR 5/2	1	-	es	7.7	2.6		1.1	2.6	30.3	13.4	12.8	7.2	0.6	2.0	55	6.7	12	25	7	390	
	-20	till	2.5Y 6/3	1	vh	es	7.6	3.6		1.5	1.3	52.0	28.0	20.0	6.0	0.8	1.2	57	6.1	12	31	8	370	
	-25	mx	2.5Y 5/2	1	vh	es	7.7	3.0		1.7	0.8	40.7	20.6	17.0	5.0	0.6	0.9	43	3.8	14	34	8	315	
	-30	sh	2.5Y 6/2	sic1	vh	e	7.6	3.5		1.5	0.3	52.3	26.4	22.0	4.8	0.9	1.0	79	2.3	16	36	5	410	
	-35	sh	2.5Y 6/2	sic1	-	es	7.6	3.2		2.0	0.4	44.5	20.4	20.8	5.0	0.7	1.1	68	5.3	16	42	10	445	
	-40	ls	2.5Y 6/2	sil	s	o	7.6	3.7		1.5	0.4	55.8	22.4	28.8	5.8	0.7	1.2	53	-	6	15	2	250	
	-45	sh	2.5Y 5/2	sic1	vh	o	7.5	4.0		1.5	0.3	62.2	24.5	32.0	6.5	1.0	1.2	75	-	22	24	2	440	
	-50	ls+sh	2.5Y 5/2	sic	vh	o	7.3	4.3		1.0	0.5	67.1	25.0	35.0	7.5	1.1	1.4	75	-	40	16	4	490	
	-53		2.5Y 5/1	c	eh	o	6.9	3.5		1.3	0.4	50.2	14.8	28.4	7.8	0.9	1.7	75	-	60	11	20	560	
	-65'	coal					6.2	4.4		6.8	1.3	57.3	26.0	25.0	14.0	0.4	2.8	76	-	-	7	2	195	
K13 (near centre 1-143-88)	*0-5	till	2.5Y 6/2	1		es	8.0	1.3		4.6	0.6	9.3	1.6	4.6	8.1	0.2	4.6	47	8.9	4	5	7	230	
	-10	t+c	10YR 6/1	c1	vh	e	5.1	5.2		0.5	1.0	90.8	22.5	31.5	37.5	0.8	7.2	67	3.0	18	19	67	330	
	-15	sh	10YR 6/1	sic1		es	6.5	5.4		12.9	1.3	99.5	27.0	40.0	45.5	1.2	7.9	74	4.9	14	30	59	430	
	-20	sh	2.5Y 6/2	sic1		e	7.2	5.7		2.9	0.8	131.1	22.0	65.5	46.0	1.3	7.0	80	3.9	22	10	11	460	
	-25	sh	2.5Y 6/1	sic1	vh	e	8.2	5.2		5.1	0.7	73.1	11.5	19.0	47.0	1.4	12.1	80	5.0	32	7	5	590	
	-30	ss	2.5Y 6/0	1	vh	es	8.5	3.2	0.4	4.6	0.7	28.4	1.6	2.2	29.6	0.7	21.6	55	24.2	28	<5	6	390	
	-35	sh	2.5Y 6/1	sic	vh	o	8.7	2.3	2.1	8.8	0.6	12.0	0.6	0.8	21.6	0.5	26.0	109	-	54	5	6	540	
	-40	sh	2.5Y 6/1	sic	vh	o	8.4	1.9	0.6	8.0	0.6	10.4	0.2	0.6	18.4	0.4	29.2	107	-	64	<5	8	600	
	-42	sh	5Y 5/1	c	eh	o	7.9	1.8	0.8	11.6	0.6	7.0	0.2	0.6	18.8	0.4	29.8	114	-	38	<5	7	630	
K14 (SE11-143-88)	0-5	till	2.5Y 5/2+6/2	1		es	8.0	0.6		3.8	0.6	2.3	1.8	3.0	1.7	0.2	1.1	47	11.6	4	<5	5	270	
	-10	till	2.5Y 6/2	c1		es	8.1	1.1		3.2	0.7	6.8	1.4	3.8	5.2	0.3	3.2	63	9.3	10	<5	7	370	
	-15	sh	2.5Y 6/1+2	sic1		e	7.8	3.6		1.6	0.7	50.9	17.6	26.0	8.8	0.8	1.9	87	-	12	7	8	460	
	-16	sh+c	mix	c1		o	4.1	5.1		-	0.8	89.0	24.0	51.0	14.0	0.8	2.3	79	-	88	28	200+	410	
	-25	coal	10YR 2/1	coal		o	3.6	10.2		-	1.4	183.9	22.0	122.0	41.0	0.3	4.8	99	-	324	50	152	100	

<sup>1/</sup>Texture of crushed (<2 mm) material.

\*A + B removed.

Table IV  
 Lab Data: Knife River Coal Company, Beulah South,  
 Deep Borings

Sampled October 1973  
 NDSU, Soils Department

Sample	Depth (ft.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime (qual.)	pH (paste)	ECE25 mmhos	Saturation Extract Soluble Ions (meq./litre)								Sat'n. %	CaCO <sub>3</sub> (Eq.%)	Soil Test Data					
									CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K			SAR	lbs/A-6" (NH <sub>4</sub> )	lbs/A (NO <sub>3</sub> )	P	K	
K15 (SW12-143-88)	0-5	ow/t	10YR 4+5/2	sl+1	h	e	7.4	1.2		5.5	0.6	7.8	5.6	6.4	1.7	0.2	0.7	35	2.0	6	9	5	210	
	-10	t+c	mix	l	h	o	5.3	0.5		2.1	0.5	3.2	1.3	1.8	2.6	0.1	2.1	54	-	2	<5	22	140	
	-11	coal	10YR 2/1	-	-	-	4.1	1.7		-	1.1	16.8	4.0	4.4	9.2	0.3	4.5	64	-	28	20	200+	245	
	-15	sh	2.5Y 6/1+2	cl	vh	o	4.2	3.3		-	0.6	41.0	13.6	11.6	15.6	0.8	4.4	56	-	22	8	35	330	
	-20	sh	2.5Y 5+7/2	sic1	vh	o	6.8	4.5		6.6	0.7	57.1	20.5	19.5	22.0	1.0	4.9	66	-	34	5	57	380	
	-25	sh	2.5Y 6/1	sic1	vh	e	8.4	2.6	0.8	8.8	0.5	18.6	2.8	4.0	21.2	0.7	11.5	78	5.1	56	7	6	450	
	-30	sh	2.5Y 6/1	sic1		e	8.5	2.2	0.8	9.4	0.6	12.7	1.2	1.6	20.2	0.5	17.1	89	6.2	68	5	6	510	
	-35	sh	2.5Y 6/1	sic1		e	8.4	2.2	1.3	11.3	0.7	12.0	0.8	1.2	22.8	0.5	22.8	84	6.2	64	6	7	500	
	-40	sh+ls	2.5Y 6+7/1	sic1		es	8.6	1.7	1.3	7.2	0.6	8.8	0.2	0.4	17.0	0.3	31.5	64	26.3	40	<5	5	390	
	-45	sis	N 6/0	sic1		e	8.9	1.7	1.7	11.3	0.7	5.1	0.2	0.4	18.0	0.2	33.3	96	6.8	54	<5	8	480	
	-50	sis	2.5Y 5+6/1	sic		e	8.8	1.7	2.3	11.9	0.5	4.1	0.2	0.4	18.0	0.2	33.3	89	6.5	60	<5	8	500	
	-55	sis	N 6/0	sic		e	8.9	1.6	2.7	11.2	0.6	3.9	0.2	0.2	17.8	0.2	40.4	105	7.2	64	<5	7	480	
	-60	sis	N 6/0	sic		o	8.9	1.5	2.1	10.2	0.7	3.6	0.2	0.2	16.0	0.2	36.4	111	-	70	<5	7	530	
	-65	sis	5Y 6/1	c		o	8.7	1.5	1.5	10.2	0.6	5.4	0.2	0.4	16.8	0.3	31.1	119	-	66	<5	7	580	
-68	sis	5Y 6/1	c		o	8.5	1.5	1.3	9.7	0.8	5.0	0.2	0.4	16.0	0.2	29.6	133	-	50	<5	7	640		
K16 (NW corner 18-143-87)	0-5	ow/t	mix	sl+1		es	8.0	1.1		4.8	1.1	6.7	2.1	4.0	6.4	0.1	3.7	42	11.4	4	-	-	-	
	-10	till	10YR 6/3	l		es	6.8	10.3		24.3	3.9	162.2	28.0	90.0	72.0	0.4	9.4	65	8.9	6	27	43	180	
	-15	ss	2.5Y 6/1+2	sic1		o	6.4	8.7		3.1	1.2	128.5	23.0	54.0	55.0	0.8	8.9	66	-	14	21	50	305	
	-20	sis	5GY 6/1+2	sic		o	7.6	7.5		1.6	0.8	112.9	22.0	48.0	44.0	1.3	7.5	88	-	16	13	12	490	
	-25	sis	5Y 6/2	sic		tr	7.6	7.3		1.9	0.7	108.6	21.0	40.0	49.0	1.2	8.9	84	3.6	18	10	7	440	
	-30	sis	5Y 6/2	sic		o	7.8	6.7		1.9	0.7	91.0	19.0	24.5	49.0	1.1	10.5	93	-	24	8	4	450	
	-33	sis	5Y 6/1+2	sic		es	8.2	5.7		3.9	0.6	71.5	12.6	13.8	48.5	1.1	13.4	94	7.8	32	9	5	440	
	-35	ls	not sampled																					
	-40	sis	5GY 6/1	sic		tr	8.8	3.0	2.1	6.7	0.7	23.1	0.5	1.5	30.0	0.6	30.0	117	-	60	13	9	540	
	-45		5GY 6/1	c		o	8.8	2.8	1.3	8.0	0.6	21.5	0.4	0.8	29.6	0.6	38.4	117	-	54	6	9	580	
-49		5GY 4+5/1	c		o	8.5	2.8	1.3	8.4	0.9	19.2	0.4	0.6	28.4	0.4	40.6	123	-	54	6	9	680		

Table IV  
 Lab Data: Knife River Coal Company, Beulah South, at sites of Deep Borings - K12-K16, 10/17/73  
 (1.5 inch cores to 6 to 9 foot depth)

Sample	Hor.	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime (qual.)	pH (paste)	ECE25	Saturation Extract Soluble Ions (meq/litre)							Sat'n. %	Soil Test Data				
										HCO3	Cl	SO4	Ca	Mg	Na	K		SAR	lbs/A-6"		lbs/A	
														N (NO4)	N (NO3)	P	K					
K12A (NE11-143-88) Williams	Ap	0-6		10YR 4/2 -		h	e	7.2	0.5	2.2	0.6	3.0	2.8	2.1	0.3	0.6	0.2	52				
	B21	-24		10YR 4/3 1		h	e	6.8	0.4	0.7	0.5	3.3	1.9	1.8	0.7	0.1	0.5	40	4	<5	5	260
	B3	-42		10YR 4/3 s1		vh	e	7.5	0.7	2.6	0.5	5.5	2.4	4.2	1.9	0.1	1.1	36	4	<5	9	200
	C	-78	till	10YR 5/2 sc1		h	es		7.8	5.0	2.7	0.7	82.0	24.0	48.0	13.0	0.4	2.2	48	4	<5	21
K13A (near centre 1-143-88) Williams	B2	0-8		10YR 5/4 1		h	e	7.4	0.7	4.6	0.2	3.8	4.0	3.6	0.8	0.2	0.4	50	4	5	3	260
	Cca	-30	till	10YR 7/2 sil		h	es	8.1	1.9	4.1	0.8	17.7	3.8	9.8	8.8	0.2	3.4	56	2	<5	4	220
	C2	-58	till	10YR 6/3 1		sh	es	8.0	7.4	4.3	2.0	126.3	24.0	77.0	31.0	0.6	4.4	55	8	6	9	290
	C	-84	t+c	10YR 2/1 -		s	e		5.3	8.9	10.4		113.3	28.5	89.0	6.0	0.2	9.0	109	2	30	61
K14A (SE11-143-88) Flaxton	Ap	0-8		10YR 4/2 1s		sh	e	6.9	0.7	3.8	0.3	3.9	4.3	2.6	0.7	0.4	0.4	37				
	B2	-22		10YR 5/2 s1		h	e	7.3	0.5	4.2	0.3	2.2	3.3	2.4	0.8	0.2	0.5	48	2	<5	1	240
	IICca	-48	till	10YR 7/2 sil		h	es	8.0	0.5	4.4	0.2	1.7	1.9	3.0	1.3	0.1	0.8	50	2	<5	1	230
	IIC	-72	till	10YR 6/3 c1		h	es		8.3	0.6	5.6	0.3	1.7	1.0	3.1	3.4	0.1	2.4	52	6	<5	1
K15A (SW12-143-88) Flaxton	IIC	-96	till	10YR 7/4 sic1		h	es	8.0	1.0	3.9	0.3	6.5	1.6	4.0	4.8	0.3	2.9	60	12	5	4	350
	A	0-6	ow	10YR 4/2 1		h	e	6.6	0.5	3.1	0.6	2.2	3.0	1.8	0.6	0.5	0.4	47				
	B	6-24	ow	10YR 4/3 s1		h	e	7.0	0.6	4.5	0.4	1.9	3.3	2.6	0.7	0.2	0.4	32	12	<5	5	260
	IIC1	24-48	till	10YR 6/3 c1		h	es		7.9	0.8	4.8	0.5	3.4	1.6	3.5	3.5	0.1	2.2	52	4	<5	3
K16A (NW Cor. 18-143-87) Williams	IIC2	48-75	till	10YR 6/3 c1		h	es	8.0	5.2	3.8	0.7	75.8	16.0	46.0	18.0	0.3	3.2	58	4	<5	4	270
	Ap	0-9		10YR 4/3 s1		sh	e	6.6	0.6	2.3	0.5	3.8	3.8	2.0	0.6	0.2	0.4	29	10		9	280
	B2	-30		10YR 5/3 1		sh	e	7.3	0.6	4.8	0.2	1.7	3.6	2.4	0.6	0.1	0.4	39	2	7	2	180
	C	-48	till	10YR 6/3 c1		h	es		7.9	0.7	5.1	0.3	3.2	3.3	3.6	1.6	0.1	0.9	51	1	6	5
Williams	C	-72	till	10YR 7/3 c1		h	es	8.3	1.1	6.4	0.6	4.9	1.2	3.9	6.7	0.1	4.2	51	1	<5	11	210
	C	-108	coal	10YR 2/1 -		s	e	7.7	6.5	10.6	1.7	88.9	26.0	42.5	32.5	0.2	5.6	61	1	11	170	100

NDSU Soils Lab  
April 1975

Table IV (Cont'd)  
Particle Size Analyses  
Deep Borings - Knife River - Beulah South

Sample	Depth (ft.)	Size Class and Particle Diameter (mm) - %								Texture
		sand						silt -0.002	clay <.002	
		vcos 2-1	cos 1-.5	ms -.25	fs -.1	vfs -.05	(total) 2-.05			
K12	15-20	1.1	2.2	5.4	16.3	11.6	37.0	35.3	27.7	clay loam
NE11-143-88	25-30						9.4	43.2	47.4	silty clay
	35-40	0.1	0	0.2	4.9	47.8	53.4	25.1	21.5	very fine sandy loam
	50-53						1.5	24.0	74.5	clay
K13	0-5	1.3	2.3	5.6	15.0	10.7	35.8	38.4	25.8	loam
(near centre) 1-143-88	10-15						4.8	56.5	38.7	silty clay loam
	25-30	3.2	3.8	3.1	11.9	27.6	49.5	33.0	17.5	loam
	30-35	0.3	0.3	0.1	0.7	10.1	12.1	55.9	32.0	silty clay loam
	40-42						3.7	23.6	72.7	clay
K14	0-5	2.4	3.2	7.3	16.4	9.5	38.3	34.7	27.0	loam-clay loam
SE11-143-88	5-10	1.3	2.0	3.1	7.8	9.4	24.1	42.7	33.2	clay loam
	10-15						5.0	41.8	53.2	silty clay
K15	0-15	1.2	4.8	19.7	28.2	8.1	62.3	20.4	17.3	fine sandy loam
SW12-143-88	15-20	0.1	0.8	2.2	2.5	11.4	17.5	55.4	27.1	silty clay loam
	30-35	0.3	1.5	6.3	6.2	1.1	16.2	53.6	30.2	silty clay loam
	35-40	3.2	2.9	5.2	6.9	12.2	31.1	49.5	19.4	loam
	50-55	0	0.9	4.2	4.1	4.0	13.8	54.9	31.3	silty clay loam
	60-65						5.7	45.5	48.8	silty clay
K16	0-5	2.9	3.9	8.0	16.7	10.3	42.2	35.8	22.0	loam
NW corner 18-143-87	5-10	3.6	2.3	8.0	10.5	10.3	31.3	38.5	30.2	clay loam
	25-30	0.4	0.4	0.2	0.4	6.4	8.1	58.8	33.1	silty clay loam
	35-40	1.0	0	0.1	0.5	7.2	8.4	57.6	34.0	silty clay loam
	45-49						0.9	29.6	69.5	clay



North American Coal Company  
 Section 36-  
 Sampled 5/23/74  
 NDSU, Soils Dept.

Table V - continued

Sample	Mat'l.	Depth (feet)	Color (moist)	Cons. (moist)	Tex. (field)	CaCO3 Eq. %	Effv. Acid	pH (paste)	ECE 25°	Saturation Extract Soluble Ions (meq./litre)							Sat'n. %	M.A.			Soil Test Data				
										CO3	HCO3	Cl	SO4	Ca	Mg	Na		K	SAR	C %	S %	Si %	lb/A/G" N(NO3)	lb/A P	lb/A K
C3A 3% E on hill - w. of north trees. Morton?	Ap	0-.5	10YR3/2	fr	sic1	8.5	e	7.7	0.7		5.3	1.1	1.8	5.4	1.8	1.0	ND	0.5	63	25	12	63		5	405
	Cca	-1.5	2.5Y5/2	fr	sic1	14.3	ev	8.1	0.6		4.3	0.4	2.8	1.7	2.1	3.6	0.1	2.6	59				<5	1	170
	C2	-3	5Y4/2+4	fr+fi	sic1	6.8	e	8.1	7.1		2.6	0.9	127	23.0	47.0	60.0	0.5	10.2	70	28	3	69	<5	1	280
	C3	-5	5Y4/2	vfi	sic1		0	7.9	9.4		1.7	1.5	100	20.0	51.0	32.0	0.6	5.4	74				5	2	330
C3	sis	0-5	2.5Y4/2	fi	sic1	5.7	es	8.0	8.0		1.3	1.5	135	20.0	55.0	62.0	0.7	10.1	ND	32	4	63	5	3	320
	sis	-10	2.5Y5/2	fi	sic1	2.8	e	7.9	7.4		1.2	0.8	116	20.0	41.0	56.0	0.7	10.1	83				5	3	300
	sis	-15	5Y5/3	fi	sic1	3.4	e	7.9	7.0		1.2	0.6	116	21.0	36.0	60.0	0.6	11.3	89	27	12	61	6	6	340
		-18	N4/0	fi	sic		0	8.1	5.0		3.0	0.2	62.8	5.6	16.0	43.2	1.2	13.2	115				6	2	450
		19-23	5Y4/1	efi	c		0	8.1	3.6		4.6	0.5	38.1	2.2	4.4	35.8	0.8	19.8	120	55	2	43	8	2	540
	coal	3 seams	black				0	6.5	6.6		4.9	0.8	80.3	7.0	13.0	65.0	1.0	20.6	114				7	13	310
		30-38	10YR2/2	fi	l		0	6.9	3.6		1.6	0.5	37.7	2.2	3.0	34.0	0.6	21.1	57	18	36	46	<5	3	300
		-45	5Y3/1	fi	sic		0	8.5	2.3	1.0	4.2	0.1	19.7	0.6	0.6	22.4	0.4	29.1	100				8	2	430
		-50	5Y4/1	vfi	sic	6.8	es	9.0	1.7	3.1	3.9	0.1	11.8	0.4	0.4	17.8	0.3	28.2	116	28	14	58	6	2	420
	sh	52-60	5Y4/1	fi	sic	9.0	es	9.1	1.4	3.1	5.4	<0.1	6.5	0.2	0.1	14.6	0.2	38.4	144				12	4	480
	sh	-67	5Y4/1	vfi	sic	7.5	e	9.1	1.4	2.9	5.8	<0.1	5.4	0.1	0.1	13.8	0.2	44.5	144	52	1	47	8	3	550
	mix	-69	5Y4/1		c		0	8.3	1.7	1.0	11.3	0.2	7.1	0.2	0.2	19.0	0.2	43.2	117				7	3	480
	sh	-75	N5/0	efi	c		0	8.9	1.5	1.9	4.5	0.2	10.2	1.4	0.1	15.1	0.2	17.6	135	56	2	42	6	2	560
		-80	5G4/1	efi	sic		0	8.9	1.6	2.1	4.1	0.2	13.5	0.2	0.1	15.3	0.2	41.4	123				6	3	510
coal	-82	10YR2/1				0	7.2	3.7	1.0	10.1	0.3	30.1	0.6	0.6	40.0	0.3	52.0	86				6	1	290	
C7A	A+B1	0-1	10YR2/2	fr+fi	l		0	7.0	1.3		6.0	0.4	9.3	7.8	3.4	3.8	0.7	1.6	53				<5	5	540
	B3+C5	1-5	2.5Y5/2	fi	sic1	5.5	ev	7.9	6.6		2.6	0.3	99.5	23.0	19.0	60.0	0.4	13.1	60				<5	1	330
C7 8% - foot slope - S below hill Saline - alkali?	soil	0-5	10YR3/2	fi	cl	2.6	es	8.4	13.0		1.6	0.2	228	21.0	66.0	142	0.5	21.6	69	47	13	40	<5	2	380
	sis	-10	2.5Y4/2	fi	sic1	4.0	c	8.5	3.9		2.5	0.2	41.8	1.4	4.0	38.8	0.3	23.7	107				5	2	290
	sis	-15	2.5Y4/2	fr+fi	sic1	5.8	es	8.5	3.2		2.4	0.1	33.9	1.2	2.2	32.8	0.2	25.2	116	24	21	55	7	4	290
	sh	-20	5Y4/1	fi	c	4.9	es	8.5	3.4	0.8	2.9	<0.1	33.5	1.0	1.8	34.0	0.6	28.8	137				9	4	470
	sh	-25	5Y4/1	efi	c	8.5	e	8.9	2.8	1.5	3.3	<0.1	25.1	0.6	0.6	28.4	0.4	36.9	157	38		62	8	4	510
	sh	-30	5Y4/1	vfi	c	9.3	es	8.9	2.6	1.0	4.6	<0.1	23.3	0.6	0.4	27.6	0.4	39.4	155				10	4	470
	sh	-35	5Y4+5/1	vfi	c	3.1	e	8.2	4.0	1.0	3.8	<0.1	37.7	1.0	1.0	40.0	0.6	40.0	126	80		20	12	3	530
	coal	-37	black					6.6	8.5		5.6	<0.1	100	5.0	4.0	96.0	0.8	45.3	87				12	2	310





Sampled 7/74  
NCSU Soils Dept.

Table V - continued  
North American Coal Co. - Indian Head Mine  
Sec. 36-144-89

Sample	Depth (ft.)	Mat'l.	Color (moist)	Con. (moist)	Tex. (field)	CaCO <sub>3</sub> Eq. %	Eff'v. HCl	pH (paste)	ECE 25°C	Soil Test Data								SAR	Sat'n. %	Soil Test Data														
										Saturation CO <sub>3</sub>	Extract HCO <sub>3</sub>	Soluble Cl	Ions SO <sub>4</sub>	(meq./litre) Ca	Mg	Na	K			lb/A/6" N(NO <sub>3</sub> )	lb/A P	lb/A K												
C5	0-.5	A	10YR3/1	vfr	fsl		0	7.5	0.43																									
1.5" cores to 5 feet	1.5-1.5	B2	10YR3/3	fr	l		0	7.8	0.35																0.1	42	<5	6	400					
	1.5-3.5	Cca	2.5Y4/2	fr	l	13.0	ev	8.5	0.66															0.4	47	<5	4	140						
	3.5-5	till	2.5Y4/2	fr	l	10.3	es	8.5	2.20	<0.1													4	45	<5	1	195							
	5-10	till	2.5Y4/3	fi	siel	3.0	e	7.5	8.00															4	51	<5	4	220						
	10-15	mix	5Y4+5/1	vfi	sic	.01	e-	4.5	7.50														12	67	34	11	260							
	15-16	FU	coal																				6	63	140	66	300							
	16-20	carb sh	10YR2/2	fr			0	4.4	9.10																									
	20-25	carb sh	10YR3/1	fr	sil		0	5.1	7.20															10	48	140	61	200						
	25-30	carb sh	10YR3/1	vfr	l		0	4.9	9.20															9	50	63	7	235						
	30-38	carb sh	10YR3/1	vfr	l		0	4.9	8.20															13	47	50	27	210						
	38-45	carb sh	5Y6/1	fr	fsl	2.9	e-	8.9	2.67	0.8														17	47	15	45	230						
	45-50	carb sh	5GY5/1	vfi	sic	9.4	e	8.7	2.30	0.8														28	114	12	4	390						
	50-58	sh	5GY5or2/1	vfi	sic		0	8.2	2.81															30	140	14	5	575						
	58-65	sh	5GY4/1	vfi	c		0	8.9	1.76	1.1														34	112	<5	5	610						
	65-78	sh	5G+5GY4/1	vfi	c		0	8.7	2.10	1.0														28	135	<5	5	540						
																								35	125	<5	5	535						
C9	0-.8	A	10YR3/2	fi	siel		0	7.1	0.92																									
7% SW Regent	.8-2	B2-3	10YR4/2	fi	siel	5.4	es	8.6	2.60	0.5																								
	2-3	alluv.	10YR4/2	fr	siel	3.5	es	8.3	10.9																									
	3-5	alluv.	10YR4/2	fr	siel	2.6	es	8.0	9.00																									
	5-10	alluv.	2.5Y5/2	fr	sil	3.0	es	8.1	9.00																									
	10-15	FU, sis	5Y4/2+3	fi	siel	4.8	es	8.1	6.70																									
	15-20	FU, sis	5Y4/1+4	vfi	sic	2.1	e	8.2	4.80																									
	20-25	FU, sis	5Y4/1+3	vfi	sic		0	8.2	3.55																									
	25-30	FU, sis	5Y4/1+3	vfi	sic		0	8.4	2.6	0.8																								
	30-35	FU, sis	5Y4/1+3	fi	siel	6.7	e	8.4	2.7	0.8																								
	35-40	FU, sis	5Y4/1+N4	vfi	sic	5.2	e	8.7	2.4	1.0																								
	40-47	FU, sis	5GY5/1	vfi	sic	8.0	e																											



Table V A  
Lab Data Indian Head Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (Paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
IH 75-315	0-2	fs1		6.7	0.43	35	0.6		2.0	0.2	2.8	2.5	1.4	0.8	0.3
	2-5	fs1		7.6	0.75	31	1.1		1.7	2.4	4.8	4.2	2.5	2.0	0.2
	5-10	cl		7.8	2.1	61	9.3		3.0	3.9	16.0	3.0	3.3	16.5	0.1
	10-15	cl		7.5	4.5	64	8.2		3.4	3.8	52.9	14.4	14.4	31.0	0.3
	14-20	sil		5.4	3.2	43	12		0.6	1.3	33.2	4.4	4.8	25.6	0.3
	20-25	sil	3.1	7.4	6.0	59	11		3.4	0.5	81.3	20.5	16.0	48.0	0.7
	25-30	sic1	2.0	8.2	3.7	107	19	0.4	6.2	0.2	36.0	3.2	3.6	35.2	0.8
	30-42	sic	7.0	8.3	2.4	120	31	0.5	7.5	0.1	16.7	0.5	0.6	23.2	0.5
	42-44	lig (coal)		6.4	4.0	94	41		9.1	too dark	37.9	1.2	1.2	44.4	0.2
	44-45	sic		7.4	2.4	105	48		9.5	0.1	15.4	0.1	0.4	24.0	0.4
	45-50	sic		8.1	2.5	130	39	0.2	8.2	<.1	17.5	0.4	0.4	24.8	0.4
	50-57	sic1	7.3	8.6	1.69	147	63	0.5	8.1	<.1	11.7	0.1	0.1	19.8	0.3
	57-63	c	10.4	8.6	1.61	158	56	0.9	7.6	<.1	9.6	0.1	0.1	17.6	0.3
	63-77	sic1	4.9	8.7	1.58	143	54	0.7	9.0	<.1	7.9	0.1	0.1	17.2	0.2
	77-85	sic	7.8	8.7	1.50	130	43	0.7	9.5	<.1	6.8	0.1	0.2	16.5	0.3
	85-87	sic1	4.0	8.7	1.46	141	51	1.0	8.3	0.1	7.1	0.1	0.1	16.0	0.2
	87-89	c		8.1	1.75	125	49	0.7	8.8	0.1	10.0	0.1	0.2	19.0	0.3
89-98	lig (coal)		6.5	3.5	91	34		8.7	too dark	36.3	1.6	1.4	41.8	0.2	
98-105	sic		7.8	2.1	116	42	1.2	11.8	<.1	11.1	0.3	0.3	23.2	0.3	
IH 75-317	0-5	sic	5.2	8.0	8.6	71	11		2.2	0.3	141.8	21.0	56.5	66.0	0.8
	5-14	c	5.4	7.8	6.2	88	10		2.1	0.2	87.1	18.0	24.5	46.0	0.9
	15-25	sic	2.1	6.7	5.5	79	13	1.0	10.1	0.3	69.9	14.5	16.0	50.0	0.8
	25-30	sic1	8.1	8.5	2.8	118	24	0.2	5.5	<.1	25.0	1.0	1.6	27.6	0.6
	30-35	c	12.2	8.4	2.0	131	46	0.2	6.6	<.1	14.3	0.2	0.2	20.5	0.3
	35-40	c	3.9	8.4	2.6	130	36	0.2	7.0	0.1	19.4	0.4	0.6	25.2	0.5
	40-45	c	8.0	8.4	1.85	122	57	0.5	8.8	0.1	13.4	0.1	0.2	22.2	0.3
	45-50	sic1	6.4	8.5	1.80	119	49	0.7	7.7	0.3	7.3	0.1	0.1	15.5	0.3
	50-55	c		8.6	1.83	130	59	0.4	7.4	<.1	11.3	0.1	0.1	18.6	0.3
	55-56	lig		6.7	5.1	89	42		---	---	----	1.5	2.0	56.0	0.4
	56-63	lig		6.3	5.5	89	32		9.7	0.1	58.0	3.0	4.0	60.5	0.3
	63-65	c		6.9	2.2	120	34		6.1	0.1	17.7	0.4	0.5	22.7	0.3
	65-70	sic		8.4	1.6	139	43	0.5	8.3	0.1	8.2	0.2	0.1	16.5	0.3
70-75	sic1	5.7	8.3	2.2	109	43	0.8	12.2	0.1	11.4	0.2	0.4	23.6	0.3	

Table V A (Cont.d)  
Lab Data Indian Head - Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
IH 75-327A	0-5	cl	6.2	8.2	10.0	85	16		2.2	1.1	151.6	6.0	58.0	90.0	0.9
B	5-10	sicl	2.1	8.0	10.0	73	13		3.7	0.9	155.4	21.0	56.0	82.0	1.0
C	10-15	lig	1.9	8.0	8.1	75	15		6.2	0.7	139.8	20.5	43.0	82.0	1.2
D	15-20	sic		7.7	7.0	77	10		1.6	0.5	100.6	20.0	29.5	52.0	1.2
E1	20-25	sicl		8.2	3.0	102	19		2.5	0.2	33.9	1.4	3.8	30.8	0.6
E2	25-30	sic	6.2	8.4	2.2	132	23	0.4	3.2	0.1	20.2	0.5	1.3	21.7	0.4
F	30-35	scl	36.8	8.5	3.0	69	38	0.8	5.1	0.1	25.7	0.4	0.8	29.8	0.7
G	35-42.5	cl	6.6	8.5	2.6	112	41	1.4	7.8	0.1	17.9	0.3	0.5	26.0	0.4
H	42.5-48	lig		6.6	6.3	72	30		13.7	<.1	65.0	5.0	5.0	68.0	0.7
I	48-57	c	10.2	8.6	1.90	142	39	1.3	6.0	<.1	12.9	0.3	0.2	19.3	0.4
J	57-58	c	20.8	8.4	2.6	77	42	0.6	9.2	<.1	19.6	0.4	0.5	28.0	0.5
K	58-60	c	9.9	8.3	2.3	98	50	0.8	9.0	<.1	18.8	0.3	0.3	27.6	0.4
L	60-65	c	1.8	8.5	2.2	95	44	0.7	7.2	<.1	15.2	0.3	0.2	22.2	0.3
M	65-70	sic		8.6	2.0	83	71	0.6	6.3	<.1	16.2	0.1	0.1	22.6	0.3
N	70-72	c		8.7	1.57	105	52	1.0	7.5	<.1	8.3	0.1	0.1	16.4	0.2
O	72-75	lig		6.6	3.3	97	60		10.1	<.1	28.9	0.4	0.4	38.0	0.2





NORTH AMERICAN COAL COMPANY  
 UNDERWOOD AREA  
 Sampled 7/8/74  
 NDSU Soils Dept.  
 F.W. Schroer

Table VI - continued

Sample	Depth (ft.)	Mat'l.	Color (moist)	Cons. (moist)	Tex. (field)	CaCO <sub>3</sub> Eq. %	Effv. HCL	pH (paste)	ECE 25° C	Saturation Extract Soluble Ions (meq./litre)								Sat'n. %	M.A.			Soil Test Data lb/A/6"		
										HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	SAR		C %	Si %	S %	N(NO <sub>3</sub> )	P	K
UW406 S1/4 corner 2-146-82 (drilled dry)	0-5	till	2.5Y4/2	vfi	cl	10.3	es	8.2	0.41	2.9	0	1.2	1.0	2.1	1.8	0.2	1.5	68				<5	9	460
	5-10	till	2.5Y3/2	vfi	cl	10.6	es	7.8	3.79	1.3	0.1	105.0	34.8	54.0	16.8	0.7	2.5	63				<5	12	510
	10-15	till	2.5Y3/2	vfi	cl	13.4	es	7.8	4.00	1.2	0	63.1	24.0	24.4	15.2	0.7	3.1	59				<5	14	490
	15-20	till	5Y4/2+3	vfi	cl	12.2	es	7.7	3.70	1.0	0.2	54.8	22.0	18.4	14.8	0.8	3.3	59				<5	13	540
UW 407D S1/4 corner 1-146-82 (drilled dry) (sampled by Carlson et al.)	0-5	till	2.5Y4/2	fr	l	15.1	es	8.0	0.82	2.8	0.5	8.1	3.0	5.0	3.3	0.1	1.7	57				7	3	400
	5-10	till	2.5Y4/2	fi	cl	12.6	es	7.7	4.20	1.3	0.7	69.3	26.8	34.0	9.8	0.7	1.8	59				5	7	500
	10-15	till	5Y4/2 (Mo)	vfi	sic	10.8	es	7.7	3.10	1.4	0.8	45.0	20.0	18.4	8.0	0.8	1.8	67				48	8	600
	15-20	till	5Y4/2	vfi	sic	9.4	es	7.6	3.70	1.0	0.7	54.2	25.8	20.4	8.7	1.0	1.8	66				66	9	570
	20-25	till	2.5Y4+3/2	vfi	cl	11.5	es	7.6	3.80	1.0	0.6	59.9	30.0	23.2	7.2	1.1	1.4	55				75	9	485
	25-30	till	2.5Y4/2	vfi	cl	12.8	es	7.7	3.85	0.9	0.7	60.1	29.2	24.4	7.2	1.1	1.4	55				88	7	490
	30-35	till	2.5Y4/2 (Mo)	vfi	cl	13.1	es	7.7	3.62	1.0	0.5	57.1	28.0	23.2	6.4	1.0	1.3	54				68	9	560
	35-40	mix	2.5+5Y4/2	vfi	cl	6.1	es	7.6	3.75	1.0	1.0	58.2	26.8	25.6	6.8	1.0	1.3	81				110	9	520
	40-45	FU	5Y5/1	fr	sic1	7.2	e	7.6	3.20	1.4	0.3	50.1	20.4	24.0	6.4	1.0	1.4	63				24	38	340
	45-48	FU	5Y+GY5/1	vfi	sic		0	7.3	2.93	1.9	0	41.7	16.2	20.0	6.4	1.0	1.5	81				22	7	440
UW407 S1/4 corner 1-146-82 (drilled wet) (sampled by Carlson et al.)	0-5					13.2	ev	8.2	0.70	3.0	0.6	5.5	2.8	4.0	2.2	0.1	2.1	53				6	6	350
	5-10					9.4	es	7.7	4.40	1.3	1.1	71.8	25.2	36.0	12.4	0.6	2.2	82				9	12	540
	10-15					10.2	es	7.8	4.20	1.3	1.5	69.1	26.8	31.6	12.8	0.7	2.4	68				<5	8	500
	15-20					8.4	es	7.7	3.95	1.0	1.3	65.0	28.4	25.0	12.0	0.9	2.3	69				90	10	530
	20-25					11.7	es+	7.7	3.90	1.0	0.8	65.1	30.0	26.0	10.0	0.9	1.9	58				100	11	480
	25-30					12.0	es	7.7	3.90	1.0	0.6	64.5	30.4	26.0	8.8	0.9	1.7	56				108	12	490
	30-35					11.4	es+	7.7	3.80	0.8	0.5	62.5	29.2	25.6	8.0	1.0	1.5	57				95	11	500
	35-38					13.6	es	7.6	3.80	1.3	0.5	63.5	30.0	26.4	8.0	0.9	1.5	57				92	16	390
	38-40					9.7	es	7.9	2.58	1.0	0	37.8	15.2	15.6	7.2	0.8	1.8	89				118	8	480
	40-43					4.2	e	7.6	3.60	1.1	0.4	49.5	24.0	25.2	8.0	1.0	1.6	95				110	10	500

Table VI A  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
FA 75-73A	0-6	scl	17.8	8.0	1.40	50	2.9		3.3	0.6	20.0	5.6	9.4	0.8	0.9
B	6-15	cl	8.0	7.7	1.30	57	1.6		2.7	0.2	12.2	5.4	5.5	3.7	0.5
C	15-18	sicl		7.5	1.00	73	1.2		2.3	0.4	8.4	4.7	3.6	2.4	0.4
G	27-35	c	10.2	7.1	1.80	67	1.2		8.9	0.3	13.0	10.0	7.6	3.6	1.0
H	40-45	sic	15.4	7.7	1.60	69	8.0		7.2	0.1	10.6	2.9	1.8	12.3	0.9
I	45-50	sicl	19.6	8.1	1.60	75	13	0.2	6.7	<.1	10.2	1.5	0.8	14.0	0.8
J	50-54	sil	14.4	8.1	1.50	75	19	0.5	7.2	0.4	8.1	0.8	0.4	14.4	0.6
K	54-57	ss		8.2	1.60	29	25	0.4	6.4	1.2	9.0	0.5	0.3	15.9	0.4
L	57-60	sic	16.8	8.4	1.35	110	27	0.6	7.1	0.3	6.5	0.3	0.2	13.6	0.4
M3	70-75	vfs1	7.4	9.1	0.90	162	28	1.2	4.2	<.1	3.7	0.1	0.1	8.8	0.1
FA 75-75A	0-3	s1	4.3	7.6	0.95	41	0.5		4.5	1.3	5.7	5.6	4.3	1.2	0.4
B1	3-8	s1	14.0	8.0	1.40	36	2.2		4.2	2.1	10.1	3.1	7.9	5.1	0.3
B3	15-20	l	9.6	7.7	1.75	50	1.7		2.8	4.1	12.8	8.5	6.0	4.6	0.6
D1	24-30	-	3.2	7.7	0.90	34	1.1		2.8	0.9	5.8	4.5	2.5	2.0	0.5
D3	35-40	ms	2.5	7.8	0.90	31	1.1		2.5	1.1	6.0	4.5	2.6	2.0	0.5
D5	45-50	-		7.9	0.80	35	1.1		2.4	1.3	5.2	4.0	2.5	2.0	0.4
D7	55-59	s	2.6	7.8	0.80	35	1.0		2.5	0.9	4.8	3.5	2.5	1.8	0.4
F	61-67	sicl	3.5	7.5	1.50	75	0.7		6.2	0.4	11.5	7.9	6.7	2.0	1.5
J	82-87	sil	0.0	6.7	1.85	63	1.9		6.1	0.4	16.0	8.4	7.8	5.4	0.9
FA 75-76A	0-2	l	8.2	7.6	1.10	42	0.5		4.4	1.1	7.1	6.7	4.3	1.1	0.5
B	2-5	l	23.8	8.0	1.50	49	1.8		3.8	3.7	9.8	2.7	9.9	4.4	0.3
C1	5-10	l-cl	12.0	7.7	6.0	54	2.0		2.2	6.2	89.7	24.0	60.0	13.0	1.1
C3	15-20	l	14.4	7.5	4.1	51	1.7		2.1	1.7	60.0	25.6	28.4	8.6	1.2
C4	20-25	l	14.6	7.5	3.6	50	1.4		2.0	1.6	50.9	24.6	22.0	6.8	1.1
E	36-41	l	11.6	7.5	2.8	46	1.0		2.1	1.7	35.1	20.9	12.8	4.2	1.0
G1	42-50	lfs	4.4	7.6	1.92	29	0.7		---	---	---	6.4	8.2	2.0	0.8
G3	55-60	fs	1.7	7.6	1.08	32	0.6		2.2	1.1	7.3	5.5	3.5	1.2	0.4



Table VI A (Cont'd)  
Lab Data Falkirk 1975

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
FA 75-77A	0-2	sil	0.8	6.8	1.85	60	0.1	5.8	0.6	12.9	11.2	6.4	0.2	1.5
B	2-5	l	16.6	8.0	0.89	52	0.8	3.9	0.6	5.5	1.7	6.4	1.6	0.3
C1	5-10	l	12.4	7.7	1.46	54	0.6	2.9	0.4	14.3	8.5	6.9	1.7	0.5
D2	20-25	l	11.6	7.5	3.8	48	1.2	2.3	1.1	52.5	24.2	24.4	6.0	1.3
E	30-38	sil	8.2	7.7	2.3	61	0.9	3.2	0.8	25.9	13.6	11.8	3.3	1.2
F2	45-50	si	8.6	7.8	1.62	66	1.0	5.3	0.6	12.7	8.4	6.0	2.6	1.6
G	53-56	sil	8.4	7.9	1.46	60	1.2	3.7	0.6	11.9	6.9	5.0	2.9	1.4
I	60-65	sic	4.6	7.6	2.2	75	1.0	5.6	0.5	20.7	13.0	8.8	3.4	1.6
FA 75-78A	0-3	l	1.6	7.5	0.88	46	0.3	3.6	0.9	5.4	5.9	3.0	0.6	0.4
C2	10-15	l	13.8	7.7	0.62	48	0.4	3.1	0.5	3.0	2.7	2.9	0.7	0.3
C4	20-24	l	18.4	7.7	0.62	44	0.4	3.8	0.7	2.1	2.8	2.8	0.7	0.3
D	24-33	sl	5.8	7.6	0.67	40	0.4	2.9	0.8	3.2	3.5	2.3	0.7	0.4
F	34-40	cl	17.4	7.4	0.91	38	0.5	4.0	0.5	5.5	5.3	2.9	1.0	0.8
G2	40-50	-	5.7	7.6	0.85	37	0.7	3.1	0.9	5.1	4.3	3.0	1.3	0.5
G3	50-55	sl	5.0	7.5	1.06	55	0.6	5.0	0.6	6.6	5.6	4.3	1.4	0.9
FA 75-79A	0-1.5	sil	<.1	7.1	0.99	67	0.1	5.1	1.6	4.0	6.1	3.2	0.3	1.1
B	1.5-6	l	13.4	8.0	0.89	49	0.7	3.8	0.8	5.3	1.7	6.4	1.5	0.3
D	8.5-10	sicl	9.4	7.7	3.8	79	2.3	2.0	0.6	54.6	21.2	24.4	10.8	0.8
F	13-20	ss	40.0	7.7	1.80	32	2.2	1.7	2.6	17.6	7.6	7.8	6.0	0.5
G2	25-30	sl	4.0	7.7	1.20	40	1.4	2.4	0.6	11.4	4.2	6.3	3.3	0.6
G4	35-40	ls	3.1	7.8	1.00	87	1.3	2.5	0.4	9.5	3.0	6.0	2.7	0.7
G6	45-50	sl		7.8	1.05	40	---	2.8	0.8	---	---	---	---	---
G7	50-55	cl	9.6	7.6	0.85	50	0.3	4.2	0.6	5.1	5.2	3.4	0.6	0.7
FA 75-80A	0-5	l	17.2	7.9	1.00	46	1.4	4.4	1.3	8.1	3.3	7.1	3.1	0.3
B1	5-10	l	17.2	7.7	5.6	46	1.7	2.3	6.3	85.7	23.0	59.5	11.0	0.8
B3	15-20	l	14.6	7.5	3.6	48	1.2	2.1	0.9	54.6	26.0	24.4	6.2	1.0
B4	20-25	l	13.0	7.6	3.0	52	1.1	2.0	0.7	42.2	20.8	18.4	4.8	0.9
B6	30-37	l	12.6	7.4	3.5	54	0.6	2.1	1.1	50.1	26.4	22.6	3.2	1.1
C	47-55	l	14.2	7.6	3.4	48	0.6	2.0	1.0	50.8	24.6	24.8	3.2	1.2
D	55-67	ss	49.4	8.2	1.60	22	1.0	3.6	0.4	15.7	4.0	11.9	2.8	1.0
F	75-95	fs	3.9	8.1	1.40	30	1.0	2.2	0.8	14.0	4.8	8.9	2.5	0.8
I	112-130	sicl	4.9	8.0	1.30	59	1.3	6.0	0.4	9.2	4.2	7.4	3.1	0.9
L	142-148	c	0.7	7.1	2.3	73	6.2	8.3	0.3	20.7	6.0	6.8	15.6	0.9

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
FA 75-81A	0-5	1	19.6	7.8	0.90	46	0.5	4.0	0.4	6.0	4.8	4.3	1.0	0.3
B1	5-10	1	21.2	8.0	0.70	46	0.6	3.7	0.5	3.5	2.4	4.0	1.1	0.2
B3	15-20	1	19.2	8.0	0.55	44	0.6	3.6	0.4	2.9	1.7	3.8	1.0	0.4
C1	20-25	1	18.2	7.7	0.60	45	0.4	3.3	0.4	2.8	2.8	2.6	0.7	0.4
C3	30-35	1	12.1	7.8	0.65	49	0.3	4.1	0.3	3.1	3.6	2.8	0.6	0.5
D	38-61	lfs	2.3	7.7	0.70	31	0.5	2.5	0.4	5.7	4.6	2.6	1.0	0.4
F	66-74	-		7.8	1.00	27	0.8	2.8	0.9	7.5	5.5	3.5	1.7	0.5
H2	85-100	s	8.4	7.8	0.85	30	0.6	2.7	0.4	6.5	4.8	3.2	1.2	0.4
I	100-103	sic	1.2	7.2	1.70	79	0.7	6.7	0.1	13.8	11.5	6.0	2.2	0.9
FA 75-82A	0-6	1	10.8	7.7	1.20	46	1.0	5.2	0.5	9.5	4.8	7.6	2.5	0.3
B1	6-10	cl	12.4	7.7	4.5	52	1.3	2.2	0.1	70.4	25.6	38.8	7.6	0.7
B3	15-20	cl	11.4	7.6	3.2	55	1.1	2.0	0.3	45.5	24.2	17.6	5.2	0.8
B5	25-30	cl	8.2	7.5	3.2	52	0.6	2.0	0.5	45.2	27.2	16.8	2.8	0.9
C1	30-35	sic1	7.2	7.7	1.30	73	0.9	2.4	0.1	12.2	6.6	5.4	2.1	0.6
D	40-44	sic1	7.7	7.6	1.60	57	0.9	2.2	0.2	17.4	8.4	8.2	2.5	0.7
F	46-50	1	19.4	7.7	1.45	51	1.0	2.5	0.2	14.4	6.5	7.3	2.6	0.7
G	50-55	sic1	10.0	7.9	1.30	63	0.9	2.7	0.1	12.4	5.7	6.7	2.2	0.6
J	62-78.5	ss	39.2	7.9	1.60	22	0.6	3.1	0.8	18.7	10.7	9.0	2.0	0.7
K	78.5-100	lfs	5.7	7.8	1.40	31	0.7	2.7	0.5	13.4	8.7	5.3	1.9	0.7
L	100-108	si	3.5	7.6	1.85	57	0.8	6.1	0.2	17.8	10.2	10.2	2.6	1.1
FA 75-83A	0-2	sil	0.4	7.7	2.3	55	0.9	6.8	0.2	25.5	17.3	10.0	3.5	1.7
B2	5-10	1	17.0	8.1	6.0	39	1.9	2.4	0.6	99.4	24.0	65.0	12.5	0.9
B4	15-20	1	14.0	7.7	5.2	46	2.1	1.9	0.3	79.4	22.0	46.5	12.0	1.1
B6	25-30	1	9.4	7.6	3.8	52	2.2	2.2	0.1	55.7	21.4	24.8	10.6	1.2
B8	35-40	1	11.4	7.7	4.2	50	2.5	2.5	0.2	62.1	24.0	27.2	12.4	1.2
E	100-105	sic1	12.0	7.3	4.3	65	3.2	4.7	0.2	59.2	26.0	21.0	15.6	1.5
F	110-133	cl	16.1	7.3	4.6	50	3.0	3.3	0.3	67.7	26.0	28.4	15.6	1.3

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)								
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	
FA 75-84A	0-3	s1	0.0	7.5	0.55	31	0.2		3.5	0.1	2.8	4.2	1.7	0.3	0.2	air
C2	12-18	1	15.2	7.7	0.48	40	0.3		3.3	0.1	2.1	3.0	1.7	0.4	0.4	air
D1	18-25	c1	16.4	7.4	1.55	44	0.4		5.5	0.2	13.3	11.0	5.8	1.3	0.9	
D3	30-35	c1	14.2	7.6	1.20	48	0.4		5.8	0.2	7.9	8.1	4.0	0.9	0.9	
D5	40-45	c1	15.0	7.6	1.30	48	0.5		5.2	0.1	9.8	8.7	4.3	1.2	0.9	
E	45-50	s1	13.8	7.6	0.95	40	0.6		3.8	0.2	6.8	6.4	2.8	1.2	0.6	
F1	100-105	sic1	13.4	7.8	1.45	72	2.2	0.5	4.4	<.1	11.0	6.6	3.1	4.9	1.3	
G2	115-120	-	18.2	7.7	1.50	64	2.1	0.6	4.3	<.1	11.9	7.2	3.4	4.9	1.2	
FA 75-85B	2-5	-	13.6	8.1	0.60	44	1.3		4.3	0.3	1.9	1.0	3.4	1.9	0.2	air
C1	5-10	1	13.6	8.2	0.80	52	2.3	0.2	3.8	0.7	4.1	0.9	4.0	3.6	0.2	air
C3	15-20	1	11.4	7.6	3.4	48	1.6		2.1	4.2	41.1	22.4	17.2	7.0	0.8	
E	23-30	s	1.5	7.6	1.30	30	1.3		2.6	1.3	10.2	6.7	3.9	2.9	0.6	
F1	30-35	1	0.0	7.5	0.65	65	0.7		2.2	0.1	4.5	3.0	2.1	1.1	0.6	
F3	40-45	sic	9.8	7.7	1.10	83	1.0	0.1	4.8	<.1	7.1	4.6	3.8	2.1	1.5	
FA 75-86A	0-3	1	0.4	7.3	1.45	47	0.2		3.5	<.1	14.8	10.2	7.1	0.6	0.4	air
B	3-6	1	17.8	8.0	0.50	47	0.8	0.1	3.5	0.1	1.8	1.2	3.0	1.2	0.2	air
D2	15-20	1	6.4	7.7	0.70	53	0.7		2.9	0.1	4.2	2.6	2.9	1.2	0.5	air
D3	20-25	1	7.2	7.5	1.45	51	0.7		2.3	0.2	14.4	8.2	6.0	1.9	0.8	
D5	30-35	1	8.0	7.6	1.48	49	0.7		2.6	0.1	16.4	9.4	6.9	2.0	0.8	
D7	40-45	1	7.6	7.6	1.95	53	0.8		4.0	<.1	21.9	12.4	9.8	2.6	1.1	
G	65-73	sil	9.3	7.8	1.58	70	1.9		2.2	0.2	16.5	6.4	7.0	4.8	0.7	
H	73-80	sic1	8.0	7.8	1.30	90	1.5		2.1	0.1	12.7	5.0	5.8	3.6	0.5	
I	80-84	sic	6.6	7.3	1.78	85	1.1		4.8	<.1	17.0	8.6	8.5	3.2	1.5	
FA 75-87A	0-2	-	1.4	7.1	0.67	51	0.2		5.8	0.2	1.9	4.5	2.9	0.3	0.2	air
B	2-8.5	c1	17.2	8.1	0.58	48	2.0	0.2	4.3	<.1	1.9	0.6	2.9	2.7	0.2	air
D1	10-15	1	7.0	7.6	4.5	51	1.3		1.9	1.4	67.4	26.0	36.2	7.4	1.1	air
D2	15-20	1	7.4	7.5	4.0	51	0.9		1.7	0.9	56.6	27.2	26.0	4.8	1.2	air
D4	25-30	1	8.8	7.5	3.7	44	0.6		1.7	0.2	56.1	27.6	26.0	3.2	1.2	air
D6	35-40	1	9.8	7.6	3.2	55	0.7		1.8	0.3	41.7	20.0	20.0	3.0	0.8	air

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)								
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na		K
FA 75-88A	0-2	-	0.5	7.2	0.87	48	0.1		4.4	0.6	4.2	4.9	3.6	0.3	0.4	air
B1	2-5	l	13.4	7.9	1.05	50	1.3		3.5	4.3	3.2	2.2	6.0	2.6	0.2	air
B3	10-17	l	14.2	7.5	4.3	49	1.4		2.2	2.8	60.7	26.8	30.4	7.6	0.9	
D2	25-33	l	8.8	7.3	3.3	50	0.6		2.2	0.8	45.8	27.6	16.8	3.0	1.4	
F	40-45	l	13.0	7.5	2.6	52	0.7		2.2	0.3	33.9	20.0	12.6	2.8	1.0	
G1	45-55	fs1	3.7	7.6	1.41	35	1.0		2.2	0.2	12.9	6.7	5.3	2.5	0.8	
FA 75-90A	0-2	fs1	6.6	7.7	0.64	40	0.3		---	---	---	3.9	2.2	0.5	0.8	air
B	2-5	l	22.6	8.2	0.54	26	0.4	0.5	3.4	0.6	1.8	1.2	4.0	0.7	0.3	air
C1	5-10	l	16.6	8.1	0.52	49	0.9	0.6	3.5	0.1	1.8	0.6	3.8	1.3	0.3	air
D	17-21	sicl	2.3	7.6	0.62	77	1.1		2.7	0.1	4.0	2.3	2.4	1.7	0.4	
E	21-25	sil	2.8	7.6	0.65	64	1.0		2.2	0.1	4.3	2.6	2.1	1.5	0.4	
G1	37-45	sicl	4.6	7.4	1.48	74	0.5		5.4	0.2	11.8	8.6	6.0	1.3	1.5	
G2	45-53	sicl	3.6	7.0	1.52	75	1.0		5.2	0.2	14.3	10.0	5.6	2.9	1.2	
FA 75-91D	9-16	sil	10.4	7.9	2.1	59	6.6		2.3	0.7	20.2	3.9	4.8	13.8	0.7	air
E	16-21	sic	11.0	7.9	2.3	81	5.6		2.2	0.3	22.7	5.6	5.6	13.2	0.8	air
F	21-23	sicl	12.2	7.9	2.5	79	5.6		2.5	0.3	25.2	6.0	6.8	14.2	1.0	air
G1	23-27	sic	12.0	8.0	2.1	79	6.0		2.6	0.3	21.3	4.8	5.2	13.4	0.8	air
G2	27-32	sicl	11.6	7.7	2.5	76	5.5		2.7	0.1	26.4	7.1	6.8	14.4	0.9	air
M	42-50	sicl	4.1	7.7	2.0	76	8.6	0.2	6.2	0.1	15.9	4.2	2.0	15.1	1.1	air
N	50-58	sic	10.4	7.9	1.91	107	13		6.8	<.1	12.7	2.0	1.0	15.6	0.9	
O1	58-70	sc	10.2	8.3	1.60	81	26	0.4	7.5	<.1	8.8	0.4	0.3	15.5	0.5	
P	80-88	scl	6.5	8.4	1.62	54	23	0.5	7.4	<.1	11.1	0.7	0.4	17.4	0.5	
FA 75-92B	2-4	scl	12.4	8.0	0.53	41	1.5		4.4	0.2	1.6	1.1	2.8	2.1	0.2	air
C	4-8	c	13.4	8.4	0.72	53	4.1	0.4	5.1	0.1	2.8	0.4	2.7	5.1	0.2	air
E1	10-15	fs1	10.0	7.9	2.8	55	1.8		1.6	2.9	41.4	16.2	21.2	7.8	0.7	air
F	20-24	sil	5.2	7.6	4.1	63	0.5		1.4	0.3	60.9	28.0	30.8	2.8	1.0	air
G	24-26	sicl	1.0	6.6	4.5	73	0.5		2.4	0.3	65.6	29.0	35.6	2.8	0.9	air
L1	40-45	sicl	4.6	7.8	1.50	70	0.9		4.9	0.1	12.8	8.1	5.9	2.4	1.4	
L2	45-50	sicl	6.3	7.8	1.35	69	1.5		5.4	<.1	10.5	6.4	4.6	3.6	1.3	
L3	50-56	sicl	6.8	7.6	1.25	69	2.2		6.2	<.1	11.6	7.0	4.4	5.3	1.1	

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 4/76

Sample	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)								
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg		Na	K
FA 75-93A	0-3	-	0.0	8.0	0.70	50	1.0		4.4	0.5	3.8	1.1	5.5	1.8	0.3	air
B2	5-10	scl	10.4	7.6	3.6	46	0.7		2.1	0.6	53.2	27.6	24.0	3.4	0.9	
B3	10-14	scl	5.6	7.6	3.7	41	1.4		2.1	0.6	58.8	23.6	29.4	7.4	1.1	
D2	20-25	gcl	8.6	7.8	2.5	73	1.7		1.8	1.7	26.2	11.4	11.8	5.7	0.8	
D3	25-32	sic	2.6	7.6	2.0	79	1.7		1.9	0.6	22.9	11.1	8.4	5.2	0.7	
F	33-40	c	1.0	7.4	2.5	90	2.4		6.8	0.6	27.2	15.2	9.3	8.4	1.7	
I1	45-65	sicl	16.8	7.7	2.4	62	7.7		5.5	0.6	20.9	5.6	3.7	16.5	1.2	
I2	65-82	vfs1	9.8	8.1	2.2	60	20	0.4	6.8	0.8	15.3	1.4	0.8	20.5	0.7	
FA 75-94A	0-3	l	0.9	7.4	0.64	51	0.5		3.6	1.6	2.0	3.6	2.5	0.9	0.2	air
B	3-6	cl	15.4	7.8	0.33	55	0.2	0.3	2.9	<.1	0.9	2.0	1.7	0.3	0.1	air
C	6-10	sic	10.4	8.0	0.27	81	0.4		3.0	<.1	0.5	1.1	1.8	0.5	0.1	air
D	10-18	sicl	12.6	8.0	0.33	71	0.7		3.0	<.1	1.1	1.0	1.9	0.9	0.3	air
G	27-30	sicl	0.7	4.4	2.6	64	0.3		---	0.6	36.6	18.8	16.4	1.3	0.7	air
H1	30-35	sicl	3.8	7.5	1.30	74	0.8	0.2	3.5	<.1	13.9	7.3	6.9	2.2	1.2	
H3	40-45	sil	11.4	7.5	1.95	61	0.7	0.2	6.5	<.1	17.7	11.7	9.1	2.2	1.4	
I	45-50	sicl	3.8	7.0	2.2	76	0.9		6.0	0.2	21.5	13.8	9.5	3.2	1.2	

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
FA 75-73															
D	18-20	sic1	2.2	7.5	1.08	66	1.0		2.0	0.7	9.0	5.1	4.0	2.1	0.5
E	20-21	sil		6.5	1.66	80	0.7		3.9	0.7	16.2	9.6	8.1	2.2	0.9
F	21-27	lig		6.0	2.3	91	1.3		5.4	0.8	23.2	12.2	12.1	4.7	0.4
G2	35-40	sic1	10.5	7.1	1.71	72	1.1		7.7	0.7	11.8	9.2	6.8	3.1	1.1
M1	60-65	sic1	8.3	8.4	1.30	111	41	1.0	6.5	0.5	5.5	0.1	0.1	13.0	0.3
M2	65-70	sil	6.6	8.8	1.03	130	30	1.3	3.7	0.2	4.5	0.1	0.1	9.4	0.2
FA 75-75															
B2	8-15	l	6.4	7.6	2.5	57	1.7		1.9	6.8	20.8	10.5	12.4	5.9	0.7
C	20-24	*	6.2	7.9	1.08	32	1.4		1.9	2.2	6.7	4.9	2.7	2.8	0.4
D2	30-35	*	2.9	7.7	0.90	32	0.9		2.0	1.4	6.3	4.7	2.7	1.8	0.5
D4	40-45	*	4.6	7.8	0.91	31	1.1		1.9	3.7	4.0	4.5	2.7	2.0	0.4
D6	50-55	ls	3.2	7.8	0.76	33	0.9		2.2	0.6	4.6	3.4	2.1	1.5	0.4
E	59-61	cl	1.2	7.7	1.11	73	0.7		8.6	0.7	3.8	6.0	4.7	1.7	0.7
G	67-79	lig		6.0	3.0	84	0.7		6.0	0.7	36.7	18.8	21.0	3.0	0.6
H	79-80	lig		6.1	3.2	76	0.9		5.2	1.0	38.0	19.4	20.0	4.0	0.8
I	80-82	sic		7.0	1.46	80	1.0		5.7	0.6	10.9	7.0	6.5	2.6	1.0
K	87-89.5	lig		6.1	2.7	77	2.8		6.6	1.0	29.7	13.4	13.0	10.3	0.6
L	89.5-90	cl		6.2	2.5	70	2.6		9.0	1.3	24.6	12.6	12.3	9.2	0.8
FA 75-76															
C2	10-15	cl	12.8	7.5	5.2	59	1.6		2.1	3.6	78.5	22.5	51.0	9.5	1.2
C5	25-30	l	11.8	7.5	3.9	53	1.2		1.7	2.5	55.0	26.4	25.6	6.0	1.2
C6	30-34	l	9.6	7.4	2.7	56	0.8		1.9	1.6	30.6	20.0	12.1	3.2	1.2
F	41-42	*	21.2	7.5	3.1	33	0.6		*	*	*	26.4	16.8	3.0	1.0
G2	50-55	*		7.7	1.05	35	0.4		1.7	0.9	9.2	6.2	4.1	1.0	0.5
H	60-63	l		6.5	1.42	93	0.2		3.5	0.7	13.1	9.4	6.6	0.6	0.7
I	63-73	lig		6.2	2.4	107	0.2		7.0	0.8	25.4	18.0	14.0	0.8	0.4
J	73-75	cl		6.4	2.3	81	0.4		7.9	0.6	22.9	15.3	13.4	1.6	1.1

\* Not enough sample

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
FA 75-77														
C2	10-15	sic1	7.4	7.4	3.2	77	0.3	1.8	0.4	47.6	26.8	20.0	1.6	1.4
D1	15-20	l	10.2	7.5	3.6	61	1.1	1.8	0.9	52.8	23.0	26.0	5.2	1.3
D3	25-30	l	7.6	7.4	3.2	59	0.7	3.7	1.1	45.5	24.5	21.0	3.4	1.4
F1	38-45	sil	8.4	7.8	2.7	62	0.9	3.2	0.6	25.9	11.6	13.0	3.1	2.0
F3	50-53	si	8.3	7.9	1.50	60	0.8	3.1	0.6	14.5	9.4	5.1	2.2	1.5
H	56-60	sil	9.3	7.9	1.62	72	1.0	3.4	0.5	14.9	8.9	5.6	2.6	1.7
J	65-75	lig		6.1	2.8	87	1.0	8.2	0.9	30.8	19.0	16.0	4.2	0.7
FA 75-78														
C1	7-10	l	7.6	7.6	0.54	51	0.3	3.2	0.4	0.8	1.4	2.4	0.4	0.3
C3	15-20	l	11.2	7.6	0.59	58	0.4	1.5	0.3	4.3	2.8	2.6	0.6	0.3
E	33-34	*	38.8	7.7	0.80	31	0.4	2.8	0.4	4.6	4.3	2.5	0.8	0.6
G1	40-45	*	7.6	7.4	0.90	49	0.5	*	*	*	5.2	3.4	1.1	0.6
H	55-57.5	sl		6.4	2.5	52	0.5	7.8	0.9	26.9	16.4	16.0	2.0	1.2
I	57.5-67.5	lig		6.0	2.2	88	0.7	6.1	0.6	21.7	13.6	13.6	2.4	0.5
J	67.5-68	---		6.0	2.1	81	0.7	6.5	0.9	20.3	12.0	12.3	2.6	0.8
FA 75-79														
C	6-8.5	l	9.0	7.9	1.50	57	2.7	3.6	0.7	12.2	2.2	7.7	6.1	0.5
E	10-13	sil	8.8	7.6	4.0	66	2.1	1.8	1.0	54.6	20.5	26.0	10.0	0.9
G1	20-25	sl	9.0	7.7	1.49	48	1.3	2.0	0.8	14.7	6.1	7.5	3.3	0.6
G3	30-35	fs1	4.3	7.7	1.84	41	1.0	1.6	0.7	20.7	7.9	11.2	3.1	0.8
G5	40-45	*	6.6	7.8	2.2	44	0.9	3.7	1.0	22.8	7.4	16.0	3.1	1.0
G8	55-57.5	sl	2.1	6.9	1.63	44	1.0	8.9	0.7	10.3	6.8	9.4	2.8	0.9
H	57.5-60	lig		6.4	2.6	69	1.2	13.3	0.6	23.1	15.8	16.0	4.6	0.6
I	60-68	lig		6.2	2.9	71	1.6	10.0	0.7	30.9	17.8	16.2	6.8	0.8

\* Not enough sample

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
FA 75-80														
B2	10-15	1	11.8	7.5	3.7	52	1.2	2.1	1.7	54.3	23.2	28.0	6.0	0.9
B5	25-30	1	12.0	7.5	3.2	54	0.6	3.6	1.0	51.6	26.8	25.2	3.2	1.0
G	95-100	scl	6.8	7.7	0.77	59	0.4	2.3	0.4	5.2	3.4	3.0	0.8	0.7
J	130-132	sil		7.1	1.74	61	1.4	7.0	1.1	13.4	6.4	10.0	4.0	1.1
K	132-142	lig		6.4	2.8	79	2.2	12.1	0.8	26.8	12.8	17.7	8.5	0.7
M	148-150	cl	3.0	7.6	1.70	70	7.2	5.7	0.3	11.8	2.5	2.8	11.7	0.8
N	150-154	sic		7.5	1.85	80	8.8	6.8	0.4	12.1	2.4	2.4	13.7	0.8
O	154-158	lig		6.7	3.2	71	14	17.5	0.8	19.2	4.4	4.0	28.4	0.7
FA 75-81														
B2	10-15	1	20.8	8.0	0.66	41	0.5	3.7	0.4	3.1	1.4	4.6	0.9	0.3
C	25-30	1-cl	16.4	7.7	0.54	47	0.4	2.6	0.2	3.5	3.0	2.2	0.6	0.5
E	61-66	*	36.8	7.9	0.77	24	0.6	2.8	0.7	5.1	4.4	2.6	1.1	0.5
G	74-78	*	41.2	7.9	1.01	21	0.6	3.0	1.8	7.1	5.7	4.1	1.4	0.7
H1	78-85	*	27.0	7.9	0.76	26	0.7	2.3	3.3	2.9	4.0	2.7	1.2	0.6
FA 75-82														
B2	10-15	cl	12.0	7.4	3.8	54	1.4	1.7	0.3	55.9	25.2	24.8	7.0	0.9
B4	20-25	cl	8.6	7.4	3.2	52	0.7	2.0	0.4	44.8	26.4	16.4	3.4	1.0
C2	35-40	sicl	6.8	7.6	1.20	71	0.8	1.8	0.2	11.5	6.0	5.0	1.9	0.6
E	44-46	scl	33.2	7.7	1.62	34	0.8	2.2	0.3	16.8	7.8	8.4	2.4	0.7
H	55-60	sil	7.9	7.6	1.29	65	0.9	2.1	0.3	12.4	5.3	6.6	2.2	0.7
I	60-62	sicl	6.6	7.7	1.30	72	0.8	2.0	0.3	12.5	5.8	6.4	1.9	0.7
M	108-118	lig		6.4	2.9	93	2.3	12.2	0.3	27.1	14.0	16.0	9.0	0.6
FA 75-83														
B1	2-5	1	19.2	7.8	7.0	41	2.5	2.5	1.1	112.6	21.0	77.0	17.5	0.7
B3	10-15	1	13.7	7.6	5.9	42	1.9	1.9	0.6	93.6	22.5	60.5	12.0	1.1
B5	20-25	1	10.2	7.5	4.2	52	1.8	1.8	0.3	62.7	23.2	30.8	9.6	1.2
B7	30-35	1	8.0	7.6	3.6	54	2.4	1.9	0.2	48.6	18.4	20.6	10.6	1.1
C	60-62	*		7.5	4.7	41	2.0	2.3	0.5	71.5	26.4	35.6	11.2	1.1
D	78-80	*		7.1	4.3	51	2.4	4.8	0.5	58.9	26.4	24.8	12.0	1.0
G	133-141	*	4.0	6.4	5.5	82	6.3	11.5	0.7	67.6	28.5	19.5	31.0	0.8

\* Not enough sample



Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
FA 75-84															
B	3-7	sl	15.4	7.7	0.63	26	0.4	3.2	0.4	2.9	3.6	2.1	0.6	0.2 air	
C1	7-12	l	11.5	7.6	0.40	37	0.3	2.6	<.1	1.6	2.1	1.5	0.4	0.2 air	
D2	25-30	cl	18.4	7.3	1.62	44	0.4	5.0	0.3	14.6	11.9	5.8	1.2	1.0	
D4	35-40	cl	13.9	7.6	1.22	46	0.4	4.5	0.1	7.6	8.3	1.9	1.0	1.0	
F2	105-110	sicl	13.0	7.8	1.45	77	2.5	4.6	0.1	11.1	6.1	2.9	5.4	1.4	
G1	110-115	sicl	12.2	7.8	1.60	78	2.5	4.7	0.2	12.2	6.9	3.2	5.6	1.4	
H	127-141	lig	6.5	6.5	3.6	63	3.2	13.0	0.5	36.3	21.0	14.4	13.6	0.8	
FA 75-85															
A	0-2	*		7.7	0.75	42	0.2	5.0	0.3	2.9	4.7	2.8	0.4	0.3 air	
C2	10-15	l	13.0	7.8	2.9	49	1.8	2.0	3.6	31.6	11.6	18.1	6.8	0.7 air	
D	20-23	gl	37.4	7.8	2.0	27	1.5	2.1	3.5	16.0	11.0	5.8	4.3	0.5	
F2	35-40	sicl	6.0	7.7	1.28	86	0.7	4.2	0.4	9.2	6.5	4.5	1.6	1.2	
F4	45-50	sic	4.5	7.8	1.20	85	1.6	4.7	0.1	7.9	4.6	3.7	3.2	1.2	
G	50-60	lig	3.0	6.7	3.7	71	3.3	13.9	0.1	37.7	19.4	17.4	14.0	0.9	
FA 75-86															
D1	10-15	l	9.1	7.9	0.72	54	0.9	3.1	0.3	3.8	1.8	3.6	1.4	0.4 air	
D4	25-30	l	8.0	7.6	1.58	52	0.6	2.3	0.2	16.2	9.6	6.6	1.7	0.8	
D6	35-40	l	12.0	7.6	2.6	49	0.7	2.8	0.3	32.0	18.4	12.8	2.8	1.1	
D8	45-50	cl	8.2	7.6	1.98	56	0.8	3.5	0.2	21.4	12.4	9.1	2.6	1.0	
J	84-96	lig	0.7	6.4	2.9	92	1.2	8.4	0.4	30.8	17.3	17.0	4.8	0.5	
K	96-97	*		6.6	2.8	75	1.2	9.5	1.1	26.1	16.3	14.7	4.8	0.9	
FA 75-87															
C	8.5-10	*		8.0	1.72	27	2.6	3.9	0.7	14.7	2.0	10.5	6.4	0.4 air	
D3	20-25	l	8.4	7.5	4.0	53	0.7	1.6	0.5	57.5	29.2	25.6	3.6	1.2 air	
D5	30-35	l	8.0	7.6	4.0	50	0.7	1.5	0.4	55.9	27.6	25.6	3.4	1.2 air	
E	44-59	*		5.2	4.3	92	0.8	1.4	0.7	64.5	27.6	34.0	4.4	0.6	

\*Not enough sample

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)								
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	
FA 75-88																
B2	5-10	1	13.8	7.6	5.0	52	1.6		2.6	9.9	61.3	21.0	43.0	9.0	0.8	
C	17-20	1	13.8	7.5	3.5	45	1.2		2.2	1.3	47.5	25.2	19.2	5.6	1.0	
D1	20-25	1	11.8	7.5	3.2	50	0.8		2.0	2.5	41.9	25.6	16.0	3.6	1.2	
G2	55-63	lfs	2.4	7.5	1.13	31	1.0		2.0	0.4	11.8	6.6	4.6	2.4	0.6	
FA 75-90																
C2	10-15	1	10.2	7.8	0.70	51	1.6		3.9	0.2	3.7	1.1	3.8	2.5	0.4	
C3	15-17	cl	8.7	7.7	0.73	56	1.3		3.1	0.2	4.4	2.1	3.0	2.1	0.5	
F	25-37	lig		5.0	1.44	93	0.3		0.9	0.4	16.0	9.4	6.6	0.8	0.5	
H	53-55	lig		6.2	2.3	82	2.5		5.9	0.3	22.5	10.6	9.6	7.9	0.6	
J	55-56	*	14.1	6.9	1.80	56	2.7		9.7	0.5	10.4	7.7	5.2	6.8	0.9	
FA 75-91																
A	0-3	1	11.5	8.3	0.65	60	5.9	0.4	4.7	0.3	1.7	0.2	1.4	5.3	0.2	air
B	3-5	sicl	10.4	8.1	1.90	64	6.4		3.4	3.4	13.5	1.4	6.0	12.4	0.5	air
C	5-9	lig	3.3	7.7	5.3	85	5.2		3.7	4.1	71.6	20.0	32.0	26.5	0.9	air
H	32-34	sic	6.0	7.6	2.6	89	5.3		2.6	0.2	27.8	7.9	7.2	14.5	1.0	air
I	34-36	*	3.0	7.2	3.0	85	5.6		4.4	0.2	31.9	9.0	9.2	17.0	1.3	air
J	36-37	cl		6.5	5.0	79	5.5		10.2	0.3	62.8	23.8	21.6	26.2	1.7	air
L	40-42	sicl		6.3	3.8	74	7.7		7.1	0.3	39.2	12.0	8.6	24.8	1.2	air
O	70-80	vfs1	9.2	8.2	1.78	69	30.1		7.5	0.3	9.8	0.4	0.2	16.5	0.5	
Q	88-90	sic		7.6	2.8	66	15.3		8.2	0.4	23.0	3.6	1.9	25.3	0.8	
R	90-98	lig		6.2	2.5	110	8.3		8.8	0.2	20.7	5.8	4.5	18.9	0.5	
S	98-99	sic		7.1	2.2	74	2.9		10.8	0.3	15.4	9.7	7.2	8.4	1.2	

\* Not enough sample

Table VI A (Cont'd)  
Lab Data Falkirk Mine

Sampled by Gerald Groenewald UND-EES 1975  
Test Holes

NDSU - Soils Department 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE 25°C	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
FA 75-92															
A	0-2	*		7.2	0.74	70	0.1	6.1	0.3	2.2	4.3	3.3	0.2	0.8	air
D	8-10	l	39.4	8.0	2.4	39	2.9	2.7	2.3	23.8	4.0	15.4	9.0	0.4	air
E2	15-20	vfs1	7.7	7.6	2.4	53	1.4	1.4	2.5	23.7	9.7	12.7	4.6	0.6	air
H	26-30	lig		4.1	5.0	134	0.4	0	1.8	76.2	30.6	44.4	2.6	0.4	air
I	30-32	cl		4.0	4.8	68	0.3	0	0.2	73.1	29.6	40.8	1.8	1.1	air
J	32-37	lig		4.4	3.9	137	0.3	0	0.4	59.2	28.0	29.8	1.4	0.4	air
K	37-40	sicl		5.1	2.9	78	0.5	0.1	0.3	40.5	19.8	17.9	2.1	1.1	
M	56-59	cl		6.3	3.0	72	3.6	6.8	0.4	30.0	14.2	9.8	12.5	0.7	
FA 75-93															
B1	3-5	cl	12.8	7.9	0.68	51	1.6	4.1	0.8	2.0	1.0	3.2	2.3	0.4	air
C	14-17	cl&g	9.8	7.5	4.0	39	1.7	1.9	1.5	56.9	25.2	25.6	8.6	0.9	
D1	17-20	sicl	12.6	7.6	3.1	71	1.9	1.6	0.6	38.0	15.2	16.6	7.6	0.8	
E	32-33	lig	6.0	6.6	3.7	67	2.0	10.3	1.2	41.5	24.0	18.6	9.2	1.2	
G	40-42	sic		6.7	2.8	76	2.7	6.7	0.9	28.0	14.8	10.0	9.4	1.4	
J	81-84	sic		6.5	6.2	70	20	9.4	1.6	64.6	10.0	7.0	57.5	1.1	
K	84-95	lig		6.5	4.0	84	21	12.1	1.7	33.0	4.2	2.8	39.2	0.6	
FA 75-94															
E	18-19	*	1.2	6.6	0.83	74	0.7	6.9	0.3	2.5	4.3	3.6	1.4	0.4	air
F	19-27	lig		4.1	3.4	98	0.4	0	0.7	50.4	23.2	25.4	2.0	0.5	air
H2	34-40	sicl		7.3	1.88	66	0.5	3.4	0.3	19.1	10.4	9.3	1.7	1.4	air
J	50-53	lig	0	6.1	2.3	79	1.5	5.2	0.3	22.3	13.0	8.9	5.1	0.8	air

\* Not enough sample

Table VI A (Cont'd)

TEXTURE ABBREVIATION KEY

(From Soil Survey Manual, Agric. Handbook #18)

s - sand  
fs - fine sand  
ms - medium sand  
lfs - loamy fine sand  
fsl - fine sandy loam  
sl - sandy loam  
vfs1 - very fine sandy loam  
l - loam  
scl - sandy clay loam  
sil - silt loam

cl - clay loam  
gcl - gravelly clay loam  
sicl - silty clay loam

si - silt  
sic - silty clay  
c - clay

g - gravel

(The following are not from the Survey Manual)

ss - sandstone (chips)  
lig - lignite  
sh - hard shale

Sampled 9/74

Table VII  
Lab Data Montana Tech. - USGS  
Beulah and Zap, Deep Borings

Sample	Depth (ft.)	Mat'l.	Color (moist)	Con. (moist)	Tex. (field)	CaCO3 Eq. %	Eff'v. HCl	pH (paste)	ECE 25°C	Soluble Ions (meq./litre)							SAR	Sat'n. %	Soil Test Data			
										Sat'n. CO3	Extract HCO3	Cl	SO4	Ca	Mg	Na			K	lb/A/6" N(NO3)	lb/A P	lb/A K
B7476C	0-5	mix	2.5Y4.5/2	fr	gl	27.3	es	-----	NO SAMPLE							-----		<5	6	240		
	5-10	till	2.5Y4/2	fr	l	-	es	8.0	5.10	2.9	1.6	21.1	5.7	18.4	1.2	0.4	0.3	57				
drilled wet	10-15	till	2.5Y4/2	fr	l	13.3	es	7.7	5.29	1.8	1.5	75.8	20.2	41.6	16.4	0.8	3	62	10	6	430	
drill mud	15-20	till	2.5Y4/2Mo.	fi	l	9.0	es	7.6	4.95	1.4	1.6	73.4	23.5	36.8	15.0	1.0	3	62	12	8	490	
below 40 ft.	20-25	till	2.5Y3/2	fi	l	8.2	es	7.5	4.07	1.4	0.7	61.2	22.1	26.1	12.0	0.9	2	66	9	7	450	
	25-30	till	2.5Y4/2	fi	l	8.5	es	7.5	3.98	0.9	0.7	56.2	21.6	24.8	10.6	0.8	2	65	5	7	400	
	30-35	till	2.5Y4/2	fi	l	7.7	es	7.6	3.70	1.5	0.7	51.9	20.2	22.8	10.3	0.8	2	65	<5	7	395	
	35-40	till	2.5Y4/2	fi	l	7.9	es	7.6	3.70	1.5	0.7	49.1	21.0	19.6	9.9	0.8	2	65	<5	8	415	
B7480	0-5	till	2.5Y4/2	fr	l	11.0	es	8.0	0.53	3.8	0.2	2.0	1.8	2.5	1.6	0.1	1	51	<5	5	310	
	5-10	FU	10YR4/2	l	s	2.2	es	8.0	2.15	1.7	0.5	27.2	8.8	10.6	9.8	0.2	3	35	<5	2	140	
drilled dry	10-15	FU	10YR4/2	l	s	0	e	8.1	1.21	1.9	0.5	11.4	3.7	2.9	7.0	0.2	4	36	<5	32	160	
to 80, drilled	15-20	FU	10YR4/2	l	fs	0	e-	7.9	0.83	1.7	0.9	6.7	2.7	2.2	4.2	0.2	3	36	<5	14	175	
wet below 80	20-25	FU	10YR4/2	l	fs	0	0	7.9	0.74	1.6	0.3	6.5	2.8	2.8	2.6	0.2	2	36	<5	23	170	
	25-30	FU	10YR4/3	mix	lfs	0	0	7.6	1.39	1.0	1.0	14.3	6.5	6.8	2.7	0.3	1	48	<5	25	270	
	30-35	FU	10YR4/2	l	fs	0	0	7.5	0.72	0.5	0.7	6.4	2.6	3.0	1.8	0.2	1	39	<5	10	200	
	35-40	FU	10YR4/2	l	fs	0	0	7.3	0.80	0.7	0.7	6.9	2.9	3.4	1.8	0.2	1	34	<5	15	185	
	40-45	FU-sh	10YR4/3	l	lfs	0	0	7.7	0.69	1.9	0.5	5.2	3.1	2.9	1.4	0.2	0.8	29	<5	17	150	
	45-50	FU-sh	10YR4/2	l	s	0	0	7.6	0.62	2.3	0	4.7	2.9	2.8	1.2	0.1	0.7	30	<5	17	145	
	50-55	sh+coal	5Y5/1	efi		0	0	6.2	2.30	2.8	0.1	26.5	12.9	14.3	1.6	0.6	0.4	60	<5	10	280	
	55-60	FU	5Y5/1	fi	sic	0	0	7.8	0.80	4.0	0.1	4.5	3.3	3.1	1.5	0.7	0.8	85	<5	5	450	
	60-65	FU	5GY4/1	efi		0	0	7.2	1.11	5.6	0.1	6.9	4.8	5.0	2.1	0.7	1	86	<5	5	460	
	65-70	FU	5Y4/1	fi	sicl	3.7	e-	7.9	1.28	5.7	0.1	12.3	3.1	6.7	7.8	0.5	4	72	<5	5	300	
	70-75	FU	5Y4/1	fi	sicl	8.0	ev	8.3	0.99	0.8	4.4	0	6.4	1.3	1.1	8.8	0.4	8	79	<5	5	400
	75-80	FU	5Y4/1	fi	sicl	8.0	ev	8.5	1.00	0.9	4.9	0	6.9	0.8	10.8	0.3	12	71	<5	5	385	
	80-100	FU	5Y4/1	vfi	sic	8.5	es	8.6	1.56	2.8	7.3	0	7.1	0.3	0.2	16.5	0.2	33	139	<5	6	510
	100-110	FU	5Y4/1	fi	sicl	6.5	es	8.8	1.44	1.9	6.5	0	7.1	0.3	0.2	14.8	0.2	30	146	5	6	500
	110-117	carb si	5Y2/3	fi	sicl	8.0	es	8.0	2.20	1.8	13.5	0.5	9.8	0.5	0.2	24.7	0.2	42	96	10	5	495
	117-140	FUsi	5GY4/1	fi	sic	8.7	e	9.1	1.48	3.6	7.6	0	5.5	0.3	0.2	16.0	0.2	32	180	9	7	565
	>142	coal	BLACK	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	coal	

Table VII - continued  
 Lab Data Montana Tech. - USGS  
 Beulah and Zap, Deep Borings

Sample	Depth (ft.)	Mat'l.	Color (moist)	Con. (moist)	Tex. (field)	CaCO3 Eq. %	Eff'v. HCl	pH (paste)	ECE 25°C	Saturation				Extract Soluble Ions (meq./litre)				SAR	Sat'n. %	Soil Test Data		
										CO3	HCO3	Cl	SO4	Ca	Mg	Na	K			lb/A/6" N(NO3)	lb/A P	lb/A K
B7481	0-5	till	mix	fr	cl	12.0	ev	8.1	0.57		3.4	0.2	2.8	1.4	2.9	2.0	0.1	1	57	<5	6	330
	5-10	FU-si	5Y7/1	fr	sil	0.9	es	8.1	5.05		0.9	1.3	79.5	18.8	47.2	15.5	0.2	3	60	6	6	120
	10-15	FU-si	2.5Y7/1+4	fr	sil	0	e	8.0	4.95		1.0	3.0	73.1	9.3	47.9	19.5	0.4	4	53	7	4	120
	15-20	FU-si	2.5Y6/3	fr	vfs1		0	7.8	3.75		0.8	2.4	49.1	9.2	31.4	11.3	0.4	3	52	6	7	135
drilled dry	20-25	FU	2.5Y7/3	fr	l		0	4.8	4.60		1.5	1.9	72.30	16.0	48.3	10.6	0.8	2	52	6	4	175
	25-30	FU	2.5Y7/2	fr	l		0	4.0	5.70			1.7	77.1	22.3	45.9	9.6	1.0	2	47	5	4	170
	30-35	FU	2.5Y6/4+1	fr	l		0	3.8	7.10			2.3	58.6	22.7	28.6	8.6	1.0	2	47	5	5	175
	35-40	FU	2.5Y6/4+1	fr	l		0	3.8	8.50			1.4	71.6	20.6	41.5	8.5	1.0	2	49	<5	5	150
	40-45	FU	2.5Y5/2	l	lfs		0	4.9	6.60		2.9	0.6	110.4	21.8	84.2	7.5	0.4	1	40	<5	39	115
	45-50	FU	7.5YR4/4	l	lcos		0	6.6	3.05		4.3	0.3	41.2	30.0	11.8	3.8	0.2	0.8	32	<5	9	80
	50-55	FU	2.5Y5/3	l	ls		0	4.2	3.10			0.4	43.2	25.5	10.3	7.5	0.3	2	34	<5	57	110
	55-60	FUsh	5Y3/1+2	efi	c		0	5.0	3.12		0.2	0.1	44.7	20.5	15.7	8.0	0.8	2	73	<5	82	330
	60-65	si+coal	N5/0	fr	mix		0	6.8	3.78		3.3	0.2	52.1	18.2	22.4	13.7	1.3	3	71	<5	4	440
	65-70	FU	N5/0	fr	sil		0	8.2	2.77		2.6	0.3	32.0	8.1	10.3	16.0	0.5	5	53	<5	9	320
	70-75	FU	mix	mix	mix		0	7.7	2.53		6.2	0.1	24.9	4.5	6.7	19.5	0.5	8	85	<5	8	550
	75-80	FU	5Y4/1	fi	sic		0	8.6	1.60	0.6	3.8	0	12.0	1.3	1.3	13.5	0.3	12	109	5	7	450
	80-85	FU	5GY4/1	fi	sic1		0	8.6	1.86	0.6	4.0	0	13.5	1.2	1.1	15.5	0.3	14	94	9	5	500
	85-90	FU	BLACK																	11	4	310
	90-95	FU	5Y4/1	vfi	c		0	8.8	1.38	0.8	4.6	0	9.1	0.4	0.5	13.5	0.1	20	143	<5	7	560
	95-100	FU	N5+N7	fr	sil	7.6	e	9.3	1.73	1.8	4.8	0	11.4	0.4	0.5	17.0	0.1	25	116	<5	7	420
	100-105	FU	5Y4/1	vfi	sic	6.8	e	8.9	1.57	1.4	6.5	0	8.1	0.2	0.2	15.5	0.1	35	181	8	7	590
	105-110	FU	5Y4/1	vfi	sic	10.4	es	9.1	1.41	2.4	5.9	0	6.7	0.2	0.2	14.5	0.1	33	168	<5	5	490
	110-115	FU	5Y4/1	vfi	sic1	12.9	es	9.1	1.62	2.36	6.4	0	8.0	0.3	0.1	16.3	0.1	37	130	<5	4	440
	115-120	FU	5Y5/1	fi	sic1	10.9	es	9.1	1.72	2.2	7.0	0.1	9.1	0.4	0.1	17.8	0.1	36	120	<5	9	405
	120-125	FU	5Y5/1	fi	sic1	11.7	es	9.2	1.57	2.6	7.7	0	6.3	0.4	0.1	16.0	0.1	32	147	<5	3	430
	125-130	FU	5Y5/1	fi	sic1	8.8	es	9.4	1.49	4.0	6.5	0.1	4.9	0.4	0	15.0	0.1	34	132	6	4	390
	130-135	FU	N5/	fr	sil	4.6	e	9.4	1.52	5.0	6.8	0.3	3.5	0.4	0	15.1	0.1	34	116	13	7	395
	135-140	FU	5Y5/1	fi	sic1	8.2	es	9.4	1.64	4.8	7.3	0.1	5.0	0.3	0.2	16.5	0.2	33	140	7	6	350
	140-150	FUsh	5GY4/1	vfi	c	8.0	es	8.9	1.50	2.8	7.4	0.1	6.4	0.3	0.2	16.0	0.2	32	148	8	7	580
	150-160	mix	mix	vfi	sic	5.6	e	8.2	2.20	2.0	15.5	0	7.4	0.5	0.2	23.9	0.3	41	113	15	6	520
	160-179	coal	BLACK																	10	4	240

Table VII - continued  
 Lab Data Montana Tech. - USGS  
 Beulah and Zap, Deep Borings

Sample	Depth (ft.)	Mat'l.	Color (moist)	Con. (moist)	Tex. (field)	CaCO3 Eq. %	Eff'v. HCl	pH (paste)	ECF 25°C	Saturation Extract Soluble Ions (meq./litre)								SAR	Soil Test Data				
										CO3	HCO3	Cl	SO4	Ca	Mg	Na	K		Sat'n. %	lb/A/6" N(NO3)	lb/A P	lb/A K	
B7482  drilled dry to 130, wet below 130  sand 92-130 no sample recovery	0-5	till	2.5Y4/2	fi	cl	13.4	es	8.1	0.50		4.1	0.3	1.6	0.8	2.8	2.3	0.1	2	58	<5	3	360	
	5-10	till	2.5Y4/3	fi	cl	13.2	es	8.0	0.73		3.2	0.4	4.3	1.2	3.4	3.1	0.2	2	58	<5	9	390	
	10-15	till	2.5Y4/3	fi	l	12.5	es	7.9	2.36		2.0	0.8	28.1	11.1	14.6	4.8	0.4	1	57	<5	9	360	
	15-20	FU	2.5Y5/2	l	ms		0	7.7	1.43		1.7	0.8	14.4	7.3	5.4	3.8	0.4	2	38	<5	6	200	
	20-40	FU	2.5Y5/2	l	fs		0	7.8	0.90		1.5	0.4	8.0	3.2	3.2	3.2	0.3	2	45	<5	1	260	
	40-60	FU	2.5Y5/2	l	fs		0	7.6	0.99		1.8	0.3	8.8	3.0	3.8	3.7	0.4	2	39	<5	2	310	
	60-68	FU	2.5Y4/3	fr	l	5.5	es	7.8	1.55		1.9	0.4	15.6	4.3	7.0	6.0	0.6	3	55	<5	3	390	
	70-80	FU	2.5Y4/3	vfr	fs		0	7.3	4.45		1.8	0.4	66.7	25.9	33.5	9.5	1.0	2	38	<5	10	290	
	80-85	FU	2.5Y4/4	l	lfs		0	7.2	0.80		1.6	0.2	7.4	3.2	3.8	1.9	0.3	1	42	<5	6	240	
	85-92	FU	5Y3/1	l	ms		0	7.6	1.11		4.2	0.3	8.6	5.7	3.8	3.1	0.5	1	36	<5	5	190	
	130-140	carb. sh	5Y5/1+2/1	fi	sic	7.0	e	8.7	1.71	1.4	9.8	0	8.8	0.5	0.8	18.5	0.2	23	122	<5	5	505	
	140-160	FU	5Y4/1	fi	sicl	11.6	e	9.2	1.73	3.2	9.0	0.1	7.5	0.4	0.2	19.0	0.2	35	115	9	5	420	
	160-180	FU	5Y4/1	fi	aicl	6.9	e	9.2	1.72	3.6	8.4	0	7.2	0.6	0	18.4	0.2	34	116	9	9	410	
	180-190	FU	5Y4/1	vfi	sic	3.8	es	8.5	1.79	1.2	10.0	0	9.8	0.6	0.2	20.0	0.2	32	119	<5	7	540	
B7483	0-5	?s	mix	l	gs	7.8	es	7.6	0.47		3.8	0.3	2.1	1.8	3.0	1.3	0.1	0.8	29	<5	5	200	
	5-10	?s	10YR4/2	l	ms	4.9	e	8.4	0.33	0.2	2.5	0.2	1.2	1.0	1.7	1.3	0.1	1	30		14	140	
	10-15	?s	2.5Y4/2	l	lfs	6.7	e	8.2	0.33		2.5	0.3	1.5	1.4	1.1	1.7	0.1	2	27	<5	2	130	
	15-20	?s	2.5Y4/2	l	ms		0	8.2	0.27		2.2	0.1	1.3	1.3	0.7	1.5	0.1	2	29	<5	4	115	
	20-25	?s	2.5Y4/2	l	gs	7.8	e	8.1	0.40		2.6	0.4	1.8	1.8	0.9	2.0	0.1	2	25	<5	5	180	
B7484  drilled dry to 58 feet, wet below 58	0-5	ABC			cl	9.6	e+ev	7.7	2.54		2.0	0.5	34.5	11.1	16.3	9.3	0.3	3	54	<5	6	480	
	5-10	till	2.5Y4/2	fi	cl	7.9	es	7.8	6.50		1.4	6.1	97.2	22.7	48.8	32.5	0.7	5	61	5	5	275	
	10-15	till	10YR4/3	fi	cl	6.6	es	7.7	3.62		1.4	1.7	47.9	15.5	16.4	18.5	0.6	5	58	8	5	370	
	15-20	till	10YR4/2	fi	cl	6.6	es	7.8	1.64		1.7	0.6	17.4	5.4	4.0	9.9	0.4	5	56	8	5	340	
	20-25	till	2.5Y4/3	fi	cl	5.9	e	7.8	1.18		1.9	0.4	11.2	3.7	2.2	7.2	0.4	4	49	7	6	350	
	25-30	old till?	2.5Y4/2	vfi	cl	6.2	e	7.7	1.50		1.6	0.2	16.0	5.7	3.8	7.8	0.5	4	53	8	5	310	
	30-35	old till?	10YR4/3	mix	l	6.1	es	7.8	1.11		1.9	0.1	11.2	3.3	2.5	7.0	0.4	4	50				
	35-40	old till?	10YR4/3	fr+fi	l+cl	4.8	e	7.8	1.10		1.9	0.1	10.8	3.2	1.9	7.3	0.4	5	51	5	6	370	
	40-45	?	10YR5/4	fr	sl	3.0	e	8.0	0.81		1.9	0.2	6.9	1.7	1.1	6.0	0.2	5	36	<5	6	370	
	45-50	FU	10YR5/4	fr	sl	4.9	e	7.9	0.75		2.7	0.2	6.6	1.5	0.8	7.0	0.2	7	34	-	7	250	
	50-55	FU	10YR4/2+3	fr	sl+cl	4.5	e	8.0	0.67		2.7	0.1	5.6	1.2	0.7	6.3	0.2	6	37				
	55-58	FU	10YR3/3+4/3	fr	scl	5.4	e	7.8	0.91		3.5	0.1	8.1	2.2	1.7	7.3	0.5	5	48	<5	8	330	
	80-100	FU	5Y4/1	fi	sicl	11.5	e	8.2	1.18	1.4	4.6	0	6.8	1.0	1.0	10.3	0.5	10	103	<5	2	430	
	100-120	FU	5Y4/1	fi	sicl	2.6	e-	8.8	1.29	1.8	6.0	0	8.0	0.7	0.1	14.8	0.2	23	140	9	4	535	

Table VII - continued  
 Lab Data Montana Tech. - USGS  
 Beulah and Zap, Deep Borings

Sample	Depth (ft.)	Mat'l.	Color (moist)	Con. (moist)	Tex. (field)	CaCO3 Eq. %	Eff'v. HCl	pH (paste)	ECE 25°C	Saturation Extract Soluble Ions (meq./litre)								SAR	Sat'n. %	Soil Test Data		
										CO3	HCO3	Cl	SO4	Ca	Mg	Na	K			lb/A/6"	lb/A	lb/A
B7485	0-5	mix		fr+vfi	sl+c	2.8	e	7.4	0.68	4.5	0	3.0	2.2	3.4	1.7	0.1	1	54	18	11	340	
loam/fine till	5-10	till	2.5Y4/2+4	vfi	c	9.3	es	7.7	4.70	1.7	0	74.0	33.5	29.7	12.0	0.6	2	64	10	16	350	
drilled dry	10-15	till	10YR4/2+3	vfi	c	8.1	es	7.6	4.20	1.4	0.1	61.6	20.2	30.5	11.6	0.7	2	65	10	7	400	
to 20 feet	15-20	till	10YR3/2+3	vfi	cl	7.2	es	7.5	4.00	1.5	0.3	59.5	25.6	25.8	9.0	0.9	2	62	12	8	440	
	20-40	till	2.5Y4/2	fi	l	6.1	e	7.5	3.16	1.5	0.3	42.8	20.8	16.1	7.0	0.8	2	56	12	7	375	
B7488	0-5	A-C	10YR4/2	fr	cl	9.0	ev	8.2	0.50	2.8	0.3	2.6	1.4	2.2	2.0	0.1	2	52	<5	4	285	
on hill	5-10	till	10YR4/2	fr	l	6.7	es	7.7	3.68	1.3	2.3	51.9	24.7	22.4	7.9	0.5	2	54	10	5	340	
Zahl-Wms.	10-15	till	10YR4/3	fr	l	5.9	es	7.6	3.65	1.0	2.6	50.1	28.5	19.0	6.0	0.6	1	54	22	9	335	
	15-20	till	10YR4/2	fr	l	5.3	es	7.7	1.91	1.3	1.5	20.7	12.2	7.7	3.1	0.4	1	51	28	7	315	
drilled dry	20-25	till	10YR4/2	fi	l	6.0	es	7.6	3.10	1.2	1.0	42.8	27.5	14.0	2.8	0.6	0.6	50	34	7	360	
to 60, wet	25-30	till	10YR4/2	l	fs	3.5	e	7.8	1.21	1.2	0.1	12.7	8.8	3.8	1.1	0.3	0.4	34	32	7	190	
below 60	30-35		10YR4/2	l	fs	4.1	e	7.7	1.26	1.3	0.1	13.1	9.3	3.8	1.0	0.4	0.4	33	30	8	215	
	35-40		10YR4/1	l	fs	2.2	e-	7.9	0.58	1.5	0.1	4.7	4.0	1.4	0.8	0.2	0.5	33	10	5	170	
(poor samples	40-45		10YR4/2	vfr	lfs	5.0	e	7.8	0.50	1.9	0.2	3.5	3.4	1.4	0.5	0.3	0.3	37	<5	5	290	
50-60)	45-50		10YR4/1	vfr	lfs	3.6	e	8.0	0.71	2.4	0.2	5.5	4.7	2.0	1.0	0.4	0.5	39	<5	5	255	
	50-55		10YR4/2	vfr	fsl	3.4	e	7.9	0.75	2.0	0.1	6.3	4.8	2.1	1.2	0.4	0.6	33	<5	6	245	
coal ? 74-90	55-60		mix	fr	fs+cl	3.5	e	7.8	0.73	2.1	0	6.2	4.7	2.2	1.0	0.4	0.6	40	9	6	260	
and below 180	60-65	FU	2.5Y4/1	fr	fsl	3.4	e	7.9	0.92	1.9	0	9.2	6.6	2.8	1.3	0.4	0.6	39	11	7	240	
	105-130	FU	5GY5/1	fi	sic	0	0	8.4	1.61	0.1	8.0	0	10.2	0.7	1.2	16.2	0.2	1.5	133	6	5	550
	155-180	FU	5GY5/1	fi	sic	0	0	8.7	1.53	1.4	7.3	0	8.3	0.6	0.2	16.0	0.2	2	140	12	6	485
B7489	0-5	ABC				11.3	ev	8.1	0.50	3.5	0	2.1	1.0	1.8	2.7	0.1	2	58	<5	5	275	
SE cor 4-144-89	5-10	till				5.8	es	7.7	4.30	1.4	0.4	53.5	21.3	32.7	1.3	0.6	0.2	43	11	9	290	
Wms. loam	10-15	till				6.1	es	7.6	3.65	1.3	1.4	39.2	18.8	21.5	1.0	0.6	0.2	54	32	9	340	
	15-20	mix						6.7	4.70	9.7	0.8	55.4	25.4	32.0	8.0	0.6	1.5	53	32	37	260	
coal at 60, 77,	20-25	FU				4.3		7.5	4.49	1.2	0	73.0	25.1	42.8	5.2	1.0	0.9	62	18	4	310	
125 and 145?	25-30	FU				3.7		7.5	4.40	1.1	0	69.6	24.3	40.4	5.0	1.0	0.9	63	17	4	330	
	30-35	FU-sh				2.4		7.6	3.53	1.3	0	50.7	18.6	27.8	4.5	1.0	0.9	91	23	17	450	
	35-40	FU-sh				2.7		7.5	3.10	1.2	0	46.0	18.0	24.3	4.0	1.0	0.9	87	13	8	445	
	40-45	FU				4.3		7.5	3.50	1.3	0	52.9	21.6	27.6	4.0	1.0	0.8	75	<5	5	375	
	45-50	FU-sh						7.5	2.33	1.6	0.1	30.2	12.0	15.5	3.5	0.9	0.9	83	<5	6	440	
	50-55	FU-sh						7.8	1.85	2.0	0	21.3	9.3	10.5	2.5	1.0	0.8	84	<5	4	470	
	55-60	FU-sh						7.5	1.80	3.4	0	19.3	7.2	12.1	2.3	1.0	0.7	90	<5	6	550	
	60-65	coal+sh	black					6.6	1.87	4.3	0.1	19.6	10.6	10.1	2.5	0.9	0.8	63	<5	5	340	
	80-100					5.7		8.3	1.79	4.3	0	14.4	1.8	1.2	15.0	0.7	12	118	<5	5	530	
	100-125					5.0		8.8	2.30	1.0	6.3	0	14.6	0.5	0.5	19.5	0.3	27	141	17	2	480
	155-188					8.5		8.9	1.77	1.6	7.9	0	9.7	0.5	0.2	16.6	0.3	27	142	5	6	510



Table VIII  
 Lab Data: Knife River Coal Company Beulah South - Reclaimed area in SE. 2-143-88; 8/9/73.  
 (1.5 inch cores to 60")

Sample	Depth (in.)	Mat'l.	Color (dry)	Con. Tex. (dry)	Con. B.D.	Lime (qual.)	pH (paste)	Saturation Extract Soluble Ions (meq./litre)										SAR	Sat'n. %	Soil Test Data			
								ECE25	HCO3	Cl	SO4	Ca	Mg	Na	K	lbs/A-6" (NH4)	lbs/A (NO3)			P	K		
KR-1	0-6	mx-till	2.5Y 5/2	cl vh		e	7.6	3.8	3.2	0.6	56.0	27.6	26.0	5.5	0.7	1.1	54		11	9	350		
	-12	mx,5%sh*	2.5Y 5/2	cl vh		e	7.3	3.8	2.7	0.7	60.5	25.0	31.6	6.5	0.8	1.2	62		17	5	380		
	-24	mx	2.5Y 5/2+4	sicl vh		e	7.4	4.2	1.8	0.6	64.2	25.0	34.8	6.0	0.8	1.1	70		36	4	430		
	-36	mx,10%sh	2.5Y 5/2	sic vh+eh		-	7.4	4.0	1.5	0.8	62.5	24.2	33.6	6.2	0.8	1.1	65	32	43	5	390		
	-48	mx,5%sh	2.5Y 6/2	sicl vh+eh		e	7.4	4.0	1.7	0.7	63.0	25.0	33.6	6.0	0.8	1.1	63	24	47	6	400		
	-60	mx,5%sh	2.5Y 6/2+3	cl vh+eh		e	7.5	3.7	1.7	0.9	56.1	25.4	26.4	6.2	0.7	1.2	60	18	44	9	380		
KR-2	0-6	till	2.5Y 5/2	sicl vh	1.50	es	7.6	3.8	2.0	1.0	57.7	25.0	28.0	7.0	0.7	1.4	56	16	17	8	330		
	-12	till	2.5Y 5/2	cl vh	1.48	es	7.6	3.8	2.1	0.9	59.0	25.4	28.4	7.6	0.6	1.5	45	12	5	5	290		
	-24	till	2.5Y 5/2	cl vh	1.20	es	7.6	3.6	2.2	1.0	54.5	23.8	26.4	6.8	0.7	1.4	57	16	6	7	320		
	-36	till	2.5Y 6/2	sicl h	1.19	es	7.5	3.6	2.1	0.7	54.9	24.2	26.4	6.4	0.7	1.2	60	16	<5	6	330		
	-48	till,7%sh	2.5Y 6/2	sil h	1.18	es	7.6	3.8	2.5	0.7	58.7	24.2	30.0	7.0	0.7	1.4	57	16	<5	7	330		
	-60	mx,5%sh	2.5Y 5/2	sil h	1.10	es	7.6	4.0	2.3	0.7	63.1	25.4	30.8	7.8	0.7	1.5	57	14	<5	5	300		
KR-3	0-6	mx	2.5Y 5/2+3	sicl h		es	7.1	3.9	3.5	0.7	61.0	26.6	32.0	5.8	0.8	1.1	57	28	5	10	320		
	-12	mx,20%sh	2.5Y 5/2+1	sil h		es	7.1	4.1	4.1	0.9	65.0	26.4	36.3	6.4	0.9	1.1	55	28	5	8	320		
	-24	till,9%sh	2.5Y 5/2	sicl h		es	6.9	4.3	4.0	1.1	61.2	25.4	33.6	6.4	0.9	1.2	64	28	6	8	310		
	-36	mx	2.5Y 5/2	sicl -		e	6.9	4.0	4.3	0.7	60.4	26.6	32.5	5.6	0.7	1.0	61	60	<5	15	260		
	-48	mx,8%sh	2.5Y 5/2	sicl h		e	7.2	3.8	2.6	0.1	59.1	26.6	30.0	4.6	0.6	0.9	59	62	<5	7	210		
	-60	mx,8%sh	2.5Y 5/2	sicl h		e	6.7	4.3	7.0	0.6	65.2	27.6	38.4	6.0	0.8	1.1	60	28	<5	14	350		
KR-4	0-6	mx-coal	2.5Y 5/2+c	l h	1.08	e	6.5	3.7	8.0	0.4	48.2	30.4	22.2	3.2	0.8	0.6	54	18	<5	8	260		
	-12	mx-coal	2.5Y 5/4+c	sicl vh	1.42	e	7.4	4.0	2.3	0.1	61.5	25.4	30.4	7.0	1.1	1.3	62	26	<5	7	360		
	-24	till,8%sh	2.5Y 5+6/2	sil vh+eh	1.25	e	7.6	4.1	2.3	0.2	62.3	23.0	28.0	12.4	1.4	2.5	62	26	<5	8	430		
	-36	sh,20%sh	2.5Y 5+6/1	sic eh+vh	1.14	e	7.3	4.5	2.9	0.1	68.2	25.4	29.6	14.8	1.4	2.8	64	28	<5	8	460		
	-48	mx,12%sh	10YR 4+5/2	sic h+vh	1.11	e	7.1	4.3	3.3	0.3	65.8	25.8	30.8	11.6	1.2	2.2	62	22	<5	8	440		
	-60	mx,6%sh	10YR 5/2	cl h	1.19	e	7.1	4.1	3.4	0.1	63.8	25.4	32.5	8.3	1.1	1.5	59	22	5	7	390		
KR-5	0-6	till	10YR 5/3	fsl vh		es	7.3	2.8	4.0	0.4	48.3	17.8	29.0	5.4	0.5	1.1	44	26	8	8	260		
	-12	shale	5Y 6/1+2	sicl vh		e	7.7	4.5	2.5	0.4	60.8	16.0	18.2	28.4	1.1	6.7	62	24	5	6	430		
	-24	ss&sh	2.5Y 6/2	sicl vh		e	7.7	4.9	2.4	0.5	65.7	13.6	19.6	34.5	0.9	8.5	62	24	6	4	390		
	-36	ss	2.5Y 6/2	sil h		e	7.7	5.4	2.2	0.5	74.3	14.8	22.8	38.4	1.0	8.9	62	22	7	3	380		
	-48	ss&sh	2.5Y 7/1	sicl h+vh		e	7.7	5.7	2.9	0.6	80.9	17.2	26.0	40.0	1.2	8.6	61	30	6	3	400		
	-60	ss&sh	10YR 6/2+3	sicl h+vh		e	7.5	6.4	2.9	0.5	85.1	21.2	30.4	35.8	1.1	7.1	61	24	8	4	390		

\*sh % is lumps > 19 mm.



Table VIII - continued  
 Knife River Coal Company Beulah South - Reclaimed 1972  
 SE-Sec. 2 + NE Sec 11 -143-88

KR	ECE					Sx	Mx	SD	RSD %	KR	ECE					Sx	Mx	SD	RSD %
	1	2	3	4	5						8	9	10	11	12				
0-6	3.8	3.8	3.9	3.7	2.8	18.0	3.6	0.453	13	0-12	4.0	3.4	3.4	3.4	3.8	18.0	3.6	0.283	8
-12	3.8	3.8	4.1	4.0	4.5	20.2	4.0	0.288	7	-24	3.8	3.8	3.7	3.6	3.4	18.3	3.7	0.167	5
-24	4.2	3.6	4.3	4.1	4.9	21.1	4.2	0.466	11	-36	2.7	3.8	3.5	3.4	3.5	16.9	3.4	0.409	12
-36	4.0	3.6	4.0	4.5	5.4	21.5	4.3	0.693	16	-48	3.4	3.7	3.7	3.6	3.8	18.2	3.6	0.152	4
-48	4.0	3.8	3.8	4.3	5.7	21.6	4.3	0.798	19	-60	3.0	3.6	-	3.4	3.8	13.8	3.4	0.342	10
-60	3.7	4.0	4.3	4.1	6.4	22.5	4.5	1.084	24										

KR	SAR					Sx	Mx	SD	RSD %	KR	SAR					Sx	Mx	SD	RSD %
	1	2	3	4	5						8	9	10	11	12				
0-6	1.1	1.4	1.1	0.6	1.1	5.3	1.1	0.288	26	0-12	1.3	1.0	2.0	1.8	1.1	7.2	1.4	0.439	21
-12	1.2	1.5	1.1	1.3	6.7	11.8	2.4	2.431	101	-24	1.2	1.1	2.3	2.0	0.9	7.5	1.5	0.612	41
-24	1.1	1.4	1.2	2.5	8.5	14.7	2.9	3.158	109	-36	1.2	1.1	1.8	2.3	0.9	7.3	1.5	0.577	38
-36	1.1	1.2	1.0	2.8	8.9	15.0	3.0	3.380	113	-48	1.1	1.0	1.8	1.9	1.1	6.9	1.4	0.432	31
-48	1.1	1.4	0.9	2.2	8.6	14.2	2.8	3.258	116	-60	1.2	0.9	-	2.0	1.2	5.3	1.3	0.472	36
-60	1.2	1.5	1.1	1.5	7.1	12.4	2.5	2.589	104										

KR	pH					Median	KR	pH					Median
	1	2	3	4	5			8	9	10	11	12	
0-6	7.6	7.6	7.1	6.5	7.3	7.0	0-12	7.3	7.4	7.5	7.6	7.6	7.4
-12	7.3	7.6	7.1	7.4	7.7	7.4	-24	7.3	7.5	7.8	7.5	7.7	7.5
-24	7.4	7.6	6.9	7.6	7.7	7.4	-36	7.4	7.4	7.8	7.6	7.7	7.6
-36	7.4	7.5	6.9	7.3	7.7	7.4	-48	7.4	7.5	7.8	7.4	7.6	7.6
-48	7.4	7.6	7.2	7.1	7.7	7.4	-60	7.5	7.5	-	7.6	7.6	7.6
-60	7.5	7.6	6.7	7.1	7.5	7.1							

Table IX  
Lab Data: Knife River Coal Company Beulah South - Reclaimed area in NE 12-143-88 and NW 7-143-87  
(1.5 inch cores to 60")

8/9/73

Sample	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime B.D. (qual.)	pH (paste)	Saturation Extract Soluble Ions (meq./litre)											Sat'n. %	Soil Test Data			
								ECE25	HCO3	Cl	SO4	Ca	Mg	Na	K	SAR	lbs/A-6" (NH4)	lbs/A (NO3)		P	K		
KR-13	0-6	A	10YR 3/2	--	vh 1.34	o	7.0	1.3	5.5	0.6	9.2	7.1	4.2	3.4	0.6	1.4	35	10	24	13	430		
	-18	ss+sis	2.5Y 6/1+6/2	sicl	vh 1.57	e	7.8	8.3	1.4	0.3	127.3	20.0	42.0	66.0	1.0	11.9	81	12	7	5	430		
	-36	ss+sis	2.5Y 6/2+7/2	sic	- 1.25	es	7.6	7.9	1.7	0.4	118.8	20.5	45.5	54.0	0.9	9.4	76	8	7	7	430		
	-48	mx	2.5Y 4/2+7/2	sic	s+vh 1.36	e	7.6	6.0	2.5	0.3	89.7	22.0	34.0	36.0	0.5	6.8	63	4	17	6	390		
	-60	sis	2.5Y 6/2+7/2	sicl	vh+eh 1.24	e	7.6	3.9	2.1	0.2	58.1	25.2	20.0	14.6	0.6	3.1	72	8	18	5	400		
KR-14	0-12	AB	10YR 3/2+3/3	ls	sh 1.51	o	6.6	1.0	2.1	0.3	8.0	4.2	2.1	3.4	0.7	1.9	31	6	16	9	470		
	-24	ss+sis	2.5Y 6/4+7/1	sicl	h+eh 1.37	e+ev	7.6	6.3	3.1	0.2	54.8	21.2	29.6	6.2	1.1	1.2	67	10	7	13	440		
	-36	till+sis	2.5Y 5/2+6/2	sicl	vh 1.46	e+es	7.6	5.5	2.3	0.2	80.1	21.2	27.0	33.6	0.8	6.9	70	6	<5	9	380		
	-48	till	2.5Y 5/2+5/2	sic	vh 1.29	e	7.4	5.7	2.8	0.2	82.3	21.2	27.7	35.6	0.8	7.2	66	6	5	11	380		
	-60	till+sis	2.5Y 5/2+6/2	sic	vh 1.12	e	7.6	5.7	2.4	0.1	84.2	20.8	28.4	36.6	0.9	7.4	68	8	<5	18	420		
KR-15	0-12		2.5Y 4/2+6/2	cl	vh 1.63	o+es	7.2	3.6	3.8	0.3	49.3	20.4	21.8	10.8	0.4	2.4	59	4	7	9	365		
	-24		2.5Y 6/2	sicl	vh 1.45	e	7.3	4.7	3.2	0.2	68.1	23.0	28.2	19.4	0.9	3.8	71	6	5	10	415		
	-36		2.5Y 5/2	cl	vh 1.25	es	7.4	4.5	2.4	0.1	69.5	23.6	28.2	19.4	0.8	3.8	62	10	5	9	400		
	-48		2.5Y 6/1+6/3	sicl	vh+eh 1.15	e+o	7.5	5.4	2.0	0.2	80.5	21.6	32.2	28.0	0.9	5.4	72	14	6	7	410		
	-60		2.5Y 5/2+6/2	sicl	vh+eh --	e	7.3	5.3	3.1	0.2	80.8	23.2	34.0	26.0	0.9	4.9	69	12	<5	12	420		
KR-16	0-6		10YR 4/2+6/2	l	vh 1.56	e	7.4	5.5	3.2	0.4	85.3	21.2	18.6	48.0	1.1	10.8	56	16	8	19	440		
	-18		2.5Y 6/1	sic	eh 1.46	o	7.8	4.0	3.5	0.2	48.0	8.2	8.4	34.0	1.1	11.8	106	28	6	8	480		
	-36		2.5Y 6/1	sicl	vh+eh 1.35	o	7.7	5.9	2.6	0.1	96.5	18.6	23.3	56.0	1.3	12.3	89	24	8	7	520		
	-48		2.5Y 6/1+5/1	sic	eh 1.32	tr	7.7	3.8	5.0	0.3	41.0	5.0	6.6	33.6	1.1	14.0	80	22	9	8	690		
	-60		2.5Y 6/1+5/1	sic	eh 1.41	tr	7.8	3.9	5.3	0.2	41.0	6.0	7.7	31.6	1.2	12.1	91	26	12	5	620		
KR-17	0-9	A	10YR 3/2+3/3	sl	h	o	7.0	1.1	4.9	0.5	7.1	5.6	3.7	2.7	0.5	1.3	43	6	10	8	430		
	-24	mx	2.5Y 6/1	sic	eh	e	7.6	4.2	4.2	0.2	49.4	8.0	8.8	36.0	1.0	12.5	90	24	7	6	700		
	-36	sis	2.5Y 5/1+6/1	c	eh	o	7.7	4.5	4.7	0.2	53.4	6.4	7.2	43.6	1.1	16.8	98	22	12	5	670		
	-48	sis	2.5Y 5/1	c	eh	tr	7.8	4.5	4.5	0.2	70.4	6.1	7.2	60.8	1.0	23.6	83	24	17	5	640		
	-60	sis	2.5Y 5/1	c	eh	tr	7.7	5.4	4.0	0.2	66.9	10.8	12.0	47.2	1.1	14.0	97	20	15	7	620		
KR-18	0-6	A	10YR 3/2	sl	h	o	6.6	2.0	3.8	0.5	21.3	10.7	7.5	6.6	0.8	2.2	43	8	9	7	500		
	-18	mx	2.5Y 6/2	sic	vh+eh	tr	7.7	5.4	2.7	0.2	78.1	14.2	18.5	47.2	1.1	11.7	86	18	7	7	500		
	-36	sis	2.5Y 5/1+6/2	c	eh	o	7.3	5.2	4.4	0.2	66.5	9.8	15.0	45.2	1.1	12.8	84	22	6	7	610		
	-48	sis	2.5Y 6/1	sic	eh	tr	7.6	5.3	3.8	0.5	68.7	11.4	16.0	44.4	1.2	12.0	92	28	6	6	630		
	-60	sis	2.5Y 6/1	sic	eh	tr	7.8	4.7	3.6	0.3	66.3	7.6	13.4	48.0	1.2	14.8	102	30	9	5	650		
KR-19	0-12	AB	10YR 3/3+6/1	sc	h+eh	tr	6.9	10.0	5.7	0.4	156.6	20.5	49.0	91.8	1.4	15.6	71	16	11	6	480		
	-24	sh	2.5Y 7/0+7/2	sicl	eh	tr	7.4	8.6	1.9	0.5	141.7	21.0	49.0	73.0	1.1	12.4	78	14	7	6	400		
	-36	sh	2.5Y 6/2	sicl	eh	e	7.6	8.6	2.4	0.3	145.0	22.0	54.5	70.0	1.2	11.3	81	16	8	9	470		
	-48	sis	2.5Y 6/1+2/1	sc	eh	tr	6.8	9.0	7.5	0.5	135.9	21.0	44.5	77.0	1.4	13.5	86	14	12	6	540		
	-60	sis	2.5Y 6/2	sicl	vh+eh	tr	7.4	7.5	1.6	0.2	115.5	20.5	39.5	55.0	1.3	10.2	81	18	11	3	460		

Table IX - continued

Knife River Coal Company Beulah South - Reclaimed Area 1973  
NE 12/143-88 and NW 7-143-87

KR	ECE								Sx	Mx	SD	RSD %
	13	14	15	16	17	18	19					
0-6	1.3	1.0	3.6	5.5	1.1	2.0	10.0	24.5	3.5	3.300	94	
-12	8.3	1.0	3.6	4.0	1.1	5.4	10.0	33.4	4.8	3.412	71	
-24	8.3	6.3	4.7	4.0	4.2	5.4	8.6	41.5	5.9	1.888	32	
-36	7.9	5.5	4.5	5.9	4.5	5.2	8.6	42.1	6.0	1.621	27	
-48	6.0	5.7	5.4	3.8	4.5	5.3	9.0	39.7	5.7	1.647	29	
-60	3.9	5.7	5.3	3.9	5.4	4.7	7.5	36.4	5.2	1.240	24	

	SAR								Sx	Mx	SD	RSD %
	13	14	15	16	17	18	19					
0-6	1.4	1.9	2.4	10.8	1.3	2.2	15.6	35.6	5.1	5.727	112	
-12	11.9	1.9	2.4	11.8	1.3	11.7	15.6	56.6	8.1	5.979	74	
-24	11.9	1.2	3.8	11.8	12.5	11.7	12.4	65.3	9.3	4.734	51	
-36	9.4	6.9	3.8	12.3	16.8	12.8	11.3	73.3	10.5	4.241	40	
-48	6.8	7.2	5.4	14.0	23.6	12.0	13.5	82.5	11.8	6.247	53	
-60	3.1	7.4	4.9	12.1	14.0	14.8	10.2	66.5	9.5	4.511	57	

	pH								Median
	13	14	15	16	17	18	19		
0-6	7.0	6.6	7.2	7.4	7.0	6.6	6.9	7.0	
-12	7.8	6.6	7.2	7.8	7.0	7.7	6.9	7.2	
-24	7.8	7.6	7.3	7.8	7.6	7.7	7.4	7.5	
-36	7.6	7.6	7.4	7.7	7.7	7.3	7.6	7.5	
-48	7.6	7.4	7.5	7.7	7.8	7.6	6.8	7.3	
-60	7.6	7.6	7.3	7.8	7.7	7.8	7.4	7.6	

Table X  
 Lab Data: Knife River Coal Company Gascoyne - Reclaimed, except #10 & #11.  
 (1.5" cores to 60")

Soils Department - NDSU  
 Sampled 10/3/73

Sample	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime B.D. (qual.)	pH (paste)	Saturation Extract Soluble Ions (meq/litre)								Soil Test Data						
								ECE25	HC03	Cl	S04	Ca	Mg	Na	K	SAR	Sat'n. %	lbs/A/6" (NH4)	lbs/A (NO3)	lbs/A P	lbs/A K	
GR-1	0-6		10YR 6/2	vfs1	sh	1.19	es	7.5	3.2	4.5	0.5	45.1	25.8	22.8	1.0	0.5	0.2	52	30	<5	8	140
	-12		10YR 8/2	vfs1	sh	1.38	e	7.6	4.8	2.6	0.5	82.9	26.4	56.0	3.2	0.4	0.5	48	8	<5	4	110
	-24		10YR 8/2	sil	sh+vh	1.17	e	7.8	7.7	4.2	1.5	147.2	25.3	113.0	14.0	0.6	1.7	46	8	6	9	140
	-36		10YR 7/2	sil	h	0.97	e	7.7	11.0	3.4	1.0	217.3	24.0	178.0	19.5	0.2	1.9	48	6	8	8	90
	-48	soft sis	10YR 6+7/2	sil	s+vh	0.87	e	7.0	11.7	8.7	2.0	242.9	27.4	205.0	21.0	0.2	2.0	47	6	26	6	70
	-60	ox. coal	10YR 2+7/1	-	h	0.45	e	5.4	8.0	6.3	-	153.4	33.0	107.0	19.5	0.2	2.3	72	1	140	46	70
GR-2	0-6	sis	10YR 6+7/2	sil	h	1.23	e	7.2	3.2	4.1	0.9	44.7	31.6	16.0	0.9	1.2	0.2	47	12	6	12	220
	-12	A+sis	10YR 4+7/2	sil	h-vh	1.52	e	7.5	4.7	2.8	0.6	80.6	26.4	52.8	4.2	0.6	0.7	45	16	<5	6	190
	-24	A+sis	10YR 4+7/2	vfs1	h-vh	1.34	e+es	7.4	6.0	3.1	1.1	105.4	25.8	68.4	14.8	0.6	2.2	43	12	42	9	230
	-36	95% A	10YR 4/2	fs1	sh	1.19	-o	7.2	3.4	3.3	0.7	47.0	24.7	19.7	5.6	1.0	1.2	40	16	78	9	300
	-48	B or Cca	10YR 5/3	fs1	s	1.26	ev	7.6	1.3	2.6	0.4	8.5	6.1	3.8	1.4	0.2	0.6	39	22	56	5	120
	-60	B or Cca	10YR 5/3	fs1	sh	1.09	ev	7.9	1.8	2.6	0.3	13.0	4.5	10.2	1.0	0.2	0.4	37	22	31	2	120
GR-3	0-6	A+sis	10YR 5/2	vfs1	sh	1.27	es	7.9	0.9	6.4	0.7	2.0	3.0	5.1	0.1	0.9	0.1	46	22	5	8	310
	-12	Bca+sis	10YR 4+8/2	vfs1	sh	1.13	es+ev	7.7	5.2	3.2	2.0	85.7	24.3	58.0	8.4	0.2	1.3	46	22	13	8	90
	-24	80% AC	10YR 5/2	vfs1	sh	1.26	es	7.5	5.9	4.2	3.8	115.1	26.0	80.0	16.2	0.9	2.2	41	16	17	8	230
	-36	A-AC	10YR 4+5/2	vfs1	sh	1.25	o+es	7.3	2.0	3.2	1.6	28.5	14.2	5.8	3.2	0.5	1.0	44	12	67	5	180
	-48	C	10YR 5+6/2	vfs1	sh	1.36	es+ev	7.9	7.5	1.9	1.2	136.6	24.7	83.0	29.0	0.3	4.0	40	18	34	3	110
	-60	Cca	2.5Y 6/1	sil	vh	1.19	ev	8.3	14.4	2.1	1.2	331.5	22.4	252.0	59.7	0.7	5.1	56	8	10	4	200
GR-4	0-6	sis	10YR 6+7/2	sil-sic1	vh	1.30	e	7.5	3.7	4.5	0.5	57.5	28.8	30.8	2.0	0.9	0.4	54	16	<5	9	260
	-12	sis	2.5Y 7/2	sil	vh	1.44	e	7.6	7.0	3.1	0.9	120.9	25.1	98.4	1.04	0.4	0.1	52	10	<5	5	160
	-24	sis	2.5Y 6/1	sic1	vh	1.43	e+es	7.7	7.0	2.9	0.7	138.8	24.0	104.0	14.0	0.4	1.8	52	16	6	4	150
	-36	sis	2.5Y 7/2	sil	vh	1.33	e	7.7	6.0	2.3	0.6	107.3	24.2	76.0	9.6	0.4	1.4	52	12	25	4	180
	-48	sis	2.5Y 7/2	sil	vh	1.33	e	7.6	6.1	2.5	0.6	111.2	24.2	80.0	9.8	0.3	1.4	49	6	36	6	160
	-60	sis	10YR 7/1+2	sil	vh	0.95	e	7.6	6.2	2.8	0.9	107.1	24.6	76.0	9.8	0.4	1.4	51	12	44	4	160
GR-5	0-6	B	10YR 5+7/2	sil	sh+vh	1.32	e	7.5	3.4	3.6	0.5	52.5	28.8	26.0	1.0	0.8	0.2	53	6	5	7	210
	-12	sis	10YR 7/1+2	sil	vh	1.46	e	7.7	5.1	2.1	0.7	93.0	25.0	64.4	6.0	0.4	0.9	50	6	5	2	140
	-24	80% A	10YR 4+7/2	l	s+vh	1.25	e+es	7.3	8.0	4.5	1.2	160.4	23.5	125.0	17.0	0.6	2.0	46	16	5	5	250
	-36	A+Bca	10YR 4+5/2	l	s	1.03	o+es	7.9	11.5	3.0	2.4	160.7	22.4	169.0	50.0	0.9	5.1	48	30	<5	5	200
	-48	Bca	10YR 5/2	fs1	s	1.31	es	8.3	15.0	2.0	1.5	362.0	22.4	284.0	58.5	0.6	11.6	40	26	<5	3	130
	-60	Bca	10YR 5+6/2	vfs1	s	1.12	es+ev	8.3	18.5	2.3	1.5	393.7	19.0	308.0	70.0	0.5	5.5	42	10	<5	4	120

Table X - continued  
 Knife River Coal Company Gascoyne - Reclaimed, except #10 & #11.  
 (1.5" cores to 60")

Soils Department - NDSU  
 Sampled 10/3/73

Sample	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime B.D.	Lime (qual.)	pH (paste)	Saturation Extract Soluble Ions (meq/litre)								Soil Test Data					
									ECE25	HCO3	Cl	SO4	Ca	Mg	Na	K	SAR	Sat'n. %	lbs/A-6" (NH4)	lbs/A (NO3)	lbs/A P	lbs/A K
GR-6	0-6	sis	10YR 5+7/1	vfs1	s	1.09	e	7.4	1.6	5.8	0.7	15.6	10.6	9.5	1.8	0.2	0.6	47	10	<5	55	140
	-12	coal+sis	10YR 5+7/1	l	sh	1.03	e	7.5	1.4	3.2	0.5	15.8	10.2	8.0	1.1	0.2	0.4	48	10	6	31	140
	-24	coal+sis	10YR 5+7/1	-	s-vh	0.69	e	7.0	1.5	7.0	0.3	13.8	10.5	9.1	1.3	0.2	0.4	54	26	<5	43	120
	-36	coal+sis	10YR 5+7/1	vfs1	s-vh	0.70	e	6.8	1.9	10.3	0.4	15.5	13.2	11.2	1.6	0.2	0.5	54	8	<5	43	110
	-48	coal+sis	10YR 5+7/1	vfs1	s-vh	0.95	e	7.3	0.9	5.8	0.4	4.6	5.8	3.8	1.0	0.2	0.5	50	6	7	38	120
	-60	coal+A	10YR 4+5/2	fs1	s	0.90	o	6.9	1.8	6.3	0.4	18.1	12.5	10.4	1.4	0.5	0.4	55	8	9	24	180
GR-7	0-6	sis	10YR 6+7/2	vfs1	s	0.92	es	7.0	4.7	5.2	2.6	75.0	31.2	42.0	9.4	0.2	1.6	50	22	25	18	100
	-12		10YR 7/2	sil	s	1.10	es	7.6	3.9	3.5	1.2	48.6	9.9	35.2	8.0	0.2	1.7	47	14	21	4	90
	-24		10YR 7/2	l	s	0.80	es	7.0	4.7	5.5	1.7	69.9	30.0	37.6	9.2	0.3	1.6	53	16	71	25	110
	-36		10YR 5+2/2	l+(vfs1)	h	0.93	e	7.0	4.2	4.6	0.8	65.0	28.8	34.2	7.0	0.4	1.2	53	14	65	36	140
	-48	mix	10YR 6+7/2	vfs1	sh	0.94	es	7.0	4.3	4.4	0.7	65.7	27.2	34.4	8.8	0.4	1.6	50	12	54	42	140
	-60	50% coal	10YR 5+2/2	vfs1	sh	0.62	e	6.6	4.2	7.4	0.7	62.2	28.8	33.6	7.6	0.3	1.4	64	16	29	32	110
GR-8	0-6	mix	10YR 4+7/1	fs1	s+vh	1.05	s-vh	6.8	4.0	5.3	1.1	61.2	26.4	35.6	5.0	0.6	0.9	56	10	<5	23	170
	-12	sis	2.5Y 4/1	fs1	s	0.95	s	6.9	1.3	4.1	0.7	14.1	7.4	9.8	1.4	0.3	0.5	67	10	5	33	140
	-24	fss	2.5Y 7/2	vfs1	s	1.29	s	7.0	1.3	2.5	0.1	14.3	6.6	8.6	1.4	0.3	0.5	39	6	<5	17	120
	-36	fss	2.5Y 7/2	vfs1	s-h	1.23	s-h	7.1	1.2	3.0	0.2	13.3	5.8	8.2	2.2	0.3	0.8	37	6	<5	11	100
	-48	fss	2.5Y 7/2	sil	s-eh	1.26	s-eh	6.7	2.2	3.4	0.7	32.6	10.8	17.6	3.8	0.4	1.0	49	12	<5	44	170
	-60	vfss	2.5Y 7/2	vfs1	s	1.28	s	6.9	1.9	2.1	0.4	23.4	9.9	12.5	3.2	0.3	1.0	39	4	<5	3	80
GR-9	0-6	coal	10YR 2/1	-	eh	0.72	o	6.4	4.4	9.2	0.7	62.8	29.6	34.4	8.7	-	1.5	75	6	6	8	110
	-12	sis	5Y 6/1	l	eh	1.48	tr	6.6	3.9	4.3	0.4	60.5	23.6	34.0	6.8	0.8	1.3	55	10	<5	3	170
	-24	sis	5Y 6/1	sil	eh	1.32	o	6.9	4.2	2.1	0.3	68.7	22.9	40.0	7.2	1.0	1.3	58	12	<5	10	250
	-36	sis	5Y 6/1	sil	eh	1.24	o	6.8	4.4	1.7	0.4	72.5	22.0	43.6	7.7	1.3	1.4	65	16	<5	8	290
	-48	sis	5Y 7/1	sil	eh	1.29	o	6.7	4.1	1.9	0.4	68.2	22.0	39.4	8.2	0.9	1.5	61	14	8	12	250
	-60	sis	10YR 6/1	sil	eh	1.18	o	6.3	4.3	1.4	0.4	69.5	23.0	39.4	8.0	0.9	1.4	64	20	<5	18	300
G-10	3'-5'	vfss	2.5Y 8/2	si	sh+l		o	7.7	0.6	1.7	0.2	4.7	1.1	3.3	2.1	0.1	1.4	39		5	1	70
	5'-7'	vfss	2.5Y 8/2	si	sh+l		o	7.4	2.6	1.4	0.5	35.1	9.9	14.6	12.3	0.2	3.5	40		6	2	100
G-11	0-7	A	10YR 4/2	fs1	vh		o	7.3	1.2	3.3	0.4	10.1	6.2	3.8	3.6	0.2	1.6	39		32	5	190
	-20	B+Cca	10YR 5/2	fs1	vh		est+ev	7.8	1.6	5.9	0.2	13.1	3.2	3.9	12.0	0.1	6.4	44		11	2	110
	-36	Cca+C	2.5Y 6/2	sil	vh		e+es	8.4	17.0	1.8	0.3	271.8	10.4	56.3	207.0	0.2	35.9	44		6	2	110
	3'-4'	sis	2.5Y 7/2	sil	vh		tr	8.3	21.4	1.4	0.5	372.9	20.0	90.3	264.0	0.5	35.6	56		8	1	150
	4'-6'	sis	2.5Y 7/1	sil	vh		tr	8.1	14.6	1.0	0.1	220.5	20.2	42.0	159.0	0.4	28.6	49		5	1	120
	6'-8'	sis	2.5Y 7/1	sil	vh-eh		tr	7.8	11.8	1.2	0.1	172.5	16.4	25.0	132.0	0.4	29.1	47		<5	2	140

Table X - continued  
 Knife River Coal Company Gascoyne  
 Sec 2-130-99W SE 1/4  
 NW 35-131-99

	ECE					Sx	Mx	SD	RSD %		ECE					Sx	Mx	SD	RSD %
	1	2	3	4	5						6	7	8	9					
0-6	3.2	3.2	0.9	3.7	3.4	14.4	2.9	1.126		0-6	1.6	4.7	4.0	4.4	14.7	3.7	1.413	38	
-12	4.8	4.7	5.2	7.0	5.1	26.8	5.4	0.940		-12	1.4	3.9	1.3	3.9	10.5	2.6	1.473	57	
-24	7.7	6.0	5.9	7.0	8.0	34.6	6.9	0.958		-24	1.5	4.7	1.3	4.2	11.7	2.9	1.774	61	
-36	11.0	3.4	2.0	6.0	11.5	33.9	6.8	4.329		-36	1.9	4.2	1.2	4.4	11.7	2.9	1.615	56	
-48	11.7	1.3	7.5	6.1	15.0	41.6	8.3	5.266		-48	0.9	4.3	2.2	4.1	11.5	2.3	1.621	70	
-60	8.0	1.8	14.4	6.2	18.5	48.9	9.8	6.653		-60	1.8	4.2	1.9	4.3	12.2	2.4	1.387	58	

	SAR					Sx	Mx	SD	RSD %		SAR					Sx	Mx	SD	RSD %
	1	2	3	4	5						6	7	8	9					
0-6	0.2	0.2	0.1	0.4	0.2	1.1	0.2	0.109	55	0-6	0.6	1.6	0.9	1.5	4.6	1.2	0.480	40	
-12	0.5	0.7	1.3	0.1	0.9	3.5	0.7	0.447	64	-12	0.4	1.7	0.5	1.3	3.9	1.0	0.629	63	
-24	1.7	2.2	2.2	1.8	2.0	9.9	2.0	0.228	11	-24	0.4	1.6	0.5	1.3	3.8	1.0	0.592	59	
-36	1.9	1.2	1.0	1.4	5.1	10.6	2.1	1.699	81	-36	0.5	1.2	0.8	1.4	3.9	1.0	0.403	40	
-48	2.0	0.6	4.0	1.4	11.6	19.6	3.9	4.473	115	-48	0.5	1.6	1.0	1.5	4.6	1.2	0.507	42	
-60	2.3	0.4	5.1	1.4	5.5	14.7	2.9	2.261	78	-60	0.4	1.4	1.0	1.4	4.2	1.0	0.472	47	

	pH					Median		pH					Median
	1	2	3	4	5			6	7	8	9		
0-6	7.5	7.2	7.9	7.5	7.5	7.5	0-6	7.4	7.0	6.8	6.4	6.9	
-12	7.6	7.5	7.7	7.6	7.7	7.6	-12	7.5	7.6	6.9	6.6	7.1	
-24	7.8	7.4	7.5	7.7	7.3	7.5	-24	7.0	7.0	7.0	6.9	7.0	
-36	7.7	7.2	7.3	7.7	7.9	7.5	-36	6.8	7.0	7.1	6.8	6.9	
-48	7.0	7.6	7.9	7.6	8.3	7.7	-48	7.3	7.0	6.7	6.7	7.0	
-60	5.4	7.9	8.3	7.6	8.3	6.8	-60	6.9	6.6	6.9	6.3	6.6	



Table X (Cont'd)  
 Knife River Coal Co. - Gascoyne Mine  
 Particle Size Analyses

sample	Depth (ft.)	Size Class and Particle Diameter (mm) - %								Texture
		vcos 2-1	cos 1-.5	ms -.25	fs -.1	vfs -.05	sand (total) 2-.05	silt -.002	clay <.002	
G10	3-5	0	0.1	0.1	0.6	52.6	53.8	40.4	5.8	very fine sandy loam
	5-7	0.1	0.2	0	0.5	27.5	28.7	64.6	6.7	silt loam
G11	0-.6	1.3	2.0	3.1	27.7	19.8	54.6	29.5	15.9	fine sandy loam
	.6-1.7	1.2	0.9	2.2	19.2	13.5	37.6	31.6	30.8	clay loam
	1.7-3	0.2	0.7	0.8	6.4	12.1	20.0	53.9	26.1	silt loam
	3-4	0	0.1	0.1	0.3	0.6	1.4	69.0	29.6	silty clay loam
	4-6	0.2	0.1	0.1	0.4	10.1	11.3	72.1	16.6	silt loam
	6-8	0	0	0.1	1.5	12.4	14.2	68.1	17.7	silt loam

G10: From an old high wall NW of workshop area likely in SW 27-131-99.

G11: From south bank of EW roadway that crossed (1973) mine pit NW of shop area, probably NE, NW 1/4, 34-131-99.

For other data on these samples see Table X, Lab Data: Knife River Coal Company Gascoyne.

Sampled - 8/8/73  
 F.W. Schroer - NDSU, Soils Dept.

Table XI  
 Lab Data: NORTH AMERICAN COAL COMPANY - ZAP - RECLAIMED AREAS  
 (sampled around ARS 1973 plots & in field seeded 1973 east of plots)

Sample	Depth (in.)	Color (dry)	Tex.	Con. (dry)	B.D.	Lime (Qual.)	pH (paste)	ECE25 mmhos	Saturation Extract Soluble Ions (meq./litre)							SAR	Sat'n. %	Ext'd. N(as NH <sub>4</sub> ) lbs/A/6"	Soil Test Data lbs/A/6"			
									CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na				K	N	P	K
NR-1	0-6	10YR 6/1	sic	eh		e	8.4	3.0	0.6	4.9	0.3	26.3	0.8	0.8	30.0	0.5	33.7	112	48	36	9	580
	-12	10YR 6/3	sic	eh		e&es	8.4	2.8	0.6	5.5	0.2	23.1	0.8	0.6	27.6	0.4	33.2	102	48	24	6	500
	-24	2.5Y 5/1-6/2	sic	eh		e&es	8.4	3.5	0.6	4.4	0.3	30.4	1.2	1.2	32.8	0.5	30.1	99	60	13	6	470
	-36	2.5Y 6/1-6/2	sic	eh		e	8.2	6.6	-	3.6	0.3	74.9	11.4	7.5	59.0	0.9	19.2	89	46	26	5	430
	-48	2.5Y 5/1-5/2	c	eh		e	8.3	3.6	0.4	5.1	0.3	32.3	1.8	1.8	34.0	0.5	25.4	95	46	28	7	460
	-60	2.5Y 6/1	c	eh		e	8.5	2.8	0.6	5.6	0.3	23.5	0.8	0.6	27.6	0.4	33.2	107	68	14	5	470
NR-2	0-6	2.5Y 6/1-6/2	c	eh		e	8.1	4.7	-	4.5	0.3	47.8	3.4	3.3	45.2	0.7	24.7	90	40	76	12	510
	-12	2.5Y 6/1-6/2	sic	eh		e	8.0	4.3	-	4.6	0.3	42.5	2.8	2.8	41.2	0.6	24.7	96	38	75	10	500
	-24	2.5Y 5/1	c	eh		e	8.0	5.5	-	3.9	0.3	60.6	5.2	5.6	53.2	0.8	22.9	83	34	84	10	410
	-36	2.5Y 5/1	c	eh		e	8.0	4.8	-	5.2	0.3	48.6	3.4	3.6	46.4	0.7	24.8	92	36	85	14	410
	-48	2.5Y 6/1	c	h		e	7.8	5.1	-	5.2	0.4	58.5	4.8	5.4	53.2	0.7	23.6	84	34	88	13	450
	-60	2.5Y 6/1	c	eh		e	7.9	5.5	-	5.0	0.6	56.0	4.0	4.4	52.4	0.8	25.7	81	34	80	9	450
NR-3	0-6	2.5Y 5/1	sic	vh	1.34	e	8.0	5.9	-	4.4	0.4	66.6	6.4	6.0	58.0	1.0	23.4	93	28	104	17	520
	-12	2.5Y 6/1	sic	eh	1.51	e	8.2	4.4	-	4.9	0.1	42.5	2.4	2.4	42.0	0.7	27.3	90	28	70	7	490
	-24	2.5Y 5/1-6/1	c	vh	1.39	e	7.8	4.0	0.6	6.8	0.3	36.7	1.8	1.6	40.4	0.6	31.1	122	28	56	10	530
	-36	2.5Y 5/1-6/2	sic	eh	1.25	e	7.8	4.3	-	7.0	0.2	39.4	2.0	2.0	42.0	0.6	29.8	121	28	56	18	540
	-48	2.5Y 6/1	c	eh	1.19	e	7.4	7.5	0.6	3.4	0.2	96.0	16.5	9.3	73.0	1.4	20.3	109	28	58	13	570
	-60	2.5Y 5/1-6/1	c	-	1.18	e	7.7	4.3	-	7.6	0.2	41.0	2.4	2.1	43.6	0.7	29.1	117	30	54	10	510
NR-4	0-12	2.5Y 6/1	sic	eh		e	7.7	5.4	-	4.7	0.4	60.0	4.6	6.4	53.2	0.9	22.7	99	34	64	10	470
	-24	2.5Y 6/1	sic	eh		e	7.7	4.4	0.4	5.1	0.4	44.3	2.6	3.3	43.6	0.7	25.5	106	32	71	7	500
	-36	2.5Y 6/1	sic	eh		e	7.9	4.0	0.4	5.1	0.4	41.1	2.0	2.4	42.0	0.6	28.4	106	34	74	7	490
	-48	2.5Y 6/1	sic	eh		e	8.0	3.8	0.4	4.8	0.5	37.5	1.6	2.2	38.8	0.6	28.3	107	28	66	8	410
	-60	2.5Y 6/1	sic	eh		e	8.0	3.7	0.8	6.5	0.4	33.4	0.6	1.2	38.8	0.5	41.3	107	32	42	6	420
NR-5	0-12	2.5Y 5/1	c	eh	1.33	e	7.9	3.6	-	7.1	0.2	32.4	1.0	1.4	36.8	0.5	33.8	113	28	57	7	440
	-24	2.5Y 6/1	c	eh	1.26	e	7.9	3.8	-	7.5	0.3	35.3	1.2	1.7	39.6	0.6	33.0	109	28	56	7	440
	-36	2.5Y 6/1-7/1	sic	eh	1.23	e-tr	7.8	4.3	0.6	5.2	0.3	40.5	1.8	2.2	42.0	0.6	29.8	98	24	64	6	420
	-48	2.5Y 5/1	c	eh	1.24	e	7.9	3.7	0.6	6.0	0.3	33.7	1.2	1.4	37.5	0.5	32.9	109	28	42	6	420
	-60	2.5Y 6/1	sic	eh	1.25	e	7.9	3.7	0.4	5.8	0.2	44.1	9.5	1.5	39.0	0.5	16.7	111	30	50	6	420

Note: NR1 to 5 around ARS plots.

Table XI - continued

Sample	Depth (in.)	Color (dry)	Con. Tex. (dry)	B.D.	Lime (Qual.)	pH (paste)	ECE25 mmhos	Saturation Extract Soluble Ions (meq./litre)								SAR	Sat'n. %	Soil Test Data lbs/A/6'			
								CO3	HCO3	Cl	SO4	Ca	Mg	Na	K			Ext'd. N(as NH4) lbs/A/6'	N as (NO3)	P	K
NR-6	0-12	2.5Y 5/1	sic eh		e&es	7.7	6.5	2.6	0.4	85.0	13.0	13.1	61.0	0.9	16.9	108	35	18	8	360	
	-24	2.5Y 5/2	c eh		e	7.6	6.0	4.3	0.5	52.5	10.0	10.5	36.0	0.8	11.2	96	42	19	11	370	
	-35	2.5Y 5/1-5/3	sic vh		e	7.1	6.9	5.3	0.5	93.5	19.5	20.0	59.0	0.8	13.3	82	38	8	27	350	
	-48	2.5Y 6/1-5/2	sic vh		e	7.8	5.5	2.7	0.5	73.0	12.0	17.3	46.0	0.9	12.0	94	34	9	4	350	
	-60	2.5Y 6/1-5/3	sic vh		e	7.2	6.8	6.4	0.7	93.7	23.0	28.0	49.0	0.8	9.7	74	44	11	37	300	
NR-7	0-12	2.5Y 5/2-6/2	c eh	1.45	e	7.9	6.0	2.5	0.5	76.3	9.5	11.0	58.0	0.8	18.1	121	26	17	6	390	
	-24	2.5Y 6/1-6/3	sic vh	1.49	e	8.0	6.2	1.8	0.5	82.7	11.5	14.5	58.4	0.6	16.2	124	20	12	3	300	
	-35	2.5Y 6/2	sic vh	1.34	e&es	7.9	6.6	1.8	0.5	86.8	12.5	18.0	58.0	0.6	14.9	112	16	12	2	260	
	-48	2.5Y 4/3-6/2	cl h-vh	1.25	o&es	7.6	7.1	2.6	0.7	96.4	17.0	20.0	62.0	0.7	14.4	98	18	12	6	290	
	-60	2.5Y 6/1-6/2	sic1 -	1.18	es	7.9	6.1	2.2	0.4	81.5	12.0	14.5	57.0	0.6	15.7	115	18	15	3	300	
NR-8	0-12	2.5Y 6/1-6/2	sic eh		o&es	8.0	2.4	6.3	0.4	19.4	2.8	2.8	19.8	0.7	11.9	87	52	21	7	470	
	-24	2.5Y 6/1-6/2	c eh		e&es	7.9	2.0	5.0	0.4	15.1	1.5	1.5	17.0	0.5	13.9	98	58	21	7	430	
	-36	2.5Y 6/1-6/2	c eh		e&es	7.8	2.3	5.0	0.4	19.0	2.3	2.3	19.2	0.6	12.7	89	54	23	6	420	
	-48	2.5Y 6/1-6/2	sic eh		e	7.4	2.6	5.8	0.1	22.4	3.8	3.6	20.2	0.7	10.5	84	52	26	7	420	
	-60	2.5Y 5/2-6/2	c eh		e&es	7.7	2.4	5.8	0.3	19.2	3.0	3.1	18.5	0.7	10.6	83	54	25	7	430	
NR-9	0-12	2.5Y 6/2	sic eh	1.36	e&es	7.9	2.4	6.0	0.2	19.2	2.0	2.6	20.2	0.6	13.4	90	50	20	8	470	
	-24	2.5Y 6/1	c eh	1.23	e	7.8	3.1	5.0	0.2	28.2	3.1	3.9	25.6	0.8	13.7	93	38	25	7	420	
	-35	2.5Y 5/1	c eh	1.25	e&es	7.9	2.9	5.4	0.2	25.1	2.3	3.2	24.6	0.6	14.9	95	42	23	6	450	
	-48	2.5Y 6/1-5/3	sic eh	1.21	e	7.5	5.0	3.4	0.3	63.4	14.8	16.2	35.2	0.9	9.0	85	38	14	7	410	
	-60	2.5Y 6/1-6/4	sic vh-h	1.11	e	7.3	6.0	2.3	0.3	85.3	24.8	24.8	37.6	0.7	7.6	77	18	11	12	300	
NR-10	0-12	2.5Y 6/1-6/2	c eh		e&es	7.4	5.7	4.2	0.5	70.1	14.8	15.4	43.6	1.0	11.2	87	56	22	23	400	
	-24	2.5Y 6/1-6/2	c eh		e	7.6	4.6	4.2	0.5	51.2	8.0	9.4	37.6	0.9	12.8	90	60	27	9	410	
	-35	2.5Y 6/1-5/2	sic1 eh		e	7.8	4.0	5.0	0.4	32.1	4.0	5.0	27.7	0.8	13.1	88	56	18	6	430	
	-48	2.5Y 6/1-5/2	sic eh		e	7.2	6.4	4.2	0.4	81.3	19.2	17.6	48.0	1.1	11.2	78	42	25	11	390	
	-60	2.5Y 5/2	sic h		e&es	7.1	6.4	4.8	0.5	84.7	20.4	20.4	48.0	1.2	10.6	80	74	29	15	380	

NOTE: NR6 to 10 in 1973 field east of plots.

8/8/73

Table XI - continued  
 NORTH AMERICAN COAL COMPANY - ZAP - RECLAIMED AREAS  
 Sec. 33-144-89

ECE										ECE									
	1	2	3	4	5	Ex	Mx	SD	RSD		6	7	8	9	10	Ex	Mx	SD	RSD
0-6	3.0	4.7	5.9	5.4	3.6	22.6	4.5	1.2	27	0-12	6.5	6.0	2.4	2.4	5.7	23.0	4.6	2.028	44
-12	2.8	4.3	4.4	5.4	3.6	20.5	4.1	0.96	23	-24	6.0	6.2	2.0	3.1	4.6	21.9	4.4	1.823	41
-24	3.5	5.5	4.0	4.4	3.8	21.2	4.2	0.776	18	-36	6.9	6.6	2.3	2.0	4.0	22.7	4.5	2.110	47
-36	6.6	4.8	4.3	4.0	4.3	24.0	4.8	1.046	22	-48	5.5	7.1	2.6	5.0	6.4	26.6	5.3	1.722	32
-48	3.6	5.1	7.5	3.8	3.7	23.7	4.7	1.659	35	-60	6.8	6.1	2.4	6.0	6.4	27.7	5.54	1.783	32
-60	2.8	5.5	4.3	3.7	3.7	20.0	4.0	0.995	25										
SAR										SAR									
	1	2	3	4	5	Ex	Mx	SD	RSD		6	7	8	9	10	Ex	Mx	SD	RSD
0-6	33.7	24.7	23.4	22.7	33.8	138.3	27.7	5.606	20	0-12	16.9	18.1	11.9	13.4	11.2	71.5	14.3	3.057	21
-12	33.2	24.7	27.3	22.7	33.8	141.7	28.3	10.177	36	-24	11.2	16.2	13.9	13.7	12.8	67.8	13.6	1.820	13
-24	30.1	22.9	31.1	25.5	33.0	142.6	28.5	4.181	15	-36	13.3	14.9	12.7	14.9	13.1	68.9	13.8	1.045	8
-36	19.2	24.8	29.8	28.4	29.8	132.0	26.4	4.514	17	-48	12.0	14.4	10.5	9.0	11.2	57.1	11.4	1.998	18
-48	25.4	23.6	20.3	28.3	32.0	130.5	26.1	4.782	18	-60	9.7	15.7	10.6	7.6	10.6	54.2	10.8	2.980	28
-60	33.2	25.7	29.1	41.3	16.7	146.0	29.2	9.096	31										
pH										pH									
	1	2	3	4	5	Median					6	7	8	9	10	Median			
0-6	8.4	8.1	8.0	7.7	7.9	8.0				0-12	7.7	7.9	8.0	7.9	7.4	7.8			
-12	8.4	8.0	8.2	7.7	7.9	8.0				-24	7.6	8.0	7.9	7.8	7.6	7.8			
-24	8.4	8.0	7.8	7.7	7.9	8.0				-36	7.1	7.9	7.8	7.9	7.8	7.5			
-36	8.2	8.0	7.8	7.9	7.8	8.0				-48	7.8	7.6	7.4	7.5	7.2	7.5			
-48	8.3	7.8	7.4	8.0	7.9	7.9				-60	7.2	7.9	7.7	7.3	7.1	7.5			
-60	8.5	7.9	7.7	8.0	7.9	8.1													



Table XIII  
 Lab Data: Baukol Noonan - Reclaimed area in Sec. 31-142-83.  
 (1.5 inch cores to 60" depth)

Sampled 10/30/73, Soils Dept., N.  
 Field west of SCS grass rows.

Sample	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime B.D. (qual.)	pH (paste)	ECE25	Saturation Extract Soluble Ions (meq./litre)							SAR	Sat'n. %	Soil Test Data			
									HCO3	Cl	SO4	Ca	Mg	Na	K			lbs/A-5" (NH4)	lbs/A (NO3)	P	K
BR1	0-4	A&B	10YR 4/1	l	1.17		7.5	1.0	3.2	0.7	6.7	5.6	3.2	1.4	0.4	0.7	48				
	4-12	sis	10YR 6/1	cl	h 1.62	es	7.6	3.1	2.7	0.5	37.0	16.8	17.6	4.6	1.2	1.1	64	52	18	5	430
	-24	sis	10YR 6/1	sic	h 1.41	es	7.7	2.7	3.2	0.4	31.5	14.8	14.8	4.2	1.3	1.1	68	72	5	4	390
	-36	sis	10YR 6/1	sic	h 1.30	es	7.7	2.6	3.6	0.6	29.5	14.0	14.4	4.0	1.3	1.1	71	80	<5	4	380
	-48	sis	10YR 6/1-6/0	sicl	h 1.17	e&es	7.8	2.7	3.4	0.5	38.8	15.2	14.6	3.8	1.3	1.0	73	76	<5	5	360
	-60	sis	10YR 6/1	sicl	h 1.02	e	7.7	2.5	3.4	0.5	28.3	13.0	14.0	4.0	1.2	1.1	70	66	<5	4	350
BR2	0-6	A&B	10YR 4/1	sl	h 1.67		7.5	0.8	5.0	1.6	2.8	5.2	3.0	0.8	0.4	0.4	50	24		10	370
	6-12	mx	mx-10YR 4/1-6/3	eh	1.29	e	7.5	2.3	2.0	0.5	26.0	12.4	12.8	2.6	0.7	0.7	56				
	-24	ss&sis	mx-10YR 6/1-6/3	sil	h&vh 1.54	e&es	7.5	2.1	2.3	0.7	22.9	12.0	10.8	2.8	0.3	0.8	61	14	6	8	350
	-36	ss&sis	2.5Y 6/1-10YR 6/2	sil	h&vh 1.36	e	7.7	1.8	2.8	0.4	18.4	8.8	9.4	2.2	1.2	0.7	60	18	7	5	450
	-48	ss	10YR 6/1	sil	h 1.44	e	7.6	2.5	2.7	0.4	32.6	15.8	16.0	2.8	1.1	0.7	58	16	5	5	370
	-60	sis&ss	10YR 6/1-6/3	sicl	eh&h	e	7.7	2.4	2.8	0.4	28.3	13.4	14.8	2.2	1.1	0.6	65	32			4
BR3	0-6	A&sis	10YR 3/2-6/1		sh&vh 1.20	e&es	7.6	1.3	3.3	0.6	10.2	8.0	4.4	1.4	0.3	0.6	45				
	6-12	sis	10YR 6/1-7/2	cl	eh 1.51	e	7.5	1.6	2.4	1.1	15.2	9.7	6.3	2.4	0.3	0.9	58	10		11	300
	-24	sis	10YR 6/1-6/3	sicl	vh&eh 1.52	e&es	7.6	1.6	2.0	0.4	15.6	8.1	7.3	2.1	0.5	0.8	66	14	6	8	340
	-36	ss&sis	10YR 6/1-6/3	sicl	h&eh 1.40	e	7.4	2.8	1.0	0.4	35.3	15.6	17.2	2.8	1.1	0.7	63	18	5	6	380
	-48	ss&sis	10YR 6/2	sicl	eh 1.23	e	7.5	2.8	1.8	0.1	34.9	16.2	16.8	2.8	1.0	0.7	60	16	5	7	420
	-60		10YR 6/1-6/2	sicl	vh 1.14	e&es	7.3	2.9	2.4	0.4	34.4	16.0	17.4	2.8	1.0	0.7	63	20	5	5	400
BR4	0-6	A&sis	10YR 4/1-6/2	l	h&vh 1.08	e	7.5	0.6	2.5	0.8	2.9	3.1	2.0	0.8	0.3	0.5	55	12	5	9	360
	6-12	ss	10YR+2.5Y 6/2	l	vh 1.50	e	7.6	1.9	1.7	0.5	19.4	9.3	9.0	2.9	0.4	1.0	61	10	<5	7	290
	-24	ss&sis	10YR+2.5Y 6/2	sicl	h&eh 1.43	e&o	7.7	2.5	2.0	0.5	32.7	12.0	16.8	5.4	1.0	1.4	66	20	<5	5	440
	-36	ss&sis	10YR 6/2	sil	h&eh 1.37	e	7.7	3.0	1.5	0.4	37.8	14.8	19.0	5.0	0.9	1.2	60	12	<5	4	340
	-48	ss&sis	10YR 6/2	sicl	vh 1.37	es	7.6	3.0	1.7	0.4	36.7	16.0	18.0	3.8	1.0	0.9	64	14	<5	5	400
	-60	sis	mx-10YR 6/1-6/3	sicl	eh 1.13	e	7.7	1.9	1.3	0.5	20.2	7.2	10.4	3.6	0.8	1.2	68	18	6	4	410
BR5	0-6	ss	10YR 6/2-4/1	l	h 1.22	es	7.0	1.8	4.2	1.2	14.7	8.2	8.2	3.0	0.7	1.0	51	32		72	380
	6-12	ss	10YR 6/2-7/2	sil	h 1.43	es	7.5	3.6	1.5	1.2	45.8	18.0	24.2	5.6	0.7	1.2	56	18	6	7	300
	-24	ss	10YR 6/2	vfs1	h 1.46	e	7.4	3.5	1.5	0.4	45.2	18.4	24.2	3.8	0.7	0.8	53	8	<5	6	290
	-36	ss	10YR 6/2	sil	h&vh 1.31	es	7.6	3.0	1.6	1.0	37.7	15.2	19.2	5.0	0.9	1.2	58	14	<5	4	340
	-48	ss&sis	10YR 6/2	sil	h&eh 1.13	e&es	7.6	2.8	1.6	0.4	34.4	13.6	18.0	4.0	0.8	1.0	56	18	7	4	360
	-60	ss	10YR 6/1	sil	h&vh 1.37	e&es	7.5	3.4	1.6	0.7	45.0	17.6	23.8	5.0	0.9	1.1	58	16	11	7	350

Table XIII - continued  
 Baukol Noonan - Reclaimed area in Sec. 31-142-83.  
 (1.5 inch cores to 60" depth)

Sampled 10/30/73, Soils Dept., ND  
 Field west of SCS grass rows.

Sample	Depth (in.)	Mat'l.	Color (dry)	Tex.	Con. (dry)	Lime B.D. (qual.)	pH (paste)	Saturation Extract Soluble Ions										SAR	Soil Test Data			
								ECE25	HC03	Cl	(meq./litre)								Sat'n. %	lbs/A-6"		lbs/A
											S04	Ca	Mg	Na	K		(NH4)	(NO3)	P	K		
BR6	0-12	sis	10YR 6/2-Mo.	cl	h	1.33	e&es	7.5	2.0	1.7	0.4	23.0	10.6	11.0	3.0	0.5	0.9	57	8	<5	8	350
	-24	till	10YR 6/1-6/2	cl	h	1.37	e	7.4	2.6	2.2	0.3	32.8	14.8	14.8	5.2	0.5	1.4	57	6	<5	9	300
	-36	till&sis	10YR 6/2-6/1	sicl	h&eh	1.35	e-o	7.3	3.0	2.3	0.4	37.6	16.8	19.6	3.0	0.9	0.7	59	10	<5	5	360
	-48	ss	10YR 6/1-6/2	sil	h&sh	1.21		7.5	3.2	0.8	0.4	43.0	19.0	21.4	3.2	0.6	0.7	54	6	<5	5	260
	-60	ss	10YR 6/1-6/2	sil	h	1.05		7.5	4.2	1.3	0.5	67.7	28.0	34.4	6.4	0.7	1.2	54	6	<5	4	270
BR7	0-9	A	10YR 3/1	fsl	h	1.19	o	7.3	1.0	3.8	0.8	6.8	7.0	3.4	0.7	0.3	0.3	53	6	10	13	390
	12-24	ss&sis	2.5Y 6/2-6/1	l	h&eh	1.62	e	7.4	1.6	2.7	0.4	15.0	7.6	7.8	2.2	0.5	0.8	60	10	<5	4	350
	-36	ss&sis	2.5Y 6/2-6/4	cl	h&eh	1.34	e&es	7.3	2.6	2.4	0.4	31.4	14.0	16.4	3.2	0.6	0.8	60	8	8	5	340
	-48	ss&till	10YR 6/2	sicl	h	1.47	e	7.6	1.7	1.5	0.5	17.4	7.0	8.8	3.2	0.4	1.1	60	8	<5	3	320
	-60	ss&till	10YR 6/2	sil	h	1.35	es	7.7	1.3	1.7	0.4	12.8	5.2	6.4	2.9	0.4	1.2	60	8	<5	4	350
BR8	0-12	sis	10YR 6/3	sicl	vh&eh	1.60	e&es	7.6	1.0	2.0	0.7	8.0	5.8	3.5	1.2	0.2	0.6	59	6	<5	5	290
	-24	ss	10YR 6/1	sil	vh&h	1.53	e	7.7	1.3	2.1	0.4	11.8	7.2	4.6	2.0	0.5	0.8	60	10	<5	7	350
	-36	ss	10YR 6/1	sicl	eh	1.53	e	7.5	4.4	1.6	0.8	61.3	23.5	30.5	9.0	0.7	1.7	68	8	8	17	400
	-48	sis	2.5Y 6/1-6/2	sic	eh	1.36	e	7.4	5.1	1.3	1.1	84.9	24.0	47.0	15.5	0.8	2.6	74	12	9	24	430
	-60	sis	2.5Y 6/1-6/2	sic	h&eh	1.28		7.4	5.1	2.0	1.4	77.4	23.0	43.0	14.0	0.8	2.4	70	10	8	20	430
BR9	0-6	3"of A	10YR 4/1-6/2	fsl	h&vh	1.20	e	7.3	1.3	4.2	0.8	9.6	7.1	5.8	1.4	0.3	0.6	54	22	<5	9	320
	-12	ss	10YR 6/2, mo.	fsl	h	1.41	e&es	7.6	1.3	3.8	0.5	11.2	6.4	6.8	1.8	0.5	0.7	54	10	<5	5	300
	-24	ss	2.5Y 7/2, mo.	l	vh	1.49	e&es	7.8	1.0	2.3	0.4	9.6	4.1	5.7	2.2	0.3	1.0	56	4	<5	5	290
	-36	ss or till	2.5Y 6/2	sil	h&eh	1.30	e&es	7.4	2.7	2.0	0.4	34.0	16.2	16.2	3.4	0.6	0.9	60	8	<5	6	300
	-48	ss	2.5Y 6/1	sil	vh	1.28	e	7.5	3.2	1.8	0.5	44.3	17.0	23.8	5.0	0.8	1.1	55	10	<5	6	330
	-60	ss	2.5Y 6/1	vfsl	vh	1.40	e	7.6	2.6	1.7	0.5	31.9	12.4	17.2	4.0	0.5	1.0	50	6	<5	2	220
BR10	0-6	A&sis	10YR 4/1-6/2	fsl	sh&vh	1.30	e	7.4	3.4	3.5	1.0	52.5	32.0	20.0	4.4	0.6	0.9	51	10	<5	19	360
	-12	ss	2.5Y 6/2, mo.	vfsl	vh	1.58	e	7.5	4.4	1.5	0.5	64.5	20.5	36.0	9.5	0.5	1.8	53	14	<5	22	230
	-24	sis	5Y 6/1-6/2, mo.	sil	eh	1.54	e	7.7	3.1	1.8	0.4	39.8	15.0	20.2	6.0	0.8	1.4	71	20	<5	3	370
	-36	sis	5Y 6/1-6/2, mo.	sicl	eh	1.43	e	7.7	3.0	2.0	0.4	38.8	15.6	20.2	4.4	1.0	1.0	75	8	<5	3	400
	-48	sis	5Y 6/1-6/2, mo.	sil	eh	1.25	e	7.5	4.0	1.5	0.5	59.7	22.5	31.0	7.5	0.7	1.5	70	8	7	3	320
	-60	mx	10YR 3/1-6/2	sicl	s-eh	0.98	e	6.6	5.0	10.5	1.6	64.5	24.5	41.0	10.5	0.6	1.8	67	18	26	34	330

Table XIII - continued  
 Baukol Noonan - Reclaimed. 10/30/73.

BR	ECE										Sx	Mx	O	RSD %
	1	2	3	4	5	6	7	8	9	10				
0-6	1.0	0.8	1.3	0.6	1.8	2.0	1.0	1.0	1.3	3.4	14.2	1.4	0.818	58
6-12	3.1	2.3	1.6	1.9	3.6	2.0	1.0	1.0	1.3	4.4	22.2	2.2	1.145	52
-24	2.7	2.1	1.6	2.5	3.5	2.6	1.6	1.3	1.0	3.1	22.0	2.2	0.815	37
-36	2.6	1.8	2.8	3.0	3.0	3.0	2.6	4.4	2.7	3.0	28.9	2.9	0.644	22
-48	2.7	2.5	2.8	3.0	2.8	3.2	1.7	5.1	3.2	4.0	31.0	3.1	0.913	29
-60	2.5	2.4	2.9	1.9	3.4	4.2	1.3	5.1	2.6	5.0	31.3	3.1	1.28	41
	SAR										Sx	Mx	O	RSD %
	1	2	3	4	5	6	7	8	9	10				
0-6	0.7	0.4	0.6	0.5	1.0	0.9	0.3	0.6	0.6	0.9	6.5	0.6	0.227	38
6-12	1.1	0.7	0.9	1.0	1.2	0.9	0.3	0.6	0.7	1.8	9.2	0.9	0.405	45
-24	1.1	0.8	0.8	1.4	0.8	1.4	0.8	0.8	1.0	1.4	10.3	1.0	0.275	28
-36	1.1	0.7	0.7	1.2	1.2	0.7	0.8	1.7	0.9	1.0	10.0	1.0	0.316	32
-48	1.0	0.7	0.7	0.9	1.0	0.7	1.1	2.6	1.1	1.5	11.3	1.1	0.572	44
-60	1.1	0.6	0.7	1.2	1.1	1.2	1.2	2.4	1.0	1.8	12.3	1.2	0.523	43
	pH										Median			
	1	2	3	4	5	6	7	8	9	10				
0-6	7.5	7.5	7.6	7.5	7.0	7.5	7.3	7.6	7.3	7.4	7.3			
6-12	7.6	7.5	7.5	7.6	7.5	7.5	7.3	7.6	7.6	7.5	7.4			
-24	7.7	7.5	7.6	7.7	7.4	7.4	7.4	7.7	7.8	7.7	7.6			
-36	7.7	7.7	7.4	7.7	7.6	7.3	7.3	7.5	7.4	7.7	7.5			
-48	7.8	7.6	7.5	7.6	7.6	7.5	7.6	7.4	7.5	7.5	7.6			
-60	7.7	7.7	7.3	7.7	7.5	7.5	7.7	7.4	7.6	6.6	7.5			



Table XIV  
 Lab Data - Baukol Noonan Coal Co. - Center, ND  
 High walls near center of Sec 31-142-83

NDSU - Soils Dept., Sampled 10/29/74

Sample	Location	Depth (ft.)	Material	Color (moist)	Texture	Con. (moist)	Lime (qual)	Particl size (mm) %		
								2-.05 sand	.05-.002 silt	<.002 clay
B1 Flaxton fine sandy loam area	125' south of metal building near center 31-142-83	0-3	sands	2.5Y 3/2	sl	vfr	o	79.4	10.0	10.6
		3-7	FU	2.5Y 5/3	sil	fr	e			
		7-12	FU	2.5Y 5/2+4/2	sil	fi	e			
		12-17	FU	2.5Y 5/2+4/2	sil	efi	e	25.4	52.4	22.2
		17-22	FU	2.5Y 4/2	sil	efi	e			
		22-27	FU	5Y 5/2+5/3	l	efi	tr	36.3	42.7	21.0
Blb	probed sample, 200' W of B1, on a shale surface	0-2.5	FU	5Y 4/1 to 4/3	sic	vfi	o			
		2.5-5	fine tex./	5Y 4/1, 6/2+5/4	c	efi	o	0.7	27.9	71.4
		5-10		5Y 4/1+5/2	sicl	efi	o			
B2 Flaxton sandy loam	hilltop 0.25 miles west of B1	0-2.5	sands/	10YR 3/2	fsl	vfr	o	70.2	17.6	12.2
		2.5-5	till	10YR 4/2 to 7/2	l	fr	o-ev	44.3	30.8	24.9
		5-10	FU-sis	10YR 5/3	sil	efi	es			
		10-15	FU-sis	5Y 5/3	sil	efi	es	10.4	68.3	21.3
		15-17	rocky	(not sampled)						
	17-22	sis	5Y 4/2 to 4/4	sicl	efi	o				
	22-30	lig.								
	100' south of B2 on step wall below first coal	30-36	sis	5Y 5/2	sil	fi	e	13.5	62.8	23.7
		36-41	sis+s	5Y 4/2	sil	fi	e			
		41-46	FU	5Y 4/2	sicl	vfi	e			
46-51		FU	5Y 4/2+5/1	sil	efi	e				
51-55	FU	5Y 4/1	l	efi	e	34.4	43.5	22.1		
B2g	west of B2, between 2 seams, greyer colors than at B2	25-27	lig.							
		27-33	sis+s	5Y 4/1+4/3	c	efi	o	1.2	33.2	65.6
		33-40	sis+s	(not sampled)						
		40-46	sis+s	5Y 4/1	sicl	efi	e			
		46-50	sis+s	5GY 4/1	l	efi	e	36.3	42.3	21.4
		50-55	sis+s	5Y 4/1	sil	vfi	e			
		55-60	sis+s	5Y 4/1	sicl+sil	vfi	es	20.9	57.3	21.8
		60-65	sis+s	5Y 4/1	sicl+sil	vfi	e			
65-?	lig.									

Note: Blb samples and upper 5 to 7 feet of B1 and B2 sampled with core sampler; others from high walls.

Table XIV  
 Lab Data - Baukol Noonan Coal Co. - Center, ND  
 High walls near center of Sec 31-142-82

NDSU, Soils Department

Sample	Depth (ft.)	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE mmho/cm	Sat. %	SAR	Saturation Extract Soluble Ions (meq./L)						
							CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
B1	0-3	---	7.4	0.40	25	0.7	2.3	<.1	2.2	2.2	1.4	0.9	0.1
	3-7	7.8	7.9	0.43	56	2.2	2.5	0.1	2.2	1.0	1.3	2.3	0.1
	7-12	14.7	7.9	0.66	47	2.2	2.4	0.3	4.0	1.6	2.1	2.9	0.2
	12-17	8.4	7.8	1.31	55	1.6	1.7	0.3	12.7	4.6	6.0	3.8	0.3
	17-22	7.6	7.7	3.0	51	1.0	1.0	<.1	42.3	16.7	21.7	4.6	0.3
	22-27	6.5	7.3	3.6	60	0.9	1.9	<.1	53.5	22.0	28.0	4.6	0.8
	B1,b	0-2.5		6.7	6.2	84	3.5	1.0	1.1	101.4	21.5	59.0	22.5
2.5-5			6.4	5.7	81	2.7	0.9	0.6	92.6	23.5	53.0	16.6	1.1
5-10			7.2	5.5	68	2.5	2.1	0.4	88.0	24.5	50.0	15.0	1.0
B2	0-2.5	---	6.5	0.24	28	0.4	1.4	<.1	1.4	1.4	0.9	0.4	0.1
	2.5-5	5.5	7.6	0.48	43	1.5	3.7	<.1	1.9	1.4	2.2	2.0	0.1
	5-10	12.4	8.0	0.90	55	2.9	2.4	<.1	7.3	1.6	3.5	4.6	0.1
	10-15	10.6	7.6	3.6	62	2.9	1.5	0.1	48.8	16.4	21.4	12.5	0.3
	15-17	- (silicious material, not sampled)											
	17-22		7.4	2.7	75	1.8	2.7	0.2	32.1	10.8	17.0	6.6	0.6
	22-30	- (lignite, not sampled)											
	30-36	7.6	7.9	0.93	59	0.9	1.7	0.1	7.5	2.7	4.7	1.6	0.3
	36-41	8.1	7.9	0.39	52	1.1	2.1	0.1	2.2	1.2	1.7	1.3	0.2
	41-46	8.0	7.8	0.34	53	0.9	2.2	0.2	1.9	1.3	1.5	1.1	0.2
	46-51	8.8	7.8	0.60	54	0.6	2.5	0.3	5.1	2.9	3.2	1.1	0.4
	51-55	5.9	7.9	1.35	54	0.4	2.3	0.1	14.5	7.5	7.5	1.2	0.6
		(lignite, not sampled)											
B2g	25-27	- (lignite, not sampled)											
	27-33		8.0	2.5	70	1.3	2.1	0.3	30.8	11.6	15.4	4.7	1.3
	33-40	- (not sampled)											
	40-46	8.4	7.8	2.2	63	1.5	2.7	0.3	26.3	11.4	11.6	5.0	1.1
	46-50	7.7	7.9	1.9	52	1.6	2.6	0.4	19.3	8.2	8.4	4.7	0.8
	50-55	8.2	7.8	2.3	54	1.8	2.3	0.4	26.6	11.0	11.2	5.9	1.0
	55-60	8.8	7.9	2.5	57	1.9	2.4	0.4	29.6	12.2	12.4	6.5	1.0
	60-65	6.9	7.8	2.4	57	1.6	2.5	0.3	26.8	12.0	10.9	5.4	1.0
	65-?	(lignite, not sampled)											

Sampled 9/24/75  
NDSU Soils Dept.

Table XV  
Husky Mine-Dickinson, ND  
Surface Core and High Wall Samples

Sample	Depth feet	Material	Color (Moist)	Tex.	Cons. (Moist)	Bulk Dens.	Lime (qual.)	pH (paste)	ECE mmho.	Saturation Extract Soluble Ions (meq./litre)								Sat'n %	CaCO <sub>3</sub> Eq.%
										CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K		
Hy #1	0-1.5	A + fsl	10YR 3/2	fsl	vfr	1.48	--	7.0	0.68	3.9	<.1	3.6	4.4	1.8	0.4	0.85	0.2	31	
Sec. 17-139-95	1.5-3	B	10YR 3/3	fsl	vfr	1.45	--	7.2	0.45	3.0	0.1	1.9	2.7	1.4	0.3	0.65	0.2	26	
30'N, 210'E	3-4.2	C	10YR 3/3	lfs	l	1.48	--	7.4	0.65	4.1	<.1	3.1	3.9	2.5	0.4	0.37	0.3	26	
of fence	4.2-5	BR	2.5Y 5/2+7/2	sil	fr	1.47	ev	7.8	0.53	2.2	<.1	3.4	3.1	2.2	0.3	0.10	0.2	43	21.8
corner at	5-6	BR	2.5Y 5/2+7/2	sil	fr	1.48	ev	7.9	0.50	1.9	<.1	3.6	2.5	2.7	0.3	0.06	0.2	53	9.4
old dragline	6-7	BR	2.5Y 5/2+7/2	sil	fr	1.39	es	7.9	0.46	2.2	<.1	3.2	1.8	3.0	0.6	0.05	0.4	50	8.2
	7-8	BR	2/5Y 5/2+5/1	sil	vfr	1.56	es	8.0	0.59	2.1	<.1	4.4	1.6	3.3	1.6	0.08	1.0	56	8.4
(core samples)	8-9	BR	2.5Y 5/2+5/3	sil	vfr	1.56	e	8.0	1.23	1.9	0.2	11.1	2.5	5.9	4.7	0.17	2.3	56	9.0
	9-10	BR	2.5Y 5/1+5/3	sil	vfr	1.67	e	7.9	1.58	1.7	0.5	16.1	3.6	8.4	6.0	0.25	2.4	52	6.8
	10-12	BR	2.5Y 4/3	sil	fr	1.56	es	7.8	2.1	1.8	1.3	22.6	6.4	12.1	6.8	0.38	2.2	52	6.8
	12-14	sis	2.5Y 4/2+5/4	sil	fr	1.64	es	7.8	2.2	1.4	2.1	24.8	7.9	13.2	6.8	0.38	2.1	61	5.3
	14-16	sis	2.5Y 4/2+4/3	sil	fr	1.61	e	7.7	1.69	1.6	1.4	16.6	5.6	8.2	5.4	0.42	2.1	59	5.4
	16-19	sis + ss	2.5Y 4/3+5/2	sicl	fr		e	7.7	1.82	1.4	0.6	20.4	7.9	8.5	5.6	0.42	2.0	70	4.1
Hy #2	0-1	B/A	10YR 3/2	fsl	vfr	1.60	--	6.9	1.00	5.5	<.1	6.1	6.8	4.0	0.5	0.27	0.2	32	
50'N, 0.25 mi.	1-3	B	10YR 3/3	fsl	vfr	1.49	--	6.8	0.32	1.6	<.1	2.0	2.0	1.3	0.4	0.08	0.3	29	
E of fence	3-4.2	Cl	10YR 4/3	vfs1	fr	1.45	--	6.9	0.34	1.2	<.1	2.5	1.5	1.4	0.8	0.04	0.7	51	
corner at	4.2-6	BR	2.5Y 5/2+5/6	sil	fr	1.38	ev	7.9	0.93	2.1	<.1	8.1	2.0	3.0	5.2	0.05	3.3	60	5.7
old dragline	6-8	soft ss	2.5Y 5/3	vfs1	fr	1.50	es	8.0	1.30	2.4	0.1	11.2	1.4	3.6	8.6	0.09	5.4	60	5.7
	8-10	sis	2.5Y 5/3	sil	-	1.47	e	7.7	5.5	1.4	1.2	86.7	23.0	44.5	21.5	0.29	3.7	64	4.5
(core samples	10-12	ss + sis	2.5Y 5/3	sicl	vfi	1.60	e	7.6	5.2	1.1	1.2	81.6	22.5	45.0	16.0	0.41	2.8	68	4.6
to 15.6 ft.)	12-14	sis	2.5Y 4/2+5/4	sicl	vfi	1.61	e	7.9	3.6	1.3	2.0	48.2	11.0	26.4	13.6	0.41	3.1	78	6.3
	14-15.6	sis	5Y 4/1 to 4/4	sicl	fi	1.88	es	7.8	4.5	1.0	1.5	70.1	20.0	39.2	12.8	0.61	2.4	82	6.8
	- Interval not sampled - highwall, hard clay																		
(highwall)	41-44	ss + sis	5Y 6/2+6/6	vfs1	fr		--	3.6	11.8	--	0.2	188.7	21.0	164.0	3.5	0.37	0.4	44	
	44-48	ss	5Y 5/2	vfs	vfr		--	3.9	7.0	--	0.2	115.6	20.0	93.0	2.5	0.26	0.3	38	
	48-53	ss	5Y 5/2	vfs	vfr		--	3.9	10.5	--	0.2	192.2	21.0	155.0	16.0	0.37	1.7	36	
	53-55	shale	5Y 6/2	sicl	efi		e	6.7	6.2	2.8	0.1	99.9	12.5	63.5	25.5	1.24	4.1	71	6.0
	55-60	shale	5Y 5/1	sil	efi		e	7.8	4.8	1.8	0.1	68.4	11.0	33.6	24.4	1.23	5.2	56	8.4
	60-66	soft ss	5Y 5/2	sil	fr		es	7.8	3.9	1.6	<.1	50.2	12.2	14.4	24.4	0.80	6.7	50	12.3

Sampled 9/24/75  
NDSU Soils Dept.

Table XV  
Husky Mine-Dickinson, ND  
Surface Core and High Wall Samples

Sample	Depth feet	Material	Color (moist)	Tex.	Cons. (Moist)	Bulk Dens.	Lime (qual.)	pH (paste)	ECE mmho.	Saturation Extract Soluble Ions (meq./litre)				Sat'n CaCO <sub>3</sub>					
										CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	SAR	%
Hy #3	0-1	A	10YR 3/2	sl	fr	1.57	--	7.0	0.60	1.5	<.1	4.4	1.6	3.3	1.0	0.11	0.6	31	
At highwall	1-2	BC	2.5Y 5/2-5/6	sic	fi	1.56	es	7.9	1.23	4.1	0.2	9.8	1.5	7.3	5.2	0.13	2.5	67	3.7
.35 mi E. of	2-4	C	2.5Y 5/2+7/2	sic	fi	1.41	ev	8.1	2.8	1.7	0.2	34.8	4.2	20.0	12.2	0.25	3.5	75	3.0
fence corner	4-6	BR	2.5Y 5/2+5/6	sic	fi	1.49	--	7.8	6.0	1.0	0.5	114.5	21.0	72.5	22.0	0.54	3.2	88	1.3
at old	6-8	sis	2.5Y 5/2	sic	efi	----	--	7.3	7.5	0.4	0.7	135.5	16.5	93.0	26.5	0.57	3.6	93	
dragline.	8-10	sis	2.5Y 5/2	sicl	efi	1.57	--	7.3	7.5	0.7	0.8	135.7	20.0	90.0	26.5	0.65	3.6	85	
(Stake F 15)	10-11	sis	2.5Y 5/2	sicl	efi	1.61	--	6.3	7.3	3.6	0.8	126.8	21.5	86.0	23.0	0.68	3.1	75	0.9
	*11-15	sis	5Y 4/2	sicl	efi		--	4.8	7.8	0.2	1.2	138.3	20.5	93.0	25.5	0.67	3.4	76	
*Hiwall	15-17.5	lig	black		---		--	3.4	12.0	---	1.8	220.5	22.0	151.0	49.0	0.32	5.3	116	
samples	17.5-18	vol ash?	5Y 7/4		l		--	No Sample											
below 11'.	18-20	shale	5Y 4/1	sicl	efi		--	3.9	6.6	---	0.7	97.4	11.0	65.5	21.0	0.61	3.4	80	
	20-23	shale	5GY 5/1	sic	efi		--	4.3	4.3	---	0.1	61.4	6.0	37.8	17.0	0.66	3.6	77	
	23-27	shale	5GY 5/1	sic	efi		--	5.5	5.0	0.1	0.2	69.4	7.0	40.0	21.5	1.17	4.4	81	

Table XVI  
 Baukol-Noonan Coal Co.  
 Overburden Samples-Air drilled vs. Water mist drilled

NDSU - Soils Lab 7/76

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-300															
	0-5	sil	29.8	8.7	0.48	44	0.5		2.74	0.2	2.26	0.63	3.68	0.75	0.14
<u>1/</u> A	0-5	sil	36.4	8.4	0.55	52	0.4		3.46	0.2	2.22	0.60	4.45	0.70	0.13
	5-10	vfs1	(sample too small)												
A	5-10	vfs1	25.6	8.3	0.40	36	0.5		2.84	0.3	1.14	0.85	2.55	0.73	0.15
	10-15	sil	30.0	8.1	0.30	62	0.4		2.54	0.1	0.91	1.40	1.40	0.53	0.22
A	10-15	sil	35.6	8.2	0.35	45	0.7		2.76	0.2	0.81	1.18	1.60	0.80	0.19
	15-20	sil	38.2	8.2	0.31	51	0.5		2.40	0.2	0.89	1.33	1.33	0.60	0.23
A	15-20	sil + ss	54.2	8.0	0.47	40	0.9		3.70	0.6	0.86	1.73	1.95	1.20	0.28
	20-25	sil	44.4	8.2	0.33	48	0.5		2.16	0.1	1.46	1.33	1.50	0.63	0.26
A	20-25	sil	33.2	8.1	0.36	54	0.6		2.50	0.2	1.20	1.33	1.60	0.70	0.27
	25-30	sil	33.2	8.4	0.69	53	0.7		2.36	0.1	4.83	2.50	3.15	1.20	0.44
A	25-30	sil	33.4	7.9	0.90	55	0.4		2.40	0.1	7.24	3.80	4.60	0.90	0.44
	30-35	sicl	33.8	8.3	0.73	56	0.6	0.2	3.84	0.2	3.83	2.50	3.80	1.00	0.77
A	30-35	si	35.0	7.9	0.65	58	0.6		3.86	0.2	2.59	2.15	3.10	0.85	0.55
	35-40	sil	31.6	7.9	0.85	52	0.5		3.80	0.2	5.32	3.25	4.25	1.00	0.82
A	35-40	si	32.2	7.9	0.69	63	0.5		4.60	0.1	2.73	2.40	3.50	0.85	0.68
	40-45	sicl	8.4	7.9	0.80	56	0.5		4.20	0.1	4.21	3.40	3.40	0.90	0.81
A	40-45	sicl	18.4	7.9	0.75	54	0.6		4.50	0.2	3.10	2.85	3.20	1.00	0.75
	45-50	sicl	10.6	7.8	1.00	62	0.4		3.64	0.1	7.78	4.60	5.20	0.90	0.82
A	45-50	sicl	13.5	8.0	0.53	66	0.5		3.34	0.2	1.98	1.95	2.20	0.70	0.67

Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples Air vs. Water Mist Drilled

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq.%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-300															
A	50-55	sicl	15.2	7.9	0.80	70	0.5	3.60	0.1	5.13	3.25	3.85	0.95	0.78	
	50-55	sicl	13.2	8.0	0.55	73	0.5	3.50	0.1	2.12	2.15	2.30	0.65	0.62	
A	55-60	sicl	11.5	7.8	0.94	73	0.8	3.92	0.1	6.91	3.90	4.50	1.65	0.88	
	55-60	sil	22.6	7.9	0.58	61	0.6	2.96	0.1	2.71	2.05	2.30	0.85	0.57	
A	60-65	sic	13.2	7.9	0.82	78	0.8	4.10	0.1	4.95	3.20	3.65	1.45	0.85	
	60-65	sicl	10.6	7.9	0.73	85	1.0	7.00	0.1	0.73	2.75	2.75	1.55	0.78	
A	65-70	lig	5.1	6.6	2.25	84	1.0	10.10	0.1	19.72	12.90	12.60	3.40	1.02	
	65-70	lig	3.7	6.8	1.35	85	1.3	8.74	0.3	6.93	6.55	5.60	3.30	0.52	
A	70-75	-	3.2	6.5	1.90	109	1.3	10.64	0.2	13.55	10.20	9.60	4.20	0.39	
	70-75	lig	4.8	6.7	1.42	85	1.2	9.20	0.3	6.98	6.90	5.90	3.10	0.58	
A	75-80	sic	1.1	7.3	1.95	91	2.1	7.50	0.1	16.25	8.00	8.50	6.00	1.35	
	75-80	sic	2.1	8.0	0.72	96	2.8	3.60	0.1	3.36	1.30	1.60	3.40	0.76	
A	80-85	sicl	6.8	7.8	2.05	69	2.7	4.60	0.1	20.29	7.80	8.20	7.70	1.29	
	80-85	sicl	8.7	7.9	1.09	77	3.5	5.80	0.1	5.42	2.50	2.45	5.50	0.87	
A	85-90	sic	6.8	7.8	1.55	74	3.9	4.70	0.1	12.65	4.00	4.30	8.00	1.15	
	85-90	si	8.4	7.9	1.08	75	4.3	6.20	0.1	4.61	1.95	2.00	6.10	0.86	
A	90-95	sicl	10.3	7.9	1.45	67	5.4	4.90	0.1	10.53	2.50	3.05	9.00	0.98	
	90-95	si	11.4	8.0	1.00	71	5.0	5.04	0.1	4.88	1.50	1.60	6.20	0.72	
A	95-100	sicl	10.0	8.0	1.30	67	6.1	4.92	0.1	8.78	1.90	2.20	8.80	0.90	
	95-100	sil	11.5	8.0	0.95	74	5.6	5.30	0.1	4.22	1.20	1.35	6.40	0.67	
A	100-105	sicl	11.2	8.0	1.30	71	5.9	5.72	0.2	7.88	1.95	2.35	8.60	0.90	
	100-105	sicl	10.9	8.1	1.07	78	6.9	6.52	0.4	4.50	1.25	1.45	8.00	0.72	
A	105-110	sil	12.5	8.0	1.25	63	5.1	4.90	0.1	8.16	2.05	2.50	7.75	0.86	
	105-110	si	10.8	8.2	0.97	68	6.3	5.50	0.1	4.77	1.30	1.30	7.15	0.62	

Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples Air vs. Water Mist Drilled

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq. %)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
BN 76-300	110-113	sil	9.3	8.1	1.28	58	5.0	4.80	0.1	8.73	2.30	2.65	7.85	0.83
A	110-115	sil + ss	7.3	7.5	1.40	70	5.0	10.16	0.1	5.01	2.55	3.35	8.55	0.82
Water for drilling				8.3	1.59		2.5	6.9	<.1	11.1	5.1	5.7	7.2	0.19

Location: Sec. 36-142-84 caa  
 Elevation: 2088

Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples Air vs. Water Mist Drilled

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-348															
A	0-5	sicl	4.0	8.0	0.40	69	1.1	3.16	<.1	1.24	0.90	2.05	1.35	0.10	
	0-5	sil	5.6	7.8	4.70	67	4.9	3.00	2.0	63.83	13.00	32.00	23.40	0.43	
A	5-10	*	6.4	7.8	5.00	73	1.8	1.66	0.1	80.44	23.00	48.00	10.50	0.70	
	5-10	sil	7.9	7.8	4.50	62	3.1	1.40	1.5	64.35	20.80	30.40	15.60	0.45	
A	10-15	vfs1	9.2	7.7	3.45	54	1.5	1.44	0.1	48.96	13.80	29.20	6.80	0.70	
	10-15	vfs1	6.5	7.9	2.00	56	2.5	1.50	0.3	20.99	6.80	8.80	6.90	0.29	
A	15-20	vfs1	7.0	7.7	2.65	51	1.1	1.50	0.1	33.25	9.60	20.40	4.40	0.45	
	15-20	vfs1	7.1	7.8	1.54	56	2.0	1.60	0.1	16.99	5.80	7.40	5.20	0.29	
A	20-25	sil	5.7	7.3	3.40	61	0.9	2.10	<.1	48.54	16.00	29.60	4.40	0.64	
	20-25	lig		4.4	4.20	123	1.7	0	4.3	60.49	23.60	32.00	8.80	0.39	
A	25-30	lig		3.9	4.75	128	1.6	0	0.8	74.69	27.20	38.40	9.40	0.49	
	25-30	lig		4.5	3.70	88	2.0	0	0.2	54.62	20.00	24.80	9.40	0.62	
A	30-35	*		4.5	3.15	88	2.1	0	<.1	43.46	14.80	19.20	8.60	0.86	
	30-35	sic		7.1	2.10	85	3.1	5.06	0.1	19.16	6.90	8.00	8.40	1.02	
A	35-40	sic		7.1	2.90	79	2.5	3.96	<.1	35.45	12.90	15.60	9.60	1.31	
	35-40	c		7.8	1.62	85	4.6	5.20	0.2	12.64	3.90	4.00	9.20	0.94	
A	40-45	sic		7.1	2.58	81	3.7	5.42	<.1	28.27	9.60	11.10	11.90	1.09	
	40-45	sicl		7.1	2.30	81	5.5	5.64	0.1	21.87	6.40	6.40	13.80	1.01	
A	45-50	sic	7.0	7.6	1.85	75	5.4	5.00	<.1	16.23	4.10	4.80	11.40	0.93	
	45-50	sic		7.7	1.70	75	6.6	6.50	0.1	11.64	2.90	3.10	11.40	0.84	
A	50-55	sicl	6.8	7.6	1.85	72	5.8	4.56	<.1	16.48	3.80	4.50	11.90	0.84	
	50-55	sic		8.0	1.50	75	7.5	7.00	0.1	9.29	2.20	2.25	11.20	0.74	



Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples Air vs. Water Mist Drilled

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-348															
	55-60	sic	4.4	7.8	1.89	68	6.2		4.50	<.1	16.32	3.60	4.20	12.20	0.82
A	55-60	lig		6.8	2.10	89	8.5		7.04	0.1	17.35	3.60	3.90	16.50	0.49
	60-70	lig		6.5	3.10	109	4.9		6.62	<.1	34.41	11.20	12.60	16.80	0.43
A	60-65	lig	1.0	6.9	2.40	92	6.6		9.40	0.3	18.45	5.60	6.10	16.00	0.45
same as	60-70														
A	65-70	lig		6.8	1.70	84	9.2		6.36	0.1	12.06	2.00	2.40	13.60	0.52
	70-75	sic		7.5	1.55	77	8.6		8.60	<.1	8.74	1.80	2.40	12.40	0.74
A	70-75	sicl		8.0	1.52	64	15	1.80	9.00	0.1	7.84	1.00	1.00	14.50	0.44
	75-80	vfs1		8.5	1.40	68	15	1.00	5.30	<.1	7.80	0.60	0.70	12.45	0.35
A	75-80	1		8.5	1.09	71	25	1.00	7.70	0.2	3.69	0.20	0.20	11.00	0.19
Water for drilling				8.2	0.10		0.1		1.6	<.1	0.4	1.1	0.5	0.1	0.04

Location: Sec. 25-142-84; 800'E, 1580' S of NW cor.  
 Elevation: 2055

Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples-Air drilled vs. Water Mist Drilled

NDSU - Soils Lab 7/76

Sample No.	Depth (ft)	Tex.	CaCO <sub>3</sub> (Eq%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-364															
	0-5	vfs1	9.6	8.0	0.48	44	2.1	3.24	<.1	2.01	1.00	1.70	2.48	0.07	
B	0-5	vfs1	3.0	7.7	0.85	52	1.4	3.16	0.1	6.21	3.40	3.35	2.60	0.12	
	5-10	vfs1	6.6	7.8	2.40	45	3.9	1.84	<.1	29.36	7.40	11.70	11.90	0.20	
B	5-10	vfs1	7.2	8.1	2.00	46	4.1	2.26	0.9	20.18	5.40	7.40	10.40	0.14	
	10-15	fsl	18.2	7.9	2.43	42	3.8	1.90	0.8	27.88	7.80	10.80	11.70	0.28	
B	10-15	fsl + ss	27.0	7.8	2.10	37	4.0	2.60	1.3	21.46	6.80	7.60	10.70	0.26	
	15-20	fsl (lt)	7.9	7.7	2.80	40	2.9	1.90	0.9	35.86	11.60	16.00	10.70	0.36	
B	15-20	lfs	11.4	8.0	2.50	41	3.6	1.76	1.4	29.12	9.40	11.20	11.40	0.28	
	20-25	lfs + lig	4.1	6.1	4.75	49	2.6	15.8	0.7	62.96	32.00	32.40	14.60	0.46	
B	20-25	fsl	3.4	7.0	5.00	47	2.7	6.50	0.8	68.26	28.00	32.00	15.00	0.56	
	25-30	lig	0	6.3	4.00	112	4.3	4.34	0.1	52.65	15.20	22.80	18.80	0.29	
B	25-30	lig		6.7	5.70	77	5.2	7.16	0.6	83.20	28.00	33.50	29.00	0.46	
	30-35	lig		6.7	4.20	76	6.7	15.86	0.1	42.37	15.60	15.40	26.40	0.93	
B	30-35	lig		7.0	5.70	79	8.7	11.90	0.7	65.91	20.00	19.00	38.50	1.01	
	35-40	sicl	1.9	7.9	2.75	70	9.5	7.30	<.1	24.73	5.60	4.40	21.20	0.83	
B	35-40	sil	2.9	7.9	3.20	79	13	6.14	0.2	30.15	4.40	4.00	27.20	0.89	
	40-45	sicl	9.2	8.3	1.70	90	17	0.80	6.98	<.1	9.87	1.00	0.60	15.50	0.55
B	40-45	sicl	7.3	8.0	3.20	89	14	6.96	0.2	30.97	4.60	3.60	29.00	0.93	
	45-50	sicl	8.6	8.3	1.46	112	24	0.84	8.04	<.1	6.21	0.40	0.30	14.00	0.39
B	45-50	sicl	8.5	8.7	1.53	122	26	0.60	6.80	0.1	8.79	0.40	0.30	15.20	0.39
	50-55	sic	8.5	8.3	1.83	119	34	0.80	10.06	<.1	10.66	0.40	0.30	20.40	0.42
B	50-55	sicl	6.4	8.5	1.81	130	31	1.12	7.14	0.3	10.97	0.40	0.30	18.40	0.43

Table XVI (Cont'd)  
 Baukol-Noonan Coal Co.  
 Overburden Samples Air drilled vs. Water mist drilled

Sample No.	Depth (ft.)	Tex.	CaCO <sub>3</sub> (Eq%)	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions Meq/L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
BN 76-364															
	55-60	sic	7.3	7.9	2.30	103	35	2.30	11.30	<.1	12.63	0.50	0.40	23.40	0.43
B	55-60	sicl	6.1	8.5	1.88	124	38	1.20	8.90	0.2	9.80	0.30	0.20	19.20	0.40
	60-65	sic	10.0	8.5	1.78	112	49	1.78	11.16	<.1	7.14	0.20	0.10	18.90	0.34
B	60-65	sil	1.8	8.7	1.90	115	40	1.00	8.30	0.2	11.39	0.30	0.20	20.00	0.39
	65-70	-		7.2	3.2	89	40	3.20	24.80	0.1	15.11	1.20	0.60	37.80	0.41
B	65-70	sil	5.2	8.2	2.35	102	37	-	15.60	0.1	10.52	0.50	0.40	24.90	0.42
	70-75	lig	*												
B	70-75	lig + si	2.4	7.9	3.4	87	40		18.60	0.3	21.12	1.00	0.80	37.80	0.42
Water for 364				8.3	1.59		2.5		6.9	<.1	11.1	5.1	5.7	7.2	0.19

Location: Sec. 3-141-84, 350' E of NW corner, in road ditch  
 Elevation: 2120

\* Not enough sample.

1/ Water mist samples have A or B designation.

Table XVII  
Consolidation Coal Co. - Renner Cove  
Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-2 (Williams loam)	0-5 W 0-5 WI 0-5		12.0 no sample no sample	8.3	0.54	60	6.7		4.4	0.1	1.7	0.3	0.8	5.0	0.15
0.2 mi. So. of NE. corner	5-10 W 5-10 WI 5-10	1	10.6 8.6	8.0 7.9 7.7	6.0 8.4 8.2	70 62 65	6.9 10 11		1.6 1.9 3.3	0.2 4.4 3.8	89.0 129.0 130.0	21.5 24.0 22.0	32.0 48.0 50.0	36.0 62.5 64.0	0.79 0.60 0.37
	10-15 W 10-15 WI 10-15	cl (till)	7.7 5.2	7.8 8.0 7.8	6.8 5.0 4.5	75 78 71	16 13 15		1.5 1.9 3.8	2.4 4.1 4.4	92.6 58.0 47.7	21.5 8.0 4.8	26.0 13.5 10.0	48.0 42.0 40.8	0.97 0.49 0.30
	15-20 W 15-20 WI 15-20	1 (Ft. Union)	27.2	8.3 8.3 8.0	1.45 1.72 1.98	75 48 42	16 16 17		2.5 3.5 6.5	1.1 0.6 0.6	10.3 13.9 13.8	0.6 0.8 1.0	0.6 1.1 1.3	12.4 16.0 18.4	0.24 0.22 0.20
	20-25 W 20-25 WI 20-25	fs1	3.9 no sample	8.2 8.3	0.65 1.14	58 59	16 23		4.0 2.3	<.1 0.1	2.8 9.7	0.2 0.2	0.1 0.3	6.4 11.5	0.15 0.16
	25-30 W 25-30 WI 25-30	1	5.1 no sample	8.4 8.4	0.67 1.75	55 60	24 22		4.2 3.2	0.2 0.4	2.5 14.6	0.1 0.4	0.1 0.8	6.6 17.0	0.15 0.22
	30-35 W 30-35 WI 30-35	sl	3.0	8.3 8.3 7.9	0.97 1.27 1.73	88 61 58	21 26 21		4.5 3.4 8.8	0.2 0.3 0.3	5.4 8.9 7.9	0.1 0.2 0.4	0.3 0.2 0.7	9.5 12.4 15.7	0.23 0.16 0.20
	35-40 W 35-40 WI 35-40	sl	4.3	8.6 8.5 8.2	1.00 2.3 2.2	70 62 51	30 26 23		3.6 3.0 6.7	0.4 0.2 0.3	6.0 21.8 17.3	0.1 0.7 0.8	0.2 0.9 1.0	9.6 23.2 22.2	0.25 0.33 0.26
	40-45 W 40-45 WI 40-45	ls	4.3 30.8	8.6 8.7 9.0	1.20 1.70 1.38	79 40 36	45 45 42		0.4 0.8 4.2	4.9 5.0 0.1	7.3 12.3 9.4	0.1 0.1 0.1	0.1 0.2 0.1	12.2 17.6 13.4	0.30 0.23 0.12

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-2 (Cont'd)															
	45-50		7.9	8.9	1.05	137	51	0.4	5.8	0.1	5.5	<.1	<.1	11.4	0.31
	W 45-50	sic	10.3	9.0	1.20	142	47	1.7	5.3	0.1	6.3	<.1	0.1	13.0	0.21
	WI 45-50			9.5	0.85	134	36		3.3	0.1	4.8	<.1	<.1	8.1	0.08
	50-55		7.3	8.9	1.21	170	56	0.4	6.8	<.1	5.7	<.1	<.1	12.5	0.33
	W 50-55	sic	9.4	9.1	1.40	149	54	1.8	5.1	0.1	8.2	<.1	0.1	14.8	0.23
	WI 50-55			9.6	0.90	147	42		4.5	0.1	4.9	<.1	<.1	9.3	0.09
	55-60		7.3	9.0	1.16	163	53	0.8	7.1	<.1	4.4	<.1	<.1	11.9	0.32
	W 55-60	c	7.7	9.0	1.27	150	51	2.0	5.5	0.2	6.7	<.1	0.1	14.0	0.21
	WI 55-60			9.5	0.93	135	42		5.0	0.1	4.6	<.1	<.1	9.5	0.09
	60-65		3.0	8.7	1.19	151	53	0.4	6.6	<.1	5.4	<.1	<.1	11.9	0.32
	W 60-65	c	5.8	9.1	1.18	142	47	1.4	6.0	0.1	5.8	<.1	0.1	13.0	0.19
	WI 60-65			9.5	0.93	123	41		4.7	0.1	4.5	<.1	<.1	9.2	0.08
	65-70		5.3	8.9	1.26	156	48	0.3	7.0	<.1	6.1	<.1	0.1	13.1	0.17
	W 65-70	c	3.0	9.0	1.47	139	57	1.5	5.4	0.1	8.9	<.1	0.1	15.6	0.19
	WI 65-70			9.3	0.80	120	28		3.9	0.1	3.9	0.1	<.1	7.7	0.06
	70-75		5.3	8.8	1.23	153	57	0.6	7.4	<.1	5.1	<.1	<.1	12.8	0.15
	W 70-75	c	7.1	9.1	1.23	146	50	2.1	5.1	0.1	6.7	<.1	0.1	13.6	0.20
	WI 70-75			9.6	0.89	124	40		4.2	0.1	4.9	<.1	<.1	9.0	0.07
	75-80		7.9	8.9	1.10	160	53	0.7	7.2	<.1	4.2	<.1	<.1	11.9	0.13
	W 75-80	sic	7.3	9.2	1.20	140	61	2.4	4.2	0.1	7.2	<.1	<.1	13.6	0.18
	WI 75-80			9.5	0.95	112	49		4.6	0.1	6.3	<.1	<.1	10.9	0.06
	80-85		6.7	8.7	1.22	154	59	0.8	8.0	<.1	4.6	<.1	<.1	13.1	0.17
	W 80-85	c	8.0	9.1	1.30	127	54	1.7	7.0	0.1	6.3	<.1	0.1	14.8	0.19
	WI 80-85			9.4	0.95	112	45		5.5	0.2	4.5	<.1	<.1	10.0	0.07
	85-90		1.9	8.9	1.38	191	62	0.8	6.8	<.1	6.5	<.1	<.1	13.8	0.17
	W 85-90	c	4.3	8.7	1.52	130	54	1.0	7.5	0.1	9.0	0.1	0.1	17.2	0.21
	WI 85-90			9.3	1.01	119	51		5.9	0.2	5.5	<.1	<.1	11.4	0.08

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-2 (Cont'd)	93+			7.2	3.2	115	66		29.3	0.4	13.0	0.4	0.4	41.6	0.29
	W 90-93	c	4.3	9.3	1.28	180	46	2.5	6.0	0.1	6.2	0.1	0.1	14.4	0.18
	WI 90-93		no sample												

# WI data from solution extracted from the wet samples from the field; W data from regular saturation extract procedure.

Drill water from Lake Sakakawea	(TDS 436 ppm)		8.3	0.67	---	1.7	0.2	3.0	0.3	3.2	2.5	1.7	2.4	0.11
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Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tax.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-7															
(Williams	0-5		12.0	8.8	1.40	89	19	0.3	4.8	0.9	9.0	0.2	0.9	13.8	0.08
loam) 0.2	W 0-5	1	14.0	8.5	2.2	66	15		3.5	1.8	19.9	1.2	2.6	21.2	0.23
mi. So.	WI 0-5	(till)		8.1	2.4	61	16		5.5	1.9	20.8	1.2	3.1	23.7	0.16
N $\frac{1}{2}$ corner															
22-146-88	5-10		1.4	8.2	3.1	91	21		3.0	2.1	28.6	1.2	2.6	29.6	0.26
	W 5-10	cl	6.2	7.9	5.7	86	13		1.1	1.9	75.5	12.0	16.0	50.0	0.55
	WI 5-10	(till)		8.0	4.5	78	16		3.5	2.5	49.3	4.6	8.8	41.6	0.34
	10-15		0	8.2	2.7	124	22		2.3	1.0	25.3	1.1	1.6	25.6	0.27
	W 10-15	sicl, Ft.	3.7	8.1	4.1	94	17		2.7	1.6	46.4	4.6	6.4	39.2	0.47
	WI 10-15	Union		7.9	4.7	78	18		3.9	2.0	48.3	4.6	6.8	42.4	0.39
	15-20		0	8.3	2.4	127	23		2.2	0.5	22.4	0.8	1.2	22.8	0.27
	W 15-20	sicl	4.2	8.1	3.8	114	18		2.0	0.7	43.4	3.6	4.8	37.2	0.51
	WI 15-20			8.0	3.6	89	20		3.1	1.0	35.5	2.2	3.4	33.6	0.40
	20-25		0	7.3	6.7	97	14		2.5	0.4	87.3	16.5	17.0	56.0	0.68
	W 20-25	sil	0	7.2	6.8	81	15		1.4	0.5	94.9	17.5	17.5	61.0	0.79
	WI 20-25*														
	25-30		2.0	8.1	5.0	96	16		1.4	0.1	60.0	8.0	8.0	45.0	0.56
	W 25-30	vfs1	0	8.0	5.9	84	17		1.2	0.3	76.2	11.0	11.0	55.0	0.73
	WI 25-30			7.6	6.0	71	17		4.7	0.4	69.1	8.5	11.0	54.0	0.71
	30-35			8.3	3.2	135	22		2.0	<.1	32.5	1.6	2.2	30.4	0.32
	W 30-35	vfs1	0	8.2	4.1	110	19		1.5	0.2	48.9	4.4	4.8	40.8	0.54
	35-40			8.3	3.0	154	23		1.9	<.1	30.6	1.6	1.6	29.0	0.31
	W 35-40	vfs1	0	8.1	4.0	138	20		1.5	0.2	47.7	4.0	4.0	40.8	0.53
	40-45			7.8	4.8	164	18		1.4	<.1	57.1	7.0	5.4	45.6	0.43
	W 40-45	vfs1	0	7.3	4.3	163	21		0.9	0.1	57.1	4.4	4.0	43.2	0.46

\*No sample

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq.%	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)								
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K	
RC76-7 (Cont'd)	45-50		5.6	8.7	2.2	154	27		2.4	<.1	23.2	0.8	0.8	23.8	0.25	
	W 45-50	vfs1		7.9	3.4	180	24		1.5	0.1	38.2	1.8	2.4	35.2	0.35	
	50-55		0.7	9.2	1.48	175	50	0.6	2.8	<.1	10.7	<.1	0.1	13.8	0.18	
	W 50-55	vfs1	4.5	8.6	2.7	160	33	0.2	2.2	0.1	26.4	0.6	0.8	27.2	0.33	
	55-60			9.3	1.19	144	51	0.8	3.4	<.1	7.4	<.1	<.1	11.4	0.13	
	W 55-60	vfs1	3.0	8.9	2.3	137	51	0.6	2.2	0.2	20.3	0.1	0.3	22.6	0.28	
	60-65			9.0	1.30	138	59	0.2	5.1	<.1	8.0	<.1	<.1	13.1	0.14	
	W 60-65	lfs	27.0	8.7	2.1	95	58	0.3	4.7	0.1	18.1	0.1	0.2	22.6	0.28	
	65-70			9.1	1.10	132	53	1.2	6.4	<.1	4.5	<.1	<.1	11.9	0.11	
	W 65-70	1	13.6	8.6	2.9	76	47	0.3	3.0	0.2	27.3	0.4	0.4	29.6	0.37	
	70-75		8.5	8.9	1.29	137	62	0.9	9.2	<.1	4.0	<.1	<.1	13.8	0.15	
	W 70-75	c1	9.6	8.9	1.58	121	54	1.4	6.4	0.1	9.5	0.1	0.1	17.0	0.22	
	75-80			8.9	1.00	118	48	1.1	6.0	<.1	3.7	<.1	<.1	10.7	0.09	
	W 75-80	c1	6.7	8.9	1.45	117	55	1.4	6.4	0.1	7.5	<.1	0.1	15.1	0.19	
	80-85			9.1	1.00	105	46	1.3	3.9	<.1	5.2	<.1	<.1	10.2	0.08	
	W 80-85	1	5.7	8.8	2.4	112	48	0.3	5.2	0.2	19.3	0.3	0.2	24.2	0.29	
	85-90			9.0	1.05	104	47	0.8	4.4	<.1	5.4	<.1	<.1	10.4	0.08	
	W 85-90	1	5.0	9.0	1.43	102	55	1.1	6.0	0.2	8.2	<.1	0.1	15.1	0.18	
	90-95		1.8	7.1	2.2	92	43		14.5	<.1	11.9	0.3	0.4	25.6	0.17	
	W 90-95	1	5.3	9.0	1.32	102	53	1.4	5.6	0.1	7.6	<.1	0.1	14.4	0.16	
	95-100	lig		6.8	2.7	73	44		11.3	<.1	21.0	0.5	0.5	31.2	0.15	
	W 95-100		(not analysed wet)													
Drill Water Lake Sakakawea		(TDS 436 ppm)		8.3	0.67		1.7	0.2	3.0	0.3	3.2	2.5	1.7	2.4	0.11	



Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tax.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-9															
Williams loam 0.2 mi. So. of centre	0-5 *W 0-5	1	5.0 5.1	8.2 7.9	0.69 2.4	46 54	5.0 7.4		11.5 3.7	0.3 4.5	4.3 20.0	0.9 4.8	1.4 6.0	5.3 17.2	0.07 0.27
22-146-88	5-10 W 5-10	1	9.8 10.4	8.2 8.1	6.0 8.9	59 61	12 12		4.4 1.8	1.0 11.8	75.4 124.4	7.5 18.5	25.0 49.0	48.0 70.0	0.29 0.50
	10-15 W 10-15	1fs	6.3 6.8	8.1 7.9	6.3 8.6	50 51	12 12		2.3 1.4	10.7 8.3	75.9 118.4	12.0 21.0	25.5 40.5	51.0 66.0	0.43 0.61
	15-20 W 15-20	1	4.6 7.1	8.0 7.9	6.0 7.7	61 71	11 12		1.5 1.1	8.3 3.3	71.2 109.0	12.0 20.0	22.0 33.0	46.5 59.5	0.51 0.91
	20-25 W 20-25	sic1	14.0 15.4	8.0 7.9	7.3 7.0	79 82	11 12		1.6 1.2	4.4 1.3	101.8 102.4	21.0 19.5	30.0 26.5	56.0 58.0	0.83 0.89
	25-30 W 25-30	sic1	8.1 8.9	8.3 8.3	4.0 3.9	129 120	19 20		1.3 2.0	1.4 0.2	42.1 43.1	2.4 2.4	5.0 4.8	37.0 37.6	0.43 0.48
	30-35 W 30-35	sic	2.9 3.5	8.2 8.2	3.2 3.4	170 139	35 26		4.8 3.0	<.1 0.2	28.9 34.8	0.8 1.2	0.8 2.2	31.6 34.0	0.53 0.56
	35-40 W 35-40	sic	0.9 1.7	8.4 8.4	2.6 2.7	142 142	38 41	0.2	5.3 3.7	<.1 0.1	22.8 26.5	0.4 0.4	0.6 0.6	26.8 28.8	0.47 0.49
	40-45 W 40-45	c	0 0	8.9 8.8	1.7 2.2	149 141	54 55	0.4 0.6	5.4 4.5	<.1 0.1	11.9 16.6	0.1 0.1	0.1 0.2	17.2 21.2	0.23 0.30
	45-50 W 45-50	sic	0	8.8 8.8	2.1 2.0	131 128	56 51	0.2 0.8	4.3 4.0	<.1 0.1	17.9 15.3	0.1 0.1	0.2 0.2	21.8 19.6	0.31 0.28
	50-55 W 50-55	sic	2.7 4.0	8.8 8.9	1.5 1.4	139 135	49 53	0.4 0.9	4.9 4.5	<.1 0.1	10.7 9.2	0.1 <.1	0.1 0.1	15.6 14.4	0.20 0.21
	55-60 W 55-60	sic1	8.0 7.1	8.9 8.8	1.1 1.3	143 142	51 58	1.1 0.8	4.3 4.7	0.1 <.1	6.1 7.8	<.1 <.1	<.1 <.1	11.4 13.0	0.12 0.18

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)							
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K
RC76-9 (Cont'd)	60-65		8.8	8.9	1.00	148	45	1.2	4.6	0.1	4.3	<.1	<.1	10.0	0.11
	W 60-65	sic1	8.2	8.8	1.42	130	63	1.2	4.2	0.1	8.8	<.1	<.1	14.0	0.19
	65-70		11.0	8.9	1.02	148	47	1.1	5.0	0.1	4.4	<.1	<.1	10.4	0.11
	W 65-70	sic1	25.6	8.8	1.27	86	58	1.4	4.8	0.2	6.9	<.1	<.1	13.0	0.16
	70-75		12.1	9.0	1.01	145	47	1.1	5.5	<.1	4.0	<.1	<.1	10.4	0.12
	W 70-75	sic1	11.7	8.8	1.09	138	50	1.2	4.9	0.1	5.1	<.1	<.1	11.1	0.15
	75-80		11.8	8.9	1.09	144	51	1.0	6.3	<.1	4.3	<.1	<.1	11.4	0.14
	W 75-80	sic	12.2	8.7	1.44	132	53	1.2	5.3	<.1	8.3	<.1	0.1	14.4	0.22
	80-85		7.9	8.6	1.43	123	64	0.4	8.2	<.1	6.1	<.1	<.1	14.4	0.20
	W 80-85	sic	9.0	8.7	1.42	115	54	1.1	6.4	0.1	7.6	<.1	0.1	14.8	0.23
	85-89		3.2	8.4	1.52	132	56	0.8	8.7	<.1	6.1	<.1	0.1	15.2	0.22
	W 85-89	c	7.7	8.6	1.60	115	51	1.0	6.9	0.1	8.5	0.1	0.1	16.0	0.25
	89-111	lig		6.9	3.4	99	48		21.2	0.3	20.1	0.6	0.8	40.0	0.24
	W 89-111	no wet sample													

\*Drilled with water mist.

Drill water Lake Sakakawea	(TDS 436 ppm)			8.3	0.67		1.7	0.2	3.0	0.3	3.2	2.50	1.7	2.4	0.11
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Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)									
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K		
DS76-707																	
Wms loam, 15% SW, NW cor.	0-5 W 0-5	l(till) (not sampled)	17.8	8.2	0.63	46	0.3		2.9	<.1	2.9	1.2	4.0	0.5	0.09		
NE $\frac{1}{4}$ 11-145-87	5-10 W 5-10	1 scl	9.0 8.4	8.0 7.9	2.9 4.8	56 57	1.1 1.8		1.9 2.0	<.1 0.3	39.9 75.2	8.6 18.4	28.0 48.0	4.8 10.6	0.31 0.48		
	10-15 W 10-15	1 1	7.9 7.7	7.8 7.8	5.0 5.4	54 57	1.6 2.7		1.6 1.6	2.0 1.9	78.0 83.6	24.5 24.5	47.0 46.0	9.5 16.0	0.60 0.59		
	15-20 W 15-20	c1 1	7.4 8.3	7.7 7.7	3.8 4.3	55 57	1.1 2.9		1.5 1.8	1.5 0.8	54.5 61.2	25.4 23.2	25.6 25.6	5.8 14.4	0.61 0.58		
	20-25 W 20-25	1 1	9.0 8.1	7.6 7.8	3.3 2.3	55 56	0.7 1.7		1.5 1.8	0.6 0.1	47.5 29.5	25.4 13.8	20.4 11.0	3.2 6.1	0.61 0.51		
	25-30 W 25-30	1 1	7.7 8.2	7.7 7.8	4.0 2.4	55 57	1.2 2.0		1.5 1.7	1.8 <.1	62.4 29.1	26.8 13.4	31.6 10.1	6.6 6.8	0.68 0.54		
	30-35 W 30-35	1 1	0 9.4	7.8 7.7	5.0 2.4	62 54	4.8 1.9		1.8 1.5	1.4 0.1	70.9 29.2	24.0 14.6	25.5 9.2	24.0 6.5	0.58 0.56		
	35-40 W 35-40	1 1	0 11.1	7.8 7.8	4.5 2.4	61 52	3.8 1.8		1.7 1.6	0.7 0.2	63.6 30.3	25.4 15.6	21.6 9.6	18.4 6.4	0.61 0.56		
	40-45 W 40-45	1 1	0 9.4	7.7 7.8	2.6 2.1	57 53	2.3 1.9		1.7 1.8	0.1 <.1	33.5 25.0	16.4 12.4	10.1 7.9	8.2 6.0	0.59 0.53		
	45-50 W 45-50	s1(Ft. Union)1	4.7 8.5	7.7 7.7	4.0 2.6	48 53	3.9 2.3		1.7 1.5	0.3 <.1	55.1 32.7	22.2 15.2	17.2 10.4	17.2 8.1	0.56 0.53		
	50-55 W 50-55	1 1	9.0 10.0	7.7 7.8	3.1 2.4	55 53	1.9 2.2		1.6 1.5	0.2 0.1	42.0 29.7	20.8 13.6	14.4 9.8	8.0 7.4	0.61 0.50		
	55-60 W 55-60	s1 s1	21.2 17.6	7.9 7.8	4.3 3.4	44 47	4.3 3.3		1.5 1.5	0.4 0.1	61.2 45.4	21.6 18.6	21.0 14.4	20.0 13.4	0.51 0.56		

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
DS76-707 (Cont'd)	60-70 - Wet sands, not recovered, samples below this to coal are poor - mixed, sloppy, sandy material)													
	70-75	ls	2.7	7.8	4.6	45	4.4	1.8	0.2	65.3	20.8	24.8	21.2	0.45
	W 70-75	(no sample recovered)												
	75-80	ls	2.6	7.7	4.4	44	4.2	1.6	0.3	67.9	23.2	25.6	20.6	0.48
	W 75-80	sl	4.2	7.8	3.5	42	3.7	1.5	0.2	48.3	17.6	16.8	15.2	0.40
	80-100	lig	---	6.2	4.2	73	2.1	5.9	0.3	58.0	25.4	27.6	10.8	0.46
	W 80-100*	lig												
	100-120	scl	2.9	6.5	4.0	64	2.4	8.0	0.3	49.9	23.2	23.0	11.4	0.63
	W 100-120*	(no sample)												

\*Both holes drilled with water mist below 30 ft. Lower till would not come out with air.

Drill water (synthetic)	(TDS 3315 ppm)	7.9	5.1	10.4	12.9	0.1	60.4	5.0	26.6	41.6
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Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
DS76-744														
Wms loam	0-5	1(till)	16.0	8.2	0.75	48	2.1							
200' W of center	W 0-5	1(till)	16.6	7.9	3.3	49	3.5	3.3	0.7	4.0	0.9	3.8	3.2	0.13
Sec.	5-10	sil	10.2	7.9	5.0	53	1.4	2.8	2.0	41.1	11.0	20.8	13.8	0.31
2-145-87	W 5-10	scl	12.4	8.1	7.3	58	5.6	1.6	2.1	76.4	24.0	47.0	8.5	0.59
	10-15	sil	11.4	7.7	3.2	59	1.4	1.9	2.1	115.5	21.0	62.0	36.0	0.50
	W 10-15	1	12.6	8.0	6.3	59	5.6	1.4	2.4	39.9	16.2	21.0	6.0	0.57
	15-20	sil	11.4	7.7	2.7	58	1.1	1.9	1.8	91.4	20.0	43.0	31.5	0.56
	W 15-20	cl	11.4	7.8	6.0	63	5.9	1.2	1.7	29.7	14.7	13.1	4.2	0.59
	20-25	1	9.1	7.5	4.2	56	0.8	1.6	1.4	81.2	25.0	28.0	30.5	0.76
	W 20-25	1	10.6	7.8	6.0	61	5.7	1.1	0.8	57.6	30.4	24.2	4.0	0.92
	25-30	1	9.2	7.5	4.3	56	0.7	1.8	0.9	84.4	26.0	30.0	30.0	1.08
	W 25-30	1	9.3	7.8	6.0	64	5.4	1.2	0.6	58.3	29.8	25.6	3.8	0.87
	30-35	1	8.2	7.5	4.0	57	0.7	1.8	0.7	85.1	26.0	31.5	29.0	1.08
	W 30-35	1	8.6	7.8	5.5	64	4.7	1.1	0.3	56.5	28.0	25.6	3.6	0.76
	35-40	fsc1	8.6	7.5	4.1	57	0.8	1.8	0.4	78.6	25.5	30.0	24.5	0.86
	W 35-40	scl	8.5	7.8	5.6	64	4.9	1.2	0.2	58.4	27.6	27.2	4.2	0.78
	40-45	1(Ft. 1 Union)	8.9	7.5	4.2	57	0.9	1.8	0.3	83.3	26.0	32.0	26.5	0.93
	W 40-45		8.5	7.7	4.7	63	3.3	1.2	0.2	58.6	27.2	27.2	4.8	0.80
	45-50	fs1	---	7.6	4.0	49	1.4	1.5	0.3	68.5	24.6	28.0	16.8	0.92
	W 45-50	fs1	16.6	7.9	5.7	47	5.1	1.4	0.1	57.8	22.2	29.0	7.2	0.83
	50-55	vfs1	---	7.5	4.0	53	1.7	1.6	0.2	85.2	24.0	34.5	27.5	0.97
	W 50-55	fs1	9.8	7.9	5.8	53	5.1	1.3	0.3	58.0	20.0	30.0	8.6	0.86
	55-60	lfs	---	7.5	5.0	41	2.1	1.6	0.3	84.5	22.5	35.5	27.5	0.98
	W 55-60	fs1	3.2	7.9	6.8	45	5.9	1.4	0.1	77.4	20.0	46.0	12.0	0.91
								1.8	0.4	102.8	22.5	47.0	34.5	1.03

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soil Lab 5/76

Sample	Depth (ft.)	Tex.	CaCO <sub>3</sub> Eq.%	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)									
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na	K		
DS76-744 (Cont'd)	60-65	ls	---	7.4	6.0	38	2.6										
	W 60-65	(no sample recovery)						1.9	0.1	97.9	20.0	62.5	16.5	0.87			
	65-70	ls	---	7.4	6.6	42	2.9	1.7	0.1	106.6	20.0	68.0	19.5	0.87			
	W 65-70	ls	2.0	7.8	8.0	40	5.7	1.8	0.4	133.3	22.5	72.5	39.5	0.95			
	70-75	sl-ls	---	7.2	6.7	48	3.1	1.9	<.1	107.5	21.0	67.0	20.5	0.87			
	W 70-75	ls	1.5	7.8	8.0	44	5.9	1.4	0.3	128.7	21.0	69.0	39.5	0.92			
	75-80	lfs	---	7.4	6.0	42	3.3	1.5	0.1	95.7	20.0	56.0	20.5	0.85			
	W 75-80	ls	1.8	7.8	7.7	46	6.0	1.4	0.5	123.5	22.0	63.5	39.0	0.90			
	80-85	ls	---	7.1	5.1	36	3.8	2.4	0.2	74.2	20.0	36.0	20.0	0.78			
	W 80-85	(no sample recovery)															
	85-90	ms	---	7.0	4.6	36	3.6	3.2	0.1	66.8	22.2	29.0	18.2	0.66			
	W 85-90	sl	4.4	7.6	5.6	44	4.4	2.0	0.8	86.6	24.0	39.5	25.0	0.90			
	90-95	ls	8.3	7.6	4.8	36	3.0	1.5	<.1	72.5	22.6	34.4	16.2	0.71			
	W 90-95	ls	4.4	7.8	6.0	40	5.8	1.6	0.6	93.1	24.0	38.0	32.5	0.77			
	95-100	ls	0	7.4	5.8	38	2.2	1.9	<.1	94.6	21.0	61.0	14.0	0.48			
	W 95-100	(no sample recovery)															
	100-105	ls	---	7.0	6.2	37	1.7	3.9	0.3	105.2	22.0	75.0	12.0	0.44			
	W 100-105	(no sample recovery)															
	105-110	ls	---	6.9	7.0	41	1.3	4.0	0.3	120.1	20.0	94.5	9.5	0.42			
	W 105-110	(no sample recovery)															
	110-115	ls	---	5.4	7.0	38	0.8	1.3	0.4	123.1	20.0	98.0	6.5	0.26			
	W 110-114	fsl	1.6	7.4	6.8	45	4.2	2.4	0.5	112.6	21.5	65.5	28.0	0.52			
	115-120	lig	---	6.4	8.2	75	2.7	8.5	0.5	145.0	24.0	107.5	22.0	0.51			
	W 115-120	(coal cored, no sample)															

Table XVII (Cont'd)  
 Consolidation Coal Co. - Renner Cove  
 Overburden Samples Air vs. Water Mist Drilled

NDSU Soils Lab 5/76

Sample	Depth (ft.)	Tax.	CaCO <sub>3</sub> Eq. %	pH (paste)	ECE (mmho)	SAT %	SAR	Saturation Extract Soluble Ions (Meq./L)						
								CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	Ca	Mg	Na
DS76-744 (Cont'd)	120-130	lig		6.4	6.0	84	6.4	7.8	0.2	85.0	25.0	33.0	34.5	0.54
	W 120-130	(not sampled)												
	130-135	sil	0	7.6	2.9	81	8.2	3.5	<.1	30.0	5.6	6.7	20.4	0.84
	W 130-135	(not sampled)												
	135-140	sicl	7.1	8.0	2.2	95	12	3.5	<.1	18.7	2.0	2.4	17.2	0.63
	W 135-140	(not sampled)												
Drill water (synthetic)	(TDS 2015 ppm)			7.9	3.1		11	11.9	0.1	26.4	2.0	9.6	26.8	

Note: All fine sandy loam from 45 ft to coal at 113 ft is poor sample, poor recovery, sloppy and mixed, depth of origin is questionable because of hold up in hole, etc.





