CHUITNA COAL PROJECT

SOILS INFORMATION FROM PREVIOUS BASELINE STUDIES

Prepared for:
Mine Engineers, Inc.
3901 So. Industrial Road
Cheyenne, WY 82007

By:

Chien-Lu Ping
Ph.D. Certified
Professional Soil Scientist

Terry H. Brown
Ph.D. Certified
Professional Soil Scientist

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INTRODUCTION

The Chuitna Coal Mine mining permit area is located in the southern half of R12W, T13N and the northern half of R12W and T12N, Seward Meridian, Alaska. The total permit area is 6,500 acres.

The available soils information of the Chuitna mining lease area is covered in 2 reports. The first one is the USDA Natural Resources Conservation Service "Soil Survey of Yentna Area, Alaska" published in 1998 (Olszewski, 1998). The field work was performed from 1978-1982 and the published scale is 1:31,680 or 2 inches to the mile. The soils were mapped to types of series, complex and miscellaneous land types such as water and glaciers. The second report is the Soil Resource Report as part of the Diamond Chuitna Mine Permit Application to Conduct Surface Resources Information, Part C: Environmental Resources Information (Diamond Alaska Coal Company, 1985). The Soil resources inventory was conducted by Environmental Research & Technology, Inc., (ERT, 1985). This survey covered the north-eastern part of the mining permit area, approximately 2436 acres. The soils were mapped at a scale of 1:15,840 (4 inches to a mile). Although the ERT survey was done at a scale twice large than that of the USDA-NRCS, the ERT map is no more detailed than that of the latter. Both are at Order 2.5.

USDA-NRCS SOIL SURVEY

Soil Series

The USDA-NRCS soil survey recognized 12 soil series and one higher taxon (Cryorthent).

The soil units are either mapped as consociation in which soil series is further divided by single phase defined by soil texture and slope gradient, and complexes in which more than 2 soil series were identified and mapped a complexes of phases. The following map units were delineated in the mining permit area.

MU 203 Chichantna peat, 0-8% slopes

The Chichnatna peat is a very poorly drained, very deep (>60") organic soil formed in muskegs and depressions. Water table ranges from 0 to 6 inches. This map unit contains some small lakes.

MU 206 Chuit and Nakochna silt loams, 3-30 % slopes

This map unit is well drained and formed on mountain slopes. It consists of two soils. The Chuit silt loam is more than 60 inches deep and the Nakochna silt loam is shallow, usually 14 to 20 inches to bedrock. Both of these soils formed in volcanic ash over firm glacial till. The depth to the root restricting firm till is 20 to 38 inches inches in the Chuit soil.

MU 214 Killey and Hiline silt loams, 0-2 % slopes

These are very poorly drained and very deep soils formed on floodplains. The texture ranges from sand, sand loam, silt loam and loam with some rock fragments due to stratification as a result of the fluvial process. Depth to the sand and gravel is 20 to 40 inches in the Killey soil and >40 inches in the Hiline soil. This unit includes 15% of other soils and landscape units such as muskegs, small streams, beaver ponds, small area with finer soil textures, and stony surfaces.

MU 216 Kroto-Strandine-Cryrthents complex, 30-45 % slopes

This well drained, deep to very deep complex unit occurs on glaciated areas including moraines and steep mountain slopes. It consists of 35% Kroto soils, 30% Strandline soils, and 30% Cryorthents. Both the Kroto and the Strandline soils have brownish silt loams over glacial till. The depth to root restricting firm glacial till is 10 to 20 inches in the Kroto soil, 20 to 37 inches in the Strandline soil. The Cryorthents form in colluvial slopes and are mixed volcanic ash and glacial till. These soils have a gravelly silt loam texture and a more grayish color. There are 15% inclusions of wet areas, area with slope >45% and areas with surface stone sand boulders.

MU 226 Puntilla silt loam, 7-20 % slope

The Puntilla silt loam is a well drained, very deep (>60") soil on mountain side slopes. The soils formed in 14 to 38 inches of volcanic ash (silt loam) over firm glacial till (gravely loam) that restricts root growth. There are 15% inclusions of muskegs, some poorly drained mineral soils, and areas with surface stones and boulders.

MU 232 Schrock silt loam, 0-2 % slopes

This well drained deep soil formed in volcanic ash on stream terraces. The depth to gravelly substratum is 14 to 28 inches. This unit contains 10% inclusions of poorly drained areas, stream channels, soils that are gravelly throughout, and areas with stones and boulders.

MU 233 Slikok muck, 0-5% slopes

This very poorly drained and very deep soil formed in thick organic deposits along the border of toe slopes, muskegs and depressions. The depth to the impermeable layer (glacial till) is 40 to 60 inches. It contains 10% inclusions of some well drained soils, small lakes, and poorly drained muskegs

MU 236 Starichkof peat, 0-7 % slopes

This very poorly drained and very deep soil formed in deep organic deposits in muskegs. This unit also contains 10% mineral soils, small lakes and areas with boulders.

MU 237 Strandine-Kroto complex, 20-45 % slopes

This well drained and very deep complex unit consists of 45% Strandline silt loam and 40 % Kroto silt loam, and 15% inclusion of poorly drained and stony soils. The soils formed in volcanic ash over firm glacial till. The depth to root restricting glacial till is 20 to 37 inches in Strandline soils and 10 to 20 inches in Kroto soils.

MU 238 Strandine-Kroto-Chichantna complex, 1-20 % slopes

This well drained and very deep complex unit consists of 30% Strandline silt loam, 30 % Kroto silt loam, and 25% very poorly drained and very deep Chichantna soil. Within this unit there are 15% inclusions of poorly drained and stony soils, streams and small lakes. The soils formed in volcanic ash over firm glacial till. The depth to this root restricting glacial till is 20 to 37 inches in Strandline soils, 10 to 20 inches in the Kroto soil and >60 inches in the Chichantna soil.

MU 240 Strandine-Spenard-Kroto complex, 2-30 % slopes

This complex consists of three major soils; 30%deep, well drained Strandline silt loam, 30% deep, well drained Kroto silt loam, and 25% very deep and very poorly drained Spenard silt loam. There are 15 % inclusions in this unit that includes some poorly drained muskegs and some areas with boulders. All three soils formed in volcanic ash over glacial till. The depth to root restricting firm till

is 20 to 37 inches in the Strandline soil, 10 to 20 inches in the Kroto soil and 20 to 36 inches in the Spenard soil.

Soil Map Units

The following map units were delineated in the port facility and along the transportation corridors.

MUs 203, 214, 216, 217, 236 and 240 are described the same as in the previous section (1.1). There are three additional MUs mapped in the areas of concern.

MU 218 Nancy-Kashwitna complex, 0-2 % slopes

This deep, well drained complex unit consists of 50% Nancy soils and 35 % Kashwitna soil. Both Nancy and Kashwitna soils formed in volcanic ask over gravelly glacial outwash on outwash plains at lower elevations, mostly along the eastern portion of the transportation corridor and the proposed port site. Both soils have silt loam topsoil. The only difference is that the Nancy soil is deeper (20 to 30 inches) and the Kashwitna soil is shallower (10 to 20 inches) to the sand and gravelly substratum. This unit may contain 15 % of poorly drained soils in depressions, abandoned stream channels that are sandy and scattered areas with surface stones or boulders

MU 219 Nancy-Kashwitna complex, 2-7 % slopes

This deep, well drained complex unit consists of 50% Nancy soils and 35 % Kashwitna soil. Both Nancy and Kashwitna soils formed in volcanic ash over gravelly glacial outwash on outwash plains at lower elevations, mostly along the eastern portion of the transportation corridor and the proposed port site. Thus both soils have silt loam topsoil. The only difference is that the Nancy soil is deeper (20 to 30 inches) and the Kashwitna soil is shallower (10 to 20 inches) to the sand and gravelly substratum. This unit may contain 15 % of poorly drained soils in depressions, abandoned stream channels that are sandy and scattered areas with surface stones or boulders.

MU220 Nancy-Kashwitna complex, 7-12 % slopes

This deep, well drained complex unit consists of 45% Nancy soils and 40 % Kashwitna soil. Both Nancy and Kashwitna soils formed in volcanic ash over gravelly glacial outwash on outwash plains at lower elevation, mostly along the eastern portion of the transportation corridor and the proposed port site. Both soils have silt loam topsoil. The only difference is that the Nancy soil is deeper (20 to 30 inches) and the Kashwitna soil is shallower (10 to 20 inches) to the sand and gravelly substratum. This unit may contain 15 % of small areas of muskegs, soils on short and steep terrace breaks and scattered areas with surface stones or boulders.

Summary

In general, the mineral soils formed in volcanic ash over glacial till or moraine. Most mineral soils are well drained and have silt loam texture in the volcanic ash layers and gravelly loam in the glacial till substratum. The upper horizons of the soils (0 to 15 inches) are brownish. But the silt loam layers above the contact of the glacial till generally are grayish brown and the glacial till is grayish. The firm glacial till substratum perches water during part of the growing season but the water table is not high enough to cause change in drainage. Although the glacial till layer restricts roots and contains gravel, when mixed with the volcanic ash layers (silt loam), the mixture serves as a good growth medium.

ERT SOIL SURVEY

General Information

A soil survey was completed by ERT in 1985 for the application for a permit to mine the coal in the Chuitna Coal Project area. The results of the survey are summarized in this document and the Soil Survey Maps are provided in Appendix I. The ERT soil inventory covered a portion of the coal mine permit area, thus only five soil series and one taxa at the order level (Histosols, organic soils) and another at the great group level (Cryaquents). In the USDA-NRCS soil survey, the Histosols were further divided based on textures into series; the Chichantna peat, the Starichkof peat and the Slikok muck. But in the ERT survey, it recognized the Chichantna but lumped the other two at the series level. In lowlands, the ERT survey recognized two poorly drained soils that were not included in the permit area; the Jacobsen and the Moose River series. However, the NRCS survey mapped Spenard series that occupies similar landforms. These soils are all Cryaquepts with varying thickness of surface organic horizon with gravelly loamy mineral horizons. Thus in terms of environmental and engineering interpretations, there is no significant difference. On uplands, the ERT survey mapped a Talkeetna variant. The Talkeetna series formed in thick volcanic ash over glacial moraine. This soil has properties similar to that of the Strandline series in terms of landuse management interpretations.

The great contribution of this ERT survey is the laboratory data from the field sampling. This database offers an opportunity to look into the physical and chemical properties of most of the soil series surveyed in the northeastern portion of the permit area.

Physical and Chemical Properties of the Soils in the ERT Survey Area

Soil texture: Based on ERT report, most mineral horizons of upland soils have silt loam textures. However, the laboratory results showed particle size analysis as follows:

Clay 0-6%
Silt 20-60%
Sand 29-35%

Based on these ranges of particle size distribution, the textures keyed out from loamy sand to silt loam. The most likely cause for this discrepancy is the soil testing method used. Assume the laboratory used the particle size analysis according to the ASTM procedure, which requires the soils to be oven dried at 105^{o}C. Most of the topsoils (A and B horizons) of these soils on uplands in the mining permit area formed in volcanic ash. Weathered volcanic ash produces poorly crystalline clay minerals called allophone or immogolite (Shoji et al., 1988; Ping et al., 1989) and these minerals have irreversible drying properties (hysteresis). Once the soil is oven dried, the clay particles will

cemented together like sand particles and will not disperse upon rewetting (Ping et al., 1988; 1989). Thus to correctly measure the clay contents, the particle size analysis must be tested using moist samples, otherwise the water-holding capacity of the soils will be grossly underestimated.

Chemical Properties

Nearly all the soils in the mining permit area are acid. The pH values of upland mineral soils range from 3.7 to 4.6 and that of organic soils range from 4.0 to 5.1. Under such acidic condition, most cations were leached resulting in very low water soluble cations with Ca+Mg < 0.5 meg/100g. The electric conductivities are low and the exchangeable sodium percentage (ESP) is negligible (<0.6%). The cation exchange capacity (CEC) averages 40 meq/100g for upland mineral soils and >90 meq/100g for organic soils. Because of the strong acidity, the base saturation of the upland mineral soils are <60%. The chemical properties reflect the soil forming environment and the soil profile description.

Topsoil Analysis

Topsoils in the mining permit area were analyzed for the purpose of reclamation. In addition to the above parameters, the samples were analyzed for micronutrients and for potential hazard materials, such as heavy metals and toxic compounds.

In the samples analyzed, Arsenic (As), Molybdenum (Mo), Boron (B) and nitrite (NO_2^{-1}) levels are below detection limit (<0.001 ppm). The concentrations of water soluble Cu, Mn, Ni are <0.06, 0.1, and 0.3 ppm, respectively. The extractable Cu, Mn, and Ni are 1to 3, 0 to 4, and 0.8 ppm, respectively. Based on these values, the level of heavy metals is not likely a concern for toxicity, but instead the plants may be on the low side for micronutrients . The organic matter contents in the upland mineral soils range from 4 to 12% with an average value of 6%, and the total nitrogen contents range from 0.2 to 0.5%. The average value of the C/N ratio is about 20. These values are representative for a good topsoil material.

Summary

Based on the USDA-NRCS and the ERT soil survey reports, the soil environment is characterized as humid and leached; thus the topsoils are characterized with relatively low pH values and low extractable bases (Ca and Mg). However, these soil conditions currently support lush vegetation communities throughout the Chuitna Coal Project area. Since the soil environment is expected to be very similar in the reclaimed versus the pre-mined conditions, the reclaimed sites are expected to support the vegetation communities that will be established to meet land use requirements.

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