REGIONAL COPPER-NICKEL STUDY
SOILS OF THE STUDY AREA

Minnesota Environmental Quality Board

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TABLES

Abstract

The following report comprises a summarization of physicial, chemical, and typological characteristics of soils of the Regional Copper-Nickel Study Area (Study Area). Data have been collected either directly by the Regional Copper-Nickel Study (RCNS) or from published sources.

Typological information was obtained from the Minnesota Land Management Information System (MLMIS). Because data from MLMIS are not self-explanatory, a detailed summary of soil mapping and classification conventions is included in the first section of the report. Summaries of physical characteristics of soils are taken from standard Soil Series Interpretations sheets that are published by the Soil Conservation Service (SCS). Sheets for series occurring in the Study Area are presented in the Appendix. Brief summaries of the properties of individual heavy metals as they occur in soils are taken from Aubert and Pinto (1977). These summaries are followed by a discussion of the chemical characteristics of soils of the Study Area.

Most data were obtained by the RCNS during 1976 and 1977. Although soil sampling was not extensive and did not include the full range of soil conditions in the Study Area, the data presented in this report provide base-line estimates of soil chemical conditions in an environment that is essentially pollution free.

SOILS OF THE RCNSA

FIGURES

Figure 1. Computer-generated map of Soil Associations in the Study Area.

To the soil scientist, the term "soil" refers to "the collection of natural bodies on the earth surface, in places modified or even made by man of earthy materials, containing living matter and supporting or capable of supporting plants out of doors" (SSS 1975). By definition, then, soils are limited to the uppermost few meters of the earth's crust. They are derived from parent material (i.e. rock ground to a more or less fine texture) that has been subjected to a number of soil forming processes. The five factors that are generally recognized as being important in the formation of soils are parent material, climate, time, vegetation and topography.

Soils are described by profiles that are sections through surface materials down to the more-or-less unweathered parent material. Unweathered surfaces that are exposed following glaciation, volcanic activity, erosion or the activities of man are subjected to soil forming processes over time. Selective leaching and accumulation (illuviation) of these materials results in the development of characteristic layers (or horizons) in soils. Horizons have been identified that can be recognized from place to place, and these form the basis for soil classification systems. Several such systems have been devised, but the most recent and comprehensive is that proposed by the Soil Survey Staff, Soil Conservation Service, U.S.D.A. Their efforts resulted in the recent publication of Agriculture Handbook No. 436: Soil Taxonomy, A basic system for making and interpreting soil surveys (SSS 1975).

Within the system proposed by the Soil Survey Staff, the following categories are recognized. Categories are arranged in hierarchical fashion with orders being the highest category.

Orders are differentiated by the presence or absence of diagnostic horizons or features that are marks in the soil of differences in the degree and kind of dominant sets of soil forming processes that have gone on. Ten orders are recognized.

Suborders are selected to reflect the most important variables within an order. These may have to do with the presence or absence of a diagnostic horizons, or the specific effects of any of the five soil forming factors. Currently 47 suborders are recognized.

Great groups are differentiated by placing together soils that have in common the following properties--close similarities in: kind, arrangement and degree of expression of horizons; soil moisture and temperature regime; and base status. About 185 great groups have been identified in the United States.

Subgroups Three kinds of subgroups are recognized:

-those that conform to the central concept of the great group
-those that are intergrades or transitional forms to other orders, suborders, or great groups.
-those that are extragrades (e.g. those that are not representative of the great group but that are not transitional to any other known kind of soil).

Approximately 970 subgroups have been identified in the United States.

Families In this category, groups within a subgroup have been formed so that soils with similar physical and chemical properties that affect their responses to management and manipulation for use are combined. Factors that are considered are:

1. Particle-size distributions in horizons of major biological activity below plow depth (∿12")
2. Minerology of the same horizons that are considered in naming particle-size classes.
3. Temperature regime.
4. Thickness of the soil penetrable by roots.

About 4,500 families are currently recognized in the United States.

Series are the lowest category in the system. Two kinds of distinctions are made between series. First, a series cannot range across the limits between two families or between two classes of any higher category. Second, distinctions between similar series of a family represent restrictions in at least one of the ranges in properties of the family. About 10,500 series have been recognized in the United States. They are usually named after the geographic location of the originally described profile.

Within a given geographic location, soils may be mapped at several levels of detail. In the most detailed mapping, soil series distributions are determined so that maps are accurate when units of 5-10 acres (2-4 ha) are examined. Most of the agricultural areas in Minnesota are mapped at this level, as are some smaller, special-use areas. Soil surveys for counties that have been mapped in detail can be obtained from the SCS. For most of the forested counties in Minnesota, detailed soil mapping has not yet been completed. It is likely that it will be 5-10 years before detailed soil survey maps are available for the seven-county Arrowhead Region. For the Studies Area we are, therefore, forced to rely upon the more generalized soil association maps available through the MLMIS. Within

the MLMIS, soils are identified in variable V15. Data levels of V15 are segregated by units, referred to as soil associations-groups of two or three soil series that occur together on the landscape. Series within an association usually have similar family characteristics.

The distribution of soil series within each soil association that occurs in the Study Area is presented by terrestrial biology zone in Table 1. Soil association (SA) descriptions include series names and a brief characterization of lanscape features. Within each association are shown the dominant series and their subgroup and family relationships. Specialized terms used in family descriptions are:

dysic- indicates pH<4.5 in all organic horizons.

euic- indicates pH>4.5 in at least some organic horizons.

mixed- indicates minerology that is <40 percent of any one mineral other than quartz or feldspars.

montmorillonitic- indicates minerology that is more than half montmontmorillonite and noutronite by weight or a mixture that has more montmorillonite than any other one clay mineral.

skeletal- rock fragments 2 mm in diameter or greater make up 35 percent or more by volume.

Examination of the distribution of soil series within the associations shows that associations transcend subgroup (and higher category) boundaries.

Thirty-two named and an additional five unnamed series have been identified in the Study Area. These series are distributed among 21 subgroups, 15 great groups, 11 suborders and 5 orders. Maps generated by MLMIS show that the 35 series are distributed among 23 soil associations. Although the distribution of series and subgroups within a soil association is known (see Table 1), the MLMIS map of V15 for the Study Area (Figure 1) does not

show these levels of classification. Table 2 gives acreage distributions, grouped by terrestrial biology zone, for soil associations. Standard Soil Survey Interpretations for all series are found in Appendix A. Important aspects of these interpretations have been summarized in Table 3.

The complete classification for all series described in the Study Area is presented in Table 4. Included are association affiliations for the series. Note that a given series may occur in more than one association (either as a major or a minor component). In order to interpret Table 2, brief descriptions of the categories are presented in the following section. Descriptions are taken more-or-less verbatum from Agriculture Handbook No. 436. Specialized terms included in the descriptions are defined in the Glossary.

Category Descriptions

1. Alfisols have an argillic horizon-that is, a horizon in which layer-latice silicate clays have accumulated, by illuviation, to a significant extent. Alfisols have moderate to high base saturation and water is held at <15 bar tension during at least 3 months each year when the soil is warm enough for plants to grow. Alfisols may have any of a variety of cemented layers in the lower horizons. The surface horizon of typical Alfisols contains 2.0-2.25% organic matter, and .8-1.0% clay and has a base saturation of about 87%. At 50cm these values are about .2%, 2% and 87% respectively.

IA. Aqualfs are gray and mottled Alfisols that have an aquic moisture regime, or are artificially drained and have characteristics associated with wetness (e.g. mottles or iron-manganese concretions >2mm in diameter).

IA. 1. Fragiaqualfs are Aqualfs that have groundwater perched above a fragipan at some period and saturating the soil at another. Fragiaqualfs were formerly called Planosols.

IA1a. Aeric Fragiaqualfs are somewhat better drained than typical Fragiaqualfs. They usually have enough slope that water does not stand on the surface.

IA.2. Ochraqualfs have an ochric horizon and do not have a natric horizon or a fragipan. Ground water fluctuates from a level near the surface to one below the argillic horizon. These soils were formerly classified mostly as Planosols and Low-Humic Gley soils.

IA2a. Typic Ochraqualfs
IA2b. Aeric Ochraqualfs

These two soils are distinguished by the latter having somewhat better airation and, hense, a ligher color and less mottling.

IB. Boralfs are the more-or-less freely drained Alfisols of cool places. They have a frigid or cryic temperature regime and are typically strongly acid in the surface horizons. Most are forested, especially with coniferous cover.

IB1. Eutroboralfs are Boralfs that have a frigid temperature regime, an argillic horizon, the top of which is usually within 60 cm of the soil surface, and no natric horizon or fragipan. They were formerly called Grey Wooded soils.

IB1a. Typic Eutroboralfs are freely drained soils that are deep or moderately deep to bed rock.

1B1b. Aquic Eutroboralfs are wetter than those above and have mottles within the upper 25 cm of the argillic horizon.

II. Entisols - Entisols are relatively young mineral soils that are highly variable but have in common a virtual absence of horizons.

IIA. Aquents are wet Entisols. They may be in deltas on the margins of lakes where the soil is continuosly saturated with water, in flood plains of streams where the soils is saturated at some time of year, or in wet, very sandy deposits. They are bluish or gray and mottled.

IIA1. Fluvaquents are primarily wet soils of flood plains and deltas. Most have either fine or coarse stratifications that reflect deposition of sediments under changing currents and in shifting channels. They typically have higher organic carbon contents than most wet mineral soils. These soils were formerly considered to be Alluvial or Low-Humic Gley soils.

IIA2. Psammaquents are aquents that have a sandy texture and gray or mottled-gray colors. Water tables are usually at or near the surface. These soils were formerly called Low-Humic Gley soils and Regosols.

IIA2a. Humaqueptic Psammaquents have a thin A1 horizon that resembles an umbric epipedon. Base saturations are <50% in more than half the subhorizons in the upper 1m.

IIA2b. Mollic Psammaquents have a thin A1 horizon that resembles a mollic epipedon

IIB. Psamments are mainly Entisols in poorly graded (well sorted) sands in sandy parent materials that were sorted in an earlier geologic period. Ground water is deeper than 50 cm and usually is much deeper. These soils have low water-holding capacity. Gravelly and very gravelly soils are excluded from this group.

IIB1. Udipsamments are Psamments of humid regions. They are mostly brownish and freely drained and have some weatherable minerals (>5%) in the sand fraction. Mean summer and winter soil temperatures at a depth of 50 cm differ by $5^{o}C$ or more. These soils were formerly mostly considered to be Regosols.

IIB1a. Typic Udipsamments

b. Alfic Udipsamments unlike a., these soils have argillic horizons and have a base saturation >35% in some horizon.

c. Spodic Udipsamments have an albic horizon.

IIC. Orthents are Entisols of recently eroded surfaces, but they are not present in areas that have high water tables.

IIC1. Udorthents are Orthents of midlatitudes that have a udic moisture

regime. They commonly occur in recently exposed regolith , in slightly consolidated rock or thin regolith over bedrock.

IIC1a. Typic Udorthents. These soils are deep or moderately deep to bedrock have deep ground water, low animal activity and thin layers or none of fine pyroclastic deposits. Few of these soils are cultivated.

III. Histosols are soils that are dominantly organic. They contain at least 12-18% organic carbon if saturated by water and at least 20% o.c. if they are never saturated. By volume, Histosols are well over 50% organic matter. Most are saturated or nearly saturated with water most of the year. Suborders are defined by moisture regime and the degree of decompositon of the organic materials. Decomposition is often a function of temperature and great groups are defined in part by soil temperature regimes.

IIIA. Fibrists consist largely of plant remains so little decomposed that they are not destroyed by rubbing and their botanic origin can be readily determined. They tend to have the lowest ash content and bulk density of the Histosols. These soils were formerly called Bog soils.

IIIA1. Sphagnofibrists are those fibrists derived mainly from Sphagnum spp. and associated herbaceous plants.

IIIA1a. Typic Sphagnofibrists occur as raised bogs or high moors in closed depressions and as blanket bogs in more or less dissected landscapes. They are seldom cultivated but have important uses as fuel and mulches.

IIIA1b. Hemic Sphagnofibrists differ from IIIA1a in that they have more than 23 cm of subsurface and bottom layers occupied by humic materials and more than 12.5cm of the same layers occuppied by sapric materials.

IIIB. Hemists are Histosols in which the decomposition of organic materials has proceeded to the point where the botanic origin of as much as 2/3 of the material cannot be determined or the materials can be largely destroyed by rubbing between the fingers. Hemists were formerly called Bog soils.

IIIB1. Borohemists are Hemists that have a frigid but not cryic temperature regime.

IIIB1a. Typic Borohemists are soils that consist of thick, continuous hemic materials.

IIIC. Saprists consist of almost completely decomposed plant remains. They occur where ground water levels tend to fluctuate within the soil. They were formerly called Bog soils.

IIICa. Borosaprists, like Borohemists, have a frigid but not cryic temperature reqime.

IV. Inceptisols are soils of humid regions that have altered horizons that have lost bases or iron and aluminum but retain some weatherable minerals.

IVC. Aquepts are wet Inceptisols with poor to very poor drainage. Generally they have black surface horizons and mottled gray subsurface horizons. They typically occur in very flat plains, depressions or flood plains.

IVA1. Humaquepts are nearly black or peaty, very wet, acid aquepts of humid midlatitudes. Formerly they were called Humic-Gley or Half-Bog soils.

IVA1a. Histic Humaquepts have a histic epipedon, are the wettest of the Humaquepts, and are intergrades to the Histosols.

IVA2. Haplaquepts are light colored, gray aquepts that do not have a fragipan or duripan but that have ground water that stands at or near the surface for long periods. Formerly they were called Low-Humic Gley and Humic Gley soils.

IVA2a. Aeric Haplaquepts are lighter colored than Typic Haplaquepts because of either shorter periods of saturation of the whole soil or somewhat deeper groundwater.

IVA2b. Mollic Haplaquepts have darker surface horizons than Typic Haplaquepts and have relatively high base saturations.

IVB. Ochrepts are light colored, brownish more or less freely drained Inceptisals. Most have an ochric epipedon and a cambic horizon.

IVB1. Fragiocherepts are loamy soils that have a brownish cambic horizon and a fragipan at a depth of about 50cm. Perched ground water above the pan is common at some time during the year. Formerly they were included with Sols Bruns Acids.

IVB1a. Typic Fragiochrepts are soils that have no distinct mottles in the upper 30 cm and have an ochric epipedon.

IVB2. Dystrochrepts are brownish, acid Ochrepts of humid regions. They have an ochric epipedon on a cambic horizon. Formerly they were considered to be Lithosols and Alluvial soils.

IVB2a. Typic Dystrochrepts are soils that are moderately deep to deep

to bedrock , are freely drained and acid, and have an ochric epipedon.

IVB2b. Lithic Dystrochrepts usually have hard rocks at depths of 25-50 cm.

V. Spodosols have a spodic horizon-that is,a horizon in which amorphous mixtures of organic matter and aluminum, with or without iron, have accumulated. Most have little clay. Particle-size classes are mostly sandy, sandy-skeletal, coarse-loamy, loamy-skeletal or coarse-silty. These soils are most extensive in coal, humid climates and are naturally infertile.

VA. Orthods are more or less freely drained Spodosols that have a horizon of accumulation with neither Al, Fe or organic matter predominating. Moisture regimes are udic or occassionally zeric.

VA1. Haplorthods have an albic over a spodic horizon. They were formerly called Podzol or Brown Podzolic soils.

VA1a. Typic Haplorthods are deep, freely drained Haplorthods that have a single sequum and a moderate amount of organic carbon in the spodic horizon.

In addition to the soil associations (SA's) defined by the SCS, soils of the Superior National Forest (SNF) have been independently classified by D. H. Prettyman, Forest Soil Scientist, U. S. Forest Service, Duluth. Prettyman's classification scheme is based upon soil landscape units (SLU's), which incorporate soil texture and glacial landforms. Prettyman has collected data for several parameters that are useful to foresters who are responsible for managing lands within the SNF.

The Minnesota Department of Natural Resources has produced a computerized resource inventory of both SLU's and SA's for a 560 sq mile area (referred to as the MINESITE Area) that lies south and east of Ely. Table 5 lists SLU's that occur within the MINESITE Area.

Although the systems of Prettyman and the SCS are not directly analogous, SLU's are somewhat simlar to SA's in that SLU's are dominated by soils of a given series but contain inclusions of soils from other series. Table 6 is a cross-tabulation of SLU's and SA's that was produced by the staff of the MINESITE Project. The table shows that SLU's tend to be more specific than SA's for mineral soils, whereas the reverse is true for organic soils.

Trace Elements in Soils

In the following section, the status of trace elements in soils is reviewed on a world-wide basis. Typical elemental concentrations are presented as are the factors that govern the abundance and availability of individual elements. Where toxicity and/or deficiency problems have been noted, these are discussed. The summaries are abstracted from a more extusive review that was recently presented by Aubert and Pinta (1977).

Boron:

Average total boron contents of soils range from 20-50 ppm with variations due to parent material and soil types, which reflect the differences between geographical regions and climatic zones. Extremely low contents have been associated with podzolic sandy soils where concentrations may be less than 5 ppm. Calcarious soils in drier climates may have boron concentrations in excess of 150 ppm.

Available boron is typically expressed as that fraction of total boron that is soluble in hot water (Berger and Truog 1939). Average concentrations range from 0.1 to 1-2 ppm. Thus, water soluble boron typically represents 0.1-3.5% of total boron, although under some conditions the proportion may rise to 65-80% (in saline alkali soils of arid regions).

Several factors contribute to variations in total and "plant-available" boron in soils. Concentrations vary directly with humus and organic matter concentrations, and differences in distribution among horizons in a soil follow variations in humus content. Boron availability varies also with soil texture. Plants are better able to remove boron from coarse-textured soils. pH affects the availablity of boron in soils, for under basic conditions boron is in the form of compounds less easily soluble than under acid conditions. Boron may become deficient in very acid soils, for it may become leached from surface horizons. Concentrations are generally highest where rainfall is deficient.

The upper and lower limits of plant tolerance to available boron fall within a narrow range of between 0.1-0.2 and 1.5 ppm and may vary with plant species. Deficiencies are most likely to occur in acid leached soils, coarse-textured soils and calcareaous soils and may also occur under conditions of excessive cultivation and liming. Deficiencies are corrected by fertilization, whereas toxic levels are ameliorated by liming.

Chromium:

Average total chromium contents of soils range from 100-300 ppm, although extreme values range from traces to 3,000-4,000 ppm. Parent rocks rather than pedalogical processes play a major role in governing soil concentrations of chromium, which is a relatively stable element.

Chromium is only very slightly soluble in weak reagents. Available chromium extracted with 2.5% acetic acid from soils in Scotland was .01-.4% of total chromium, whereas in France 1N ammonium acetate extractable chromium was 0.1-1% of total chiromium.

Concentrations of chromium in soil horizons within a profile vary directly with humus content. Concentrations are also higher in finer textured soils compared to coarse-textured soils and are proportional to iron-oxide contents. Toxicity of chromium depends upon the valence of particular ions with the trivalent compounds being the least toxic (Grosman 1966). Soluble sulphate and nitrate compounds are more toxic than insoluble oxide or phosphate compounds. Toxicity increases as soil acidity increases and soil assimilable phosphoric acid decreases. Toxicity can be ameliorated by adding limestone and monobasic calcium phosphate.

Cobalt:

Average total cobalt contents of soils range from about 10 to 15 ppm. Extreme values may range from 0.05 to 300 ppm. Variations are attributable to both parent rocks and pedological process, especially those associated with climatic variations. In temperate and boreal regions total cobalt contents range from 0.05 to 200 ppm. Peat soils are typically low in cobalt with values rarely exceeding 5-10 ppm, even under wide variation in climatic conditions.

Available cobalt (extracted with 2.5% acetic acid) generally is in the range of 0.05 to 1 ppm. Upper and lower limits in the U.S. are 3.74 and 0.008 ppm (extracted with 2.5% acetic acid). Available cobalt as a percent of total cobalt varies widely from less than 1% to as much as 46% in leached soils in the U.S. Stronger reagent (e.g.1N nitric acid and 1N HCl) will extract greater amounts of "available" cobalt.

Cobalt accumulates in soil horizons that have high humus contents, for cobalt is fixed by humus. Cobalt is also sorbed by clay minerals, and its distribution in the profile follows that of clay. Available cobalt content depends upon the redox potential of soils. High acidity also facilitates the solubilization of cobalt compounds and aids their elimination by leaching.

Soils containing <5 ppm total cobalt may not be capable of supplying plants with quantities essential to animals. Because of the role it plays in the formation of haemoglobin, cobalt is an important element for animals. In the U.S. Alban and Kubata (1960) state that available cobalt contents should not be lower than 0.2 ppm. Deficiencies are corrected by fertilization with cobalt sulphate. Toxicity problems are not reported by Aubert and Pinta (1977).

Copper:

On a world-wide basis, average total copper concentrations range from 15 to 40 ppm, although extremes vary from traces to 200-250 ppm. Variations are due primarily to different contents of parent rocks and, to a lesser extent, to variations in soil types that correspond to climatic zones and geographic regions. Podzols over sulphide-rich bedrock in New Brunswick have copper conentrations that are five to six times greater than those in soils not over sulphide-rich bedrock. In general, the effects of parent rocks on copper contents are greatest in podzols and leached and peaty soils. Basic or neutral pH soils rich in humus contain more copper than acid pH soils. Chernozems, some saline soils and vertisols are among the soils richest in copper.

Copper has an important role in plant and animal plysiology, and therefore it is important to know "plant-available" concentrations. These vary according to extraction reagents, which include strong diluted acid (1N HCl and 1N nitric acid) and chelating agents (E.D.T.A.). Ammonium acetate and acetic acid exchangeable copper may be quite low (less than 5% of total), whereas higher concentrations (5-20% of total) are obtained by extracting with E.D.T.A. Strong reagents may extract 20-40% or more of the total copper in soils.

Concentrations of total copper vary directly with humus and adequately evolved organic matter. Copper concentrations also vary with clay contents, and in some leached and impoverished soils B horizons may be richer in copper than A_2 horizons. "Plant-available" copper is highly dependent upon soil pH. Availability generally decreases with increasing pH, but in peaty soils humic acids at pH 2.5-3.5 and fulvic acids at pH 6 form insoluble copper compounds that are unavailable to plants.

Toxicity levels may vary with plant species. Toxicity increases with decreasing pH in soils with equal "available" copper, because activity of copper ions increases when pH decreases. In general, toxicity problems arise when concentrations of "available" copper exceed 25-50 ppm. Toxicity is corrected by additions of organic matter and by liming. As a result of these practices, Copper is fixed and becomes insoluble. "Available" copper less than 0.5 to 3 ppm and total copper less than 7 to 8 ppm results in the development of deficiency symptoms for many crops. Deficiencies are removed by fertilization with copper compounds.

Lead:

The average amount of lead in soils is 15-25 ppm. Extreme values range from traces (in some tropical soils) to 1,200 ppm (in podzols of Canada). In temperate and boreal regions, concentrations are often higher than average. Lead contents in soils are influenced by concentrations of the element in the parent rocks from which soils are formed. Wide variations between horizons in a profile are generally not observed although concentrations may vary in relation to humus and organic matter concentrations. Thus lead is frequently found to be highest in surface horizons.

"Available" lead is usually expressed as that fraction that is extractable with 2.5% acetic acid (pH 2.5) or dilute nitric acid. Typically, 1-10% of total lead is extracted with acetic acid although as much as 30% (acetic acid) and 60% (nitric acid) of the total lead in soils may be extracted. Near industrial sources, concentrations of lead in soils may reach 5,000 ppm. These levels are toxic to both plants and animals. Toxicity varies with soil pH, with lead being more toxic at low concentrations in soils of high pH.

Manganese:

Total manganese concentrations in soil have been reported to vary from traces (in podzols of Poland) to 10,000 ppm (in unleached alkali soils of Chad). Average values are 50 to 1000 ppm. Variations rarely relate to soil typology but are often high among soils of the same type in a climatic region. Concentrations tend to be lower in podzol soils than in loam or clay soils, but variations are frequently related to variations in the content of parent rocks. Within a profile, manganese concentrations vary with variations in humus and organic matter content. The accumulation of manganese is frequently due to biogenetic factors. Deep rooted plants take up Mn from subsurface horizons, and the element is concentrated in surface horizons that have high organic matter contents. Manganese concentrations also vary with soil texture--sandy soils are generally lower in Mn than clayey soils.

Manganese may occur in two forms in soils: the divalent Mn^{2+}, which is soluble, mobile and readily available; and the tetravalent Mn^{4+}, which is practically insoluble, non mobile and unavailable. The different forms of "available" manganese are comprised of these cations. The sum of the "soluble," "exchangable," and reducible manganese corresponds to active manganese. Because different extracting reagents result in very different values for "plant-available" manganese, it is particularly important that extracting reagents be specified when "plant-available" manganese is reported. Depending upon the extracting reagents used, "available" Mn may make up as little as 1-2% to as much 65% or more of total Mn. "Available" manganese contents are inversely related to soil pH. In summary, pedogenic and climatic factors, and redox potential and cultivation conditions all play a role in determining "available" manganese.

Manganese deficiencies are most common on alkaline soils but may also occur on highly acid soils where excessive leaching of Mn occurs. Depending upon extracting reagents and the form of manganese determined, deficiencies for plant growth may exist at levels from <1 ppm to 100 ppm.

Toxicity is most frequently observed in acid soils, especially where organic matter is rapidly decomposed leaving high concentrations of assimilable Mn. Toxicity can be corrected either by enriching soils with organic matter or by liming to raise soil pH.

Nickel:

In temperate and boreal regions, average total nickel contents are 20-30 ppm. Values may range from traces to 500 ppm. Little information is available on "plant-available" nickel, but studies in Scotland indicate that about 2% of total nickel is extracted by 2.5% acetic acid. In the U.S.S.R. "available" nickel may comprise 15% or more of total nickel when soils are extracted with 1N HCl.

Although nickel contents of soils vary primarily with respect to concentrations in parent rocks, other factors affect nickel's distribution in soils. These factors include soil type and degree of evolution, fine fraction and metallic sesquioxide contents and, especially, humus content, for nickel is essentially a biogenic accumulation element.

Zinc:

The average zinc contents of soils range from 50 to 100 ppm, although extreme values range from traces to 900 ppm. Variations occur chiefly in in response to variations in the contents of the rocks from which soils are derived. Within a profile, zinc concentrations follow the distribution of humus and thus tend to be highest in surface horizons. In podzolic soils, zinc accumulates in illuviated B horizons. In general, fine-textured soils have higher zinc concentrations than coarse-textured soils, for clay holds zinc.

Zinc is an essential plant and animal nutrient, but it can become toxic if concentrations are too high. Extracting agents for which "available" zinc data exist are as discussed under "Copper". In the average, "available" zinc concentrations are 5-20% of total zinc, although values may attain 25-90%.

Zinc is solubilized under acid conditions. Thus, more zinc is available in acid soils unless leaching carries it away. Leaching under acid conditions in humid climates is quite common, however, and zinc deficiencies frequently occur under these circumstances. Deficiencies, in the case of crop plants are compounded by the fact that plants remove more zinc from soils and harvesting permanetly removes the element from the soil. Under alkaline conditions, zinc may be unavailable and deficiences may also occur. Although total zinc concentrations are high in fine-textured soils, clay binds zinc to such an extent that it is unavailable for plant growth. High concentrations of soil phosphorus may also limit the availablity of zinc.

Zinc deficiences are commonly observed when "available" zinc concentrations are less than 5 ppm. Corrective measures include the application of zinc fertilizers (e.g. zinc sulphate) and the weak liming of acid soils.

Zinc rarely is toxic under natural conditions, but some problems have been reported when "available" (1N HCL extraction) zinc occurs at 100 ppm. Liming can be employed to eliminate zinc toxicity.

Soil Chemical Characterizations

Soil chemical properties were determined as a part of the Plant Pathology (1976) and Terrestrial Biology (1977) sampling programs. Sampling in each year had different objectives, and, as a result, different designs were employed.

In 1976 sampling was over a broader area than in 1977. Unlike 1977, however, soils were not a criterion in site selection, and some SA's (e.g. 5, 7, and 58) were sampled frequently, whereas others were not sampled at all (most noticeably SA 9). Parameters sampled in 1976 included cation exchange capacity (CEC), pH, base saturation, $SO_4^=$, and F. Also extractable (with EDTA) Fe, Cu, Zn, Cr, Cd, Ni, and Pb, and available (ammonium acetate extraction) Ca, Mg, K, Na, and Mn were determined. Two soil depth intervals (0-6" excluding the forest floor, and 6-12") were sampled. Soils for analysis were obtained from 34 sites. Twelve sample per depth per site were collected and pooled. Thus, a single value for each parameter was obtained for each depth interval at each site. Sites were sampled twice--once in mid June and once in mid August. Soil associations covering approximately 60% of the Study Area were sampled, although only one site each occurred on SA's 4, 49, and 57. By contrast, SA 5 was sampled at 11 sites.

1976 Sampling

The results of the 1976 soil sampling are presented in Table 7 and are discussed systematically by parameter.

Base Saturation. Base saturation integrates soil exchangeable hydrogen and cation exchange capacity data. Soils from the Study Area can be combined into three groups of similar base saturation. Mineral soils appear to have values either greater than 40 percent (SA's 5 and 6) or less than about 30 percent (SA's 4, 7, 8, 10, and 49). Soils of the

latter class are generally coarser textured and/or are quite shallow. Soils with higher base saturations do not have correspondingly higher CEC values. This suggests that differences are more related to the higher ratio of bases to H^+ than to the greater availability of exchange sites. Within the mineral soils, base saturations are typically less in 6 to 12 inch intervals. Organic soils differ from mineral soils in that they generally have much higher CEC and base saturations. This is not true, however, in the very acid soils of SA 57. pH in these Borohemists are 4.0-4.3; nearly one unit lower than other soils, which are in the range 5.0-5.8.

$SO_4^=$. Sulfate levels in mineral soils were not observed to vary with SA. Mineral soil levels are, however, much lower than levels in organic soils. The former generally are in the range 15-25 ppm, whereas the latter are typically >45 ppm. Differences associated with sampling depth were observed only in organic soils where sulfate levels decrease with increasing depth.

Calcium and magnesium. Concentrations of these two major cations parallel, to some extent, values for base saturation. Among the mineral soils, values are highest in SA's 5 and 6. The organic SA 58 has concentrations that are respectively 4-5 and 10 times higher for Ca and Mg compared to mineral soils. Calcium concentrations for SA 57 are typical of the highest mineral soil values, whereas Mg concentrations are twice those in SA's 5 and 6. Except for SA 58, concentrations in the 6-12 inch interval are one half to one third those in the 0-6 inch interval.

Flouride. Concentrations of flouride are uniformly 6-11 ppm for all soils. More often than not values are higher in the 6-12 inch interval but not

significantly so.

Manganese. The organic soil SA 58 has the highest manganese values (150 ppm), although these high values are confined to the 0-6 inch interval. Among the mineral soils, values for Mn are highest (40-65 ppm) in the surface horizons of SA's 5, 10, and 49. Values for other soils were consistently 20-25 ppm. Analyses for 6-12 inch intervals are one tenth to one third those of surface intervals for all soils.

Copper. Mineral soil copper concentrations range from .2-.6 ppm except in SA 8 where values in the 0-6 inch interval average 1.0 ppm. Values in organic soils are higher (1.5-3.0 ppm), but more variable. Concentrations generally decrease slightly with depth. High copper concentrations (2.6 for June and 1.7 ppm for August) were observed for SA 8 at plot P20. This plot has shallow soils over Gabbro bedrock and lies just east of the So. Kawishiwi River. Because of the shallow soils, the 6-12 inch interval was not sampled at this plot. Foliage of aspen leaves sampled at the site did not have high concentrations of Cu.

Iron. Iron concentrations in organic soils are typically 5-6 times higher than in mineral soils. The latter are in the range 75-250 ppm, whereas the former range from 700-1200 ppm. Except in SA's 6, 49, and 58 mineral soil values at 6-12 inches are one half to two thirds those at 0-6 inches.

Zinc. Values for Zn are two to several times higher in surface soils. No clear differences exist between mineral and organic material. Some mineral soils clearly have higher values than others. Values within SA's are quite variable. Abnormally high values (10-20 ppm) were consistently observed in 0-6 inch soils at plots P24 and P25. Both of these plots are on SA 5 in the NW portion of the Study Area.

Nickel. Concentrations of Ni are highest in peat soils. Within mineral soils, the highest values are at the surface. Values generally exceed 1 ppm only in organic soils.

Cadmium. Concentrations of Cd are mostly <.1 ppm--the lower detection limit. Only occasionally were values of .2-.3 ppm observed.

Chromium. As with Cd, Cr values were generally at or below the detection limit of .1 ppm. Values higher than .1 ppm were observed only during the June sampling period, and values never exceeded .8 ppm.

Lead. Concentrations of Pb were higher in 0-6 inch intervals than in soils of 6-12 inch intervals, and they were higher in peat than in mineral soils. Within mineral soils, SA's 5 and 8 had concentrations approximately twice those in SA's 6, 7, and 49. The highest lead concentrations were observed on SA 5 at plots P25 and P28.

1977 Sampling

Sampling in 1977 was more intensive,but was largely restricted to the MINESITE Area. Fourty-eight sites were selected among the most prevalent soil and vegetation types. Soils were sampled only during late July except at two sites where samples were also collected in early June and mid September. For sites with mineral soil, 12 samples each were obtained for the forest floor and the 0-5 cm and 5-10 cm intervals. In peat soils, sampling intervals were 0-5, 5-10, and 55-60 cm. After drying, samples were quantitatively pooled so that, for each site, three samples from each depth interval were available for analysis. Parameters evaluated were total (nitric-perchloric acid digestion) K, Mg, Ca, P, Sr, Ba, Cu, Zn, Mn, Fe, Al, Ti, V, Be, Si, B, Ag, As, Pb, Zr, Th, Co, Cd, Cr, Ni, Mo, Se, and Na.

Soil chemical analysis data are summarized for 9 elements; Cu,Ni,Fe,Mn,Zn, Ca,Mg,P, and K. Means and standard error of the means (SEM), calculated as a percent of the mean, were determined for these elements in each of the five soil associations that were sampled in 1977. An overall mean and variability quotient ($SEM/\overline{X}*100$) of the four mineral soil associations combined were also calculated for each element. The results are presented in Table 8. Relationships between element concentration, soil depth, and litter are discussed, as are comparisons of mineral and organic soils, and individual SA's.

ORGANIC SOILS

Only SA 58 was sampled. Generally, concentrations of most elements (Zn,Fe,Mn,Mg,P and K) decreased with increasing soil depth. The reverse was true for Ni and Ca, however, and Cu followed no apparent trend.

Variability in concentration (as measured by $Vq=SEM/\overline{X}*100$) increased with soil depth for Cu,Mn,Zn,Mg, and P. Only for Fe did variability decrease with increasing soil depth. Ni,Ca, and K showed no trend. Of those elements that exhibited an increase in variability with depth, the rate of increase Vq occurred more rapidly between the 0-5 cm and 5-10 cm depths for Mg,Zn and Mn and

between the 5-10 cm and 55-60 cm depth for Cu and P. Overall, the variability of the average metal concentrations in organic soil were relatively high. Vq values were all over 10% except for Cu,Zn,K, and P at the 0-5 cm depth, and for Cu at 5-10 cm depth. The largest values were found for Fe (19-27%) and Mn (18-37%), whereas those of K were consistently low.

For most elements, the variability of the three samples within a site was generally lower than the variability of the average values from all eight plots. The Vq values were under 10% for all metals except K at the 55-60 cm depth and Fe and Mn at all three depths. Values for Vq ranged from 29.7% (Mn) to 5.1% (P) at the 5-10 cm depth, from 39.6 (Ni) to 4.8% (P) at the 5-10 cm depth, and from 19.9 (Mn) to 7.8 (P) at the 55-60 cm depth. There was no relationship between depth and variability.

MINERAL SOILS

Chemical analysis of mineral soils included samples from SA's 5, 7, 8, and 50. Average concentrations of most elements (Cu,Fe,Mg,P, and K) increased with depth. Only Ni and Mn decreased. Zn showed no depth-related trends.

All elements except Zn, Mn, and P were found in greater concentrations in the soil than in the litter. All average concentrations in the soil

were less than an order of magnitude higher than the litter concentrations.

There was less variability in the average element concentration of soil than litter for all elements except Cu, and P. This decrease in variability at a greater depth may be due to the absence of soil disturbance and the sporadic influx of various elements from organic matter.

The overall variability of both litter and soil was relatively low. Vq values for litter were under 10% for all elements except Mn (10.5%) and Ni (12.1%). Only Ni (13.6%) at the 0-5 cm interval had a Vq greater than 10% in soil. The highest Vq for the 5-10 cm interval also occurred with Ni. The lowest variability in litter was for Cu (2.5%) whereas the lowest variability in both the 0-5 cm (2.9%) and 5-10 cm (2.7%) intervals was for K.

COMPARISON OF ORGANIC AND MINERAL SOIL

Average forest-floor values for the four SA's on mineral soil were higher for all metals at all depths compared to organic soils. The average metal concentration of organic soil at the 0-5 cm depth, however, was usually within the range of average litter values. Only Cu, Ni, and Zn concentrations for organic soils were below the range of litter values, although litter and organic soil averages differed greatly only for Zn. The differences between litter and organic soil values generally increased with increasing organic soil depth. Cu, Ni, and Ca reached their highest concentrations at the 55-60 cm interval in organic soils and were exceptions.

Although Vq vaules for the combined mineral soil group were much lower than those of the organic soil group, a direct comparison is not appropriate, for large differences exist in the number of sites in each group. Generally, metal concentrations increased with depth in mineral soil but decreased with depth in organic soil. Ni followed no depth-related trend in either soil type. Mn and Zn in mineral soil, and Ca and Cu in organic soil also showed no depth-related trends.

COMPARISONS OF MINERAL SOIL ASSOCIATIONS

At both depths, the average concentrations of all elements, except K, varied with SA. The highest average concentrations were nearly always found in SA 7, whereas the lowest were always found in SA 50. SA 8 and 5 generally ranked second and third respectively. No apparent relationship existed between soil association and litter element concentration.

For both litter and mineral soil a comparison of average and Vq values for mineral soil associations reveals that deviant values (those that differ greatly from those of the other three soil associations) nearly always occurred in SA 7 or 50. In SA 7, unusally high average values were found in both soil depths for Ni and Zn, and in the 5-10 cm soil layer for Mn. High average values were also found in the litter for Ni and Mg. In SA 50, low average values were found for Fe at both soil depths and for P at the 0-5 cm layer. Mean concentrations for K for both soil depths were much greater compared to other soil associations. In the litter, high average values were found for Mn, Ca, and Fe. The only atypical average value found in soil assocations other than SA 7 or 50 was for Zn in the litter of SA 5.

Extremes in variability were all confined to SA 7 and 50. Unusually high Vq vaules were found in the litter of SA 7 for Ni, and the 5-10 cm soil depth for Mg. Variability in SA 50 was high in the litter for Mn and Fe. Very low Vq values were found in the litter of SA 50 for Zn and in the 5-10 cm interval of SA 7 for Mn.

The observed chemical relationships among the four soil associations appear to relate to soil texture. The highest average concentrations (except for K) were found on SA 7, which is classified as a gravelly soil. SA 5 and 8, which were similar and had lower values than SA 7, are finer textured and are classified as loamy soils. SA 50, which had the lowest concentrations for all but K, is classified as clay soil.

Several additional factors may account for the low values reported for SA 50. First, SA 50 originated from calcareous Des Moines to be till, whereas the other soils originated from the more granitic Rainy Lobe till. Second, SA 50 is represented by only 3 plots. All other soil associations were sampled in at least 8 plots. This one would expect higher Vq values for SA 50 compared to other soil associations. Third, sampling of SA 50 was confined to plots with coniferous vegetation, whereas the other three mineral soil associations were sampled under both coniferous and deciduous vegetation. Increased leaching and slower element cycling rates would result in lower values in surface soil horizons under conifers.

Table 9 compares total soil concentrations obtained for soils sampled during 1977 with world-wide values from Aubert and Pinta (1977). Values for soils of the RCNSA are within the range of world-wide average values for all elements except nickel. Values for this element are two to three times the world-wide average values. Variations within the RCNSA appear to be related to origin of parent rocks. Soils of SA 50 are derived from rocks of marine sedimentary origin and are relatively low in Ni (30-50 ppm). Soils of all other SA's originated from granitic rocks and it would appear that the nickel contained in these rocks influenced soil concentrations. Soils derived from these granitic rocks have higher concentrations for several other metals compared to SA 50, but values do not exceed the range of world-wide values.

Table 1. V15-SOIL ASSOCIATIONS DATA LEVEL DEFINITIONS

DATA LEVEL	DESCRIPTION	PROPORTION OF MAJOR SOILS (%)
1	Ontonagon-Bergland nearly level to gently sloping association	
	A) Ontonagon, Typic Eutroboralf, very fine, mixed	75
	B) Bergland, Aeric Haplaquept, very fine, mixed	15
	C) Minor soils	10
4	Ahmeek-Ronneby undulating association	
	A) Ahmeek, Typic Fragiochrepts, coarse-loamy, mixed	65
	B) Ronneby, Aeric Fragiaqualfs, coarse-loamy, mixed	15
	C) Minor soils	20
5	Newfound-Newfound (wet) undulating association	
	A) Newfound, Typic Fragiochrepts, coarse-loamy, mixed	65
	B) Newfound, (wet), Aeric Fragiaqualfs, coarse-loamy, mixed	15
	C) Minor soils	20
6	Unnamed-Toivola undulating association	
	A) Unnamed, Typic Haplorthods, coarse-loamy over sandy skeletal	75
	B) Toivola, Typic Udorthents, sandy-skeletal, mixed	15
	C) Minor soils	10
7	Toivola-Unnamed-Cloquet undulating to steep undifferentiated association	
	A) Toivola, Typic Udorthents, sandy-skeletal, mixed	60
	B) Unnamed, Typic Haplorthods, coarse-loamy over sandy-skeletal, mixed	15
	C) Cloquet, Typic Dystrochrepts, coarse-loamy over sandy or sandy-skeletal, mixed	15
	D) Minor soils	10
8	Mesaba-Barto undulating to hilly association	
	A) Mesaba, Typic Dystrochrepts, coarse-loamy, mixed	45
	B) Barto, Lithic Dystrochrepts, loamy, mixed	40
	C) Quetico, Lithic Dystrochrepts, loamy, mixed	5
	D) Minor soils	10
9	Conic-Insula undulating to hilly association	
	A) Conic, Typic Fragiochrepts, coarse-loamy, mixed	45
	B) Insula, Lithic Dystrochrepts, loamy, mixed	35
	C) Quetico, Lithic Dystrochrepts, loamy, mixed	10
	D) Minor soils	10

Table 1. V15-SOIL ASSOCIATIONS DATA LEVEL DEFINITIONS contd.

DATA LEVEL	DESCRIPTION	PROPORTION OF MAJOR SOILS (%)
10	Quetico-Bedrock outcrop undulating to very steep complex	
	A) Quetico, Lithic Dystrochrepts, loamy, mixed	60
	B) Bedrock Outcrop	30
	C) Minor soils	10
11	Indus-Wildwood nearly level association	
	A) Indus, Typic Ochraqualfs, very fine, montmorillonitic	65
	B) Wildwood, Histic Humaquepts, very fine, montmorillonitic	20
	C) Taylor, Aquic Eutroboralfs, very fine, montmorillonitic	5
	D) Minor soils	
12	Taylor-Indus nearly level to undulating association	
	A) Taylor, Aquic Eutroboralfs, very fine, montmorillonitic	45
	B) Indus, Typic Ochraqualfs, very fine, montmorillonitic	35
	C) Wildwood, Histic Humaquepts, very fine, montmorillonitic	10
	D) Minor soils	
17	Nebish-Mooselake-Shooker hilly association	
	A) Nebish, Typic Eutroboralfs, fine-loamy, mixed	50
	B) Mooselake, Typic Borohemists, euic	30
	C) Shooker, Aeric Ochraqualfs, fine-loamy, mixed	5
	D) Minor soils	15
25	Cormant-Shawano nearly level association	
	A) Cormant, Mollic Psammaquent, mixed	65
	B) Shawano, Typic Udipsamments, mixed	20
	C) Minor soils	15
26	Menahga-Cutfoot undulating association	
	A) Menahga,Typic Udipsamments, mixed	60
	B) Cutfoot, Alfic Udipsamments, mixed	30
	C) Minor soils	10
31	Alluvial Land, nearly level type	
	A) Fluvaquents	60
	B) Borosaprists	30
	C) Minor soils	10

Table 1. V15-SOIL ASSOCIATIONS DATA LEVEL DEFINITIONS contd.

DATA LEVEL	DESCRIPTION	PROPORTION OF MAJOR SOILS (%)
34	Spooner-Unnamed-Baudette nearly level association	
	A) Spooner, Typic Ochraqualfs, fine-silty, mixed	50
	B) Unnamed, Mollic Haplaquept (fine-silty)	25
	C) Baudette, Aquic Eutroboralfs, fine-silty, mixed	10
	D) Minor soils	
35	Mesaba-Barto undulating association	
	A) Mesaba, Typic Dystrochrepts, coarse-loamy, mixed	45
	B) Barto, Lithic Dystrochrepts, loamy, mixed	40
	C) Quetico, Lithic Dystrochrepts, loamy, mixed	5
	D) Minor soils	10
41	Cloquet-Emmert undulating association	
	A) Cloquet, Typic Dystrochrepts, coarse-loamy over sandy or sandy-skeletal	75
	B) Emmert, Typic Udorthents, sandy-skeletal, mixed	15
	C) Minor soils	10
48	Nemadji-Newson nearly level association	
	A) Nemadji, Spodic Udipsamments, mixed	60
	B) Newson, Humaqueptic Psammaquents, mixed	25
	C) Minor soils	15
49	Unnamed-Hibbing nearly level association	
	A) Unnamed, Aquic Eutroboralfs, fine, mixed	60
	B) Hibbing, Typic Eutroboralfs, fine, mixed	30
	C) Minor soils	10
50	Hibbing-Unnamed undulating association	
	A) Hibbing, Typic Eutroboralfs, fine, mixed	60
	B) Unnamed, Aquic Eutroboralfs, fine, mixed	30
	C) Minor soils	10
57	Greenwood nearly level association	
	A) Greenwood, Typic Borohemists, dysic	65
	B) Minor soils	35
58	Mooselake nearly level association	
	A) Mooselake, Typic Borohemists, euic	65
	B) Minor soils	35

Table 1. V-15 SOIL ASSOCIATIONS DATA LEVEL DEFINITIONS contd.

DATA LEVEL	DEFINITION	PROPORTION OF MAJOR SOILS (%)
59	Waskish-Lobo nearly level association	
	A) Waskish, Typic Spagnofibrist, dysic	50
	B) Lobo, Hemic Sphagnofibrist, dysic	35
	C) Minor soils	15
60	Mine	
62	Water	

Table 2.

Soil Association	TERRESTRIAL BIOLOGY ZONE 1	2	3	4	5	6	7	Area Totals
1	0 (0)[a]	0 (0)	0 (0)	0 (0)	0 (0)	0 (160)	0 (0)	.01 (160)
4	0 (0)	0 (0)	0 (0)	0 (0)	.1 (80)	.1 (640)	0 (0)	.05 (720)
5	.4 (720)	8.8 (5840)	5.2 (2600)	50.0 (65240)	40.9 (49360)	8.6 (42920)	5.6 (17800)	13.52 (184480)
6	0 (0)	2.5 (1680)	0 (0)	0 (0)	2.9 (3480)	.8 (3880)	.36 (80)	.67 (9120)
7	12.0 (21240)	54.8 (36160)	14.6 (7280)	5.5 (7160)	6.2 (7440)	10.6 (53080)	6.4 (20360)	11.20 (152720)
8	68.1 (120880)	.1 (120)	24.4 (12120)	11.7 (15320)	1.0 (1160)	1.0 (5240)	5.8 (18520)	12.71 (173360)
9	2.4 (4280)	0 (0)	3.0 (1480)	0 (0)	0 (0)	8.4 (42000)	65.1 (207480)	18.71 (255240)
10	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	.3 (1680)	.8 (2640)	.32 (4320)
11	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.0 (10080)	.3 (800)	.80 (10880)
12	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	.1 (520)	.2 (760)	.09 (1280)
17	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (40)	0 (40)
25	0 (0)	.1 (40)	0 (0)	0 (0)	0 (0)	1.8 (9080)	0 (0)	.67 (9120)
26	4.0 (7040)	0 (0)	0 (0)	0 (0)	0 (0)	11.7 (58480)	.3 (1080)	4.88 (66600)

Table 2.

Soil Association	TERRESTRIAL BIOLOGY ZONE 1	2	3	4	5	6	7	Area Totals
31	0	0	0	0	0	.5	0	.18
	(0)	(0)	(0)	(0)	(0)	(2480)	(0)	(2480)
34	0	0	0	0	0	.5	0	.20
	(0)	(0)	(0)	(0)	(0)	(2720)	(0)	(2720)
35	.4	0	1.3	0	0	.9	0	.32
	(840)	(0)	(640)	(0)	(0)	(2840)	(0)	(4320)
41	.4	0	0	0	0	10.6	.1	3.95
	(760)	(0)	(0)	(0)	(0)	(52880)	(200)	(53840)
48	0	0	0	0	0	.2	0	.07
	(0)	(0)	(0)	(0)	(0)	(880)	(0)	(880)
49	0	0	0	1.0	.5	2.5	0	1.05
	(0)	(0)	(0)	(1320)	(560)	(12480)	(0)	(14360)
50	0	0	1.8	3.6	1.8	8.2	0	3.58
	(0)	(0)	(880)	(4680)	(2200)	(41120)	(0)	(48880)
57	.8	0	0	.3	1.2	8.0	1.1	3.43
	(1360)	(0)	(0)	(360)	(1400)	(40040)	(3600)	(46760)
58	9.5	33.3	17.7	25.9	43.3	19.7	8.0	18.90
	(16800)	(21960)	(8760)	(33720)	(52200)	(98880)	(25480)	(257800)
59	0	.2	0	0	1.0	.3	0	.20
	(0)	(160)	(0)	(0)	(1240)	(1320)	(0)	(2720)
60	.2	0	31.0	1.7	0	3.1	.1	2.52
	(440)	(0)	(15840)	(2240)	(0)	(15720)	(160)	(34400)
62	1.8	.1	0	.3	1.3	.3	6.2	1.98
	(3200)	(40)	(0)	(400)	(1520)	(1920)	(19880)	(26960)
	100.0	99.1	99.9	100.0	100.2	100.2	100.3	101.01
	(177,560)	(66,000)	(49,600)	(130,440)	(120,640)	(501,040)	(318,880)	(1,364,160)

a. numbers in () are acres

Table 3

SOIL PROPERTIES

Soil Series	Soil Association Affiliations	Depth (in)	Texture[1]	Coarse Fraction 3" (%)	Permeability (in/hr)	Available Water Capacity (in/in)	pH	Shrink Swell Potential
Ontonagon	1a	0-6	Sicl	0	.2-.6	.18-.20	4.5-6.0	Mod.
		6-24	c	0	.06-.2	.10-.14	5.0-7.8	High
		24-60	c	0	.06	.10-.14	7.4-8.0	High
Bergland	1b	0-6	cl	0	.06-.2	.13-.16	5.1-6.0	High
		6-25	cl	0	.06-.2	.10-.14	6.0-7.3	High
		25-60	cl	0	.06	.10-.14	7.3-8.4	High
Ahmeek	4a	0-16	l-fsl	-	.6-2.0	.15-.2	5.1-6.0	Low
		16-60	fsl	0-4	.2-.6	.07-.13	5.1-7.3	Low
			fs	0-4	.6-.2	.07-.11	6.6-7.3	Low
Ronneby	4b	0-11	sil	0-5	.6-2.0	.20-.24	5.1-6.0	Low
		11-50	fsl	0-5	.2-.6	.07-.13	6.1-7.3	Low
		58-60	fsl	0-5	.2-.6	---	6.6-7.8	Low
Newfound	5a	0-16	gsl	-	2.0-6.3	.10-.14	4.5-6.0	Low
		16-50 (fragipan)	gsl	-	0.6-0.2	.05-.09	5.1-6.0	Low
Newfound(wet)	5b	0-11	gl	0-5	0.6-2.0	.16-.18	5.1-5.5	Low
		11-45	gsl	0-5	0.2-0.6	.08-.13	5.1-6.0	V.Low
		45-60	gsl	0-5	0.2-0.6	---	5.1-6.0	V.Low
Unnamed (Typic Haplorthod)	6a;7b	0-15	sl	0-5	0.6-2.0	.18-.24	4.5-6.5	Low
		15-60	gcs	0-10	20	.02-.04	4.5-6.5	V.Low
Toivola	6b;7a	0-15	vgls	0-10	20	.03-.05	5.1-6.5	Low
		15-60	vgls	5-20	20		5.1-6.5	Low
Cloquet	7c;41a	0-8	sl	0-1	.6-2.0	.22-.24	4.5-6.0	Low
		8-14	sl	0-1	.6-2.0	.18-.21	4.5-6.0	Low
		14-60	gcs	0-10	20	.02-.04	5.6-6.5	Low

Soil Series	Soil Association Affiliations	Depth (in)	Texture[1]	Coarse Fraction 3" (%)	Permeability (in/hr)	Available Water Capacity (in/in)	pH	Shrink Swell Potential
Mesaba	8a;35a	0-28	gsl	-	2.0-6.3	.10-.14	5.1-6.0	Low
Barto	8b;35b	0-15 15+	gcsl rock	-	2.0-6.3	.10-.14	5.1-6.0	Low
Quetico	8c;9c;10a;35c	0-8 8+	l rock	-	.63-2.0	.15-.20	4.5-5.5	Low
Conic	9a	0-15 15-30	gsl gsl	- -	2.0-6.3 .06-.2	.10-.14 .05-.09	4.0-6.0 4.5-6.0	Low Low
Insula	9b	0-15 15+	gsl	-	2.0-6.3	.10-.14	5.1-6.0	Low
Bedrock Outcrop	10b	--	---	-	---	---	---	---
Indus	11a;12b	0-5 5-23 23-60	cl/cll cl cl	- - -	.06-.20 .06-.20 .06-.20	.13-.16 .10-.14 .09-.13	5.6-6.5 5.6-7.8 7.5-8.0	Mod-High High High
Wildwood	11b;12c	0-6 6-18 18-60	muck cl cl	- 0 0	.06-0.6 .06-2.0 .06-.20	.35-.48 .10-.14 .09-.13	5.6-6.5 5.6-7.3 7.4-8.4	--- High High
Taylor	11c;12a	0-6 6-21 21-60	sil cl sicl	0 0 0	.63-.20 .06-.20 .06-.20	.22-.24 .10-.14 .09-.13	5.6-6.5 5.6-6.5 7.4-8.4	Low High High
Nebish	17a	0-3 3-9 9-33 33-60	l sl cll l	- - - -	.6-2.0 2-6 0.2-2.0 0.6-2.0	.20-.22 .13-.15 .15-.19 .17-.19	6.6-7.3 6.6-7.3 6.1-6.5 7.4-7.8	Mod. Low Mod. Mod.
Mooselake	17b;58a	0-60	mucky peat	0	10-20	.48-.58	5.1-6.5	High

Soil Series	Soil Association Affiliations	Depth (in)	Texture[1]	Coarse Fraction 3" (%)	Permeability (in/hr)	Available Water Capacity (in/in)	pH	Shrink-Swell Potential
Shooker	17c	0-12	sl,csl,l	-	.6-6.0	.13-.22	6.6-7.3	Low
		12-36	cll,l,scll	-	.2-2.0	.15-.19	6.6-7.3	Mod.
		36-60	l,sl	-	.6-6.0	.11-.19	7.9-8.4	Mod.
Cormant	25a	0-6	lfs,fs,ls	--	6.0-20	.08-.12	6.1-7.3	Low
		6-60	fs,s,lfs	-	6.0-20	.06-.10	6.1-7.8	Low
Shawano	26c	0-60	fs	-	6.0-20	.08-.10	5.6-6.5	Low
Menahga	26a	0-4	lcs	-	6-20	.10-.12	4.5-6.0	Low
		4-60	cs,s	-	6-20	.05-.07	4.5-6.0	Low
Cutfoot	26b	0-13	ls	0-2	6-20	.10-.12	5.1-6.0	V.Low
		13-40	cs	0-5	20	.03-.05	5.1-6.0	V.Low
		28-30	cs	0-5	6-20	.05-.07	5.6-6.5	V.Low
		40-60	s	0.5	20	.02-.04	5.6-7.8	V.Low
Fluvaquents	31a	too variable to rate	---	-	---	---	---	---
Borosaprists	31b	0-36	muck	0	6-10	.43	4-5.0	High
		36-60	l	0	.06-.06	.11-.18	4.5-7.3	Low to Mod.
Spooner	34a	0-15	vfsl	0	2-6	.2-.22	6.1-7.8	Low
		15-22	l	0	.6-2.0	.17-.19	6.1-7.8	Low to Mod.
		22-60	sil	0	.6-2.0	.2-.22	7.4-8.4	Low
Unnamed (Mollic Haplaquept)	34b	0-7	muck-si	0	.6-2.0	.25	5.1-6.5	Mod.
		7-60	si	0	.2-.6	.22	5.1-6.5	Mod.
Baudette	34c	0-8	l	0	.6-2.0	.20-.22	6.6-7.3	Low
		8-15	cll	0	.2-.6	.15-.19	6.1-7.3	Mod
		15-60	sil	0	.6-2.0	.20-.22	7.4-8.4	Low

Soil Series	Soil Association Affiliations	Depth (in)	Texture[1]	Coarse Fraction 3" (%)	Permeability (in/hr)	Available Water Capacity (in/in)	pH	Shrink-Swell Potential
Emmert	41b	0-5	gsl	0-10	2-6	.06-.10	5.1-6.5	Low
		5-60	vgcsl	0-10	20+	.02-.04	5.5-6.5	Low
Nemadji	48a	0-9	fs	0	6.3-20	.06-.14	4.5-6.0	Low
		9-60	fs	0	6.3-20	.05-.07	5.1-6.0	Low
Newson	48b	0-5	mucky sand	0	2-20	.07-.22	5.1-6.0	High
		5-60	s	0	6.3-20	.05-.07	5.1-6.0	Low
Selkirk	49a;50b	0-9	l	0	.6-2.0	.20-.22	4.5-6.0	Low
		9-36	cl	0	.06-.20	.10-.14	5.1-8.1	Mod.
		36-60	sicl	0	.06-.20	.09-.15	7.4-8.4	Mod.
Hibbing	49b;50a	0-8	l	0	.6-2.0	.2-.22	4.5-6.0	Low
		8-34	cl	0	.06-.2	.1-.14	5.1-8.4	Mod.
		34-60	cl	0	.06-.2	.1-.14	7.4-8.4	Mod.
Greenwood	57a	0-20	fibric peat	0	6-20+	.58-.70	3.5-4.5	High
		20-70	hemic peat	0	.6-6.0	.48-.58	4-5	High
Waskish	59a	0-60	fibric peat	-	12-20	.55-.65	3.4-4.5	High
Lobo	59b	0-38	fibric peat	-	6-20	.55-.65	3.4-4.5	High
		38-60	humic peat	-	2-6.3	.45-.55	4-4.5	High

[1] c = coarse
cl = clay
l = loam
s = sand
si = silt
v = very
g = gravelly
f = fine

Series	Soil Association Affiliation	Flooding	Natural Drainage	Depth to Water Table	Depth to Bedrock	Borrow Source For Road Fill	Sand	Gravel	Top Soil
Ontonagon	1a	None	well to mod.well	>5'	>5'	Poor	N.S.	N.S.	Poor
Bergland	1b	occasional ponding	poor	seasonally <1'	>10'	Poor	N.S.	N.S.	Poor
Ahmeek	4a	None	well to mod.well	<20' in spring	>10'	Fair	N.S.	N.S.	Fair
Ronneby	4b	None	somewhat poor	≤2' except mid-summer	>5'	Fair	N.S.	N.S.	Fair
Newfound	5a	None	well	>5'	>5'	Good-Fair	Poor	Poor	Poor
Newfound(wet)	5b	None	somewhat poorly-poor	≤2' except mid-summer	>5'	Fair-Poor	Poor	Poor	Fair-Poor
Unnamed	6a;7b	None	excessive	>5'	40-120"	Good	Good	Good	Poor
Toivola	6b;7a	None	excessive	>5'	>6'	Good	Poor	Good	Poor
Cloquet	7c;41a	None	excessive	>6'	>6'	Good	Fair	Good	Fair
Mesaba	8a;35a	None	well	20-40"	20-40"	Fair	Poor	Poor	Poor
Barto	8b;35b	None	well	5'	8-20"	Fair	N.S.	N.S.	Poor
Quetico	8c;9c;10a;35c	None	somewhat excessive	>5'	≤8"	Poor	N.S.	N.S.	Poor
Conic	9a	None	well	--	20-40"	Fair	Poor	Poor	Poor
Insula	9b	None	well	>5'	8-20"	Fair	Poor	Poor	Poor
Bedrock Outcrop	10b	None	well	>10'	0-4"	Poor	N.S.	N.S.	N.S.

Series	Soil Association Affiliation	Flooding	Natural Drainage	Depth to Water Table	Depth to Bedrock	Borrow Source For Road Fill	Sand	Gravel	Top Soil
Indus	11a;12b	slight	poorly, somewhat poorly	seasonally 1-3'	>5'	Poor	N.S.	N.S.	Poor
Wildwood	11b;12c	occasionally ponded	very poorly	0.5-2'	>5'	Poor	N.S.	N.S.	Poor
Taylor	11c;12a	None	well and mod. well	>5'	>5'	Poor	N.S.	N.S.	Poor
Nebish	17a	None	well	>5-10' seasonally high	>10'	Fair	N.S.	N.S.	Poor
Mooselake	17b;58a	None	very poorly	near surface	>5'	Poor	N.S.	N.S.	Poor
Shooker	17c	occasionally ponded	poorly	1-5' seasonally high	>10'	Poor	N.S.	N.S.	Poor
Cormant	25a	occasionally ponded	poorly	0-4'	>5'	Poor	Good	N.S.	Poor
Shawano	25b	None	excessive	>6'	>6'	Good	Good	N.S.	Poor
Menahga	26a	None	excessive	>6'	>5'	Good	Good	N.S.	Poor
Cutfoot	26b	None	excessive	>6'	>5'	Good	Good	Poor	Poor
Fluvaquents	31a	frequent	wet(poor)	variable with stream flow	>5'	Poor to Fair	Poor	N.S.	Poor
Borosaprists	31b	occasional	very poor	near surface	>5'	Poor	N.S.	N.S.	Poor
Spooner	34a	slight	poor to somewhat poor	1-3'	>10'	Poor	N.S.	N.S.	Poor

Series	Soil Association Affiliation	Flooding	Natural Drainage	Depth to Water Table	Depth to Bedrock	Borrow Source For Road Fill	Sand	Gravel	Top Soil
Unnamed (Mollic Haplaquept)	34b	occasionally flooded often ponded	very poor	0-2'	>5'	Poor	N.S.	N.S.	Poor
Baudette	34c	slight	mod. well to well	3-6'	>10'	Fair	N.S.	N.S.	Good to Fair
Emmert	41b	None	excessive	>10'	>10'	Good	Good	Good	Poor
Nemadji	48a	None	somewhat poor	2'	>10'	Fair	Good	N.S.	Poor
Newson	48b	occasionally ponded	poor, very poor	1'	>10'	Poor	Good	N.S.	Poor
Selkirk	49a;50b	occasional brief	somewhat poor to poor	1-3'	>5'	Fair	N.S.	N.S.	Fair
Hibbing	49b;50a	None	well and mod. well	>5'	>10'	Fair	N.S.	N.S.	Fair
Greenwood	57a	None	poor (bog)	surface	>5'	Poor	N.S.	N.S.	Poor to Fair
Waskish	59a	None	poor (bog)	0-2'	>5'	Poor	N.S.	N.S.	Poor to Fair
Lobo	59b	None	poor (bog)	0-2'	>5'	Poor	N.S.	N.S.	Poor to Fair

Woodland Suitability

Series	Soil Association Affiliation	Available P	Available K	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Potential Frost Action	Sanitary Landfill	Sewage Absorption Fields	Sewage Lagoon	Road Location
Ontonagon	1a	low	low	sli.-mod.(0-12)[2] sev. (12-25)	mod.-sev.	mod.-sev.	mod.-sev.	mod.	severe	severe	sli.(0-2) mod.(2-6) sev. >6	severe
Bergland	1b	low	low	slight	severe	severe	severe	mod.	severe	severe	slight	severe
Ahmeek	4a	mod.	mod.	sli. (0-12) mod.-sev.(12-25)	sli.-mod.	slight	mod.-sev.	high	sli. (0-12) mod.(12-25)	severe	sev. >6	severe
Ronneby	4b	low	low	slight	moderate	moderate	mod.-sev.	high	severe	severe	severe	moderate
Newfound	5a	---	---	sli.-sev.	sli.-mod.	slight	mod.	low	moderate	severe	severe	sli.-sev.
Newfound(wet)	5b	---	---	slight	moderate	slight	mod.-sev.	high	severe	severe	severe	severe
Unnamed (Typic Haplorthod)	6a;7b	---	---	sli.(0-12) mod.(12-35)	sli.-mod.	mod.-sev.	slight	low	severe	sli.(0-8) mod.(8-15) sev.(15+)	severe	slight moderate severe
Toivola	6b;7a	---	---	slight increases w. slope	mod.(0-12) increases w. slope	mod.-sev.	low	---	severe	sli.(0-6) mod.(6-12) sev.(12+)	severe	slight moderate severe
Cloquet	7c;41a	low	low	sli.(0-12) mod.-sev.(12-33)	slight mod.-sev.	moderate moderate	sli.-mod.	low	severe	sli.(0-6) mod.(6-12) sev.(12+)	severe	slight moderate severe
Mesaba	8a;35a	---	---	slight sev. (steep sl)	slight sev.(steep sl)	slight	moderate	low	severe	severe	severe	severe

Woodland Suitability (contd.)

Series	Soil Association Affiliation	Available P	Available K	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Potential Frost Action	Sanitary Landfill	Sewage Absorption Fields	Sewage Lagoon	Road Location
Barto	8b;35b	---	---	mod.-severe (steep sl)	sli.-sev. (steep sl)	slight	slight	low	severe	severe	severe	severe
Quetico	8c;9c;10a;35c	---	---	mod.-sev.	mod.-sev.	slight	slight	low	severe	severe	severe	severe
Conic	9a	---	---	mod.-sev.	sli.-sev.	slight	moderate	---	severe	severe	severe	severe
Insula	9b	---	---	mod.-sev.	sli.-sev. (steepsl)	slight	slight	low	severe	severe	severe	severe
Bedrock Outcrop	10b	---	---	severe	severe	severe	severe	low	severe	severe	severe	severe
Indus	11a;12b	---	---	slight	moderate	moderate	severe	moderate	severe	severe	severe	severe
Wildwood	11b;12c	---	---	slight	severe	moderate	severe	moderate	severe	severe	severe	severe
Taylor	11c;12a	---	---	sli.-mod.(0-12) sev.(12-25)	mod.-sev.	sli.-sev.	mod.-sev.	moderate	severe	severe	sli.(0-2) mod.(2-6) sev.(>6)	severe
Nebish	17a	---	---	sli. (2-12) mod. >12	sli.(2-12) mod. >12	slight	moderate	moderate	sli.(0-12) mod.(12-25) sev. (>25)	moderate sev. >12%	mod. sev. >6%	moderate
Mooselake	17b;58a	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Shooker	17c	---	---	slight	moderate	moderate	severe	high	severe	severe severe	moderate severe	severe severe
Cormant	25a	--	--	slight	moderate	moderate	moderate	moderate	severe	sli.(0-6)	sev.	sli.(0-6)

Woodland Suitability (contd.)

Series	Soil Association Affiliation	Available P	Available K	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Potential Frost Action	Sanitary Landfill	Sewage Absorption Fields	Sewage Lagoon	Road Location
Shawano	25b	---	---	slight	slight	severe	mod.-sev.	low	severe	mod.(>6)	severe	mod.(>6)
Menahga	26a	---	---	---	---	---	---	low	severe	sli.(0-8) mod.(>8)	severe	sli.(0-8) mod.(>8)
Cutfoot	26b	---	---	sli.(0-12)	sli.(0-12)	severe	slight	low	severe	sli.(0-8) mod.(8-15) sev.(>15)	severe	sli.(0-8) mod.(0-15) sev.(>15)
Fluvaquents	31a	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Borosaprists	31b	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Spooner	34a	---	---	slight	moderate	moderate	severe	high	severe	severe	severe	severe
Unnamed (Mollic Haplaquept)	34b	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Baudette	34c	---	---	sli.-mod.(12)	sli.-mod(12)	slight	severe	moderate	moderate	severe	moderate	moderate
Emmert	41b	low	low	sli.(0-12) mod.-sev.(12-25)	sli.(0-12) mod.(12-25)	moderate	sli.-mod.	low	severe	sli.(0-6) mod.(6-12) sev.(>12)	moderate	sli.(0-6) mod.(6-12) sev.(>12)
Nemadji	48a	low	low	slight	moderate	moderate	mod.-sev.	moderate	severe	severe	severe	moderate
Newson	48b	low	low	slight	severe	severe	severe	moderate	severe	severe	severe	moderate
Selkirk	49a;50b	---	---	slight	moderate	moderate	mod.-sev.	moderate	severe	severe	slight	severe

Woodland Suitability (contd.)

Series	Soil Association Affiliation	Available P	Available K	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Potential Frost Action	Sanitary Landfill	Sewage Absorption Fields	Sewage Lagoon	Road Location
Hibbing	49b;50a	low	low	sli.(0-12) mod.(12-25)	sli.(0-12) mod.(12-25)	slight	mod.-sli.(0-12) mod.-sev.(12-25)	mod.-high	severe	severe	slight	severe
Greenwood	57a	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Waskish	59a	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe
Lobo	59b	---	---	slight	severe	severe	severe	high	severe	severe	severe	severe

2 values in ( ) are percent slope
mod. = moderate
sli. = slight
sev. = severe
sl. = slope

TABLE 4

	Series Affiliations
I. Alfisols	
A. Aqualfs	
1. Fragiaqualfs	
a. Aeric	Ronneby (4B) Newfound (Wet) (5B)
2. Ochraqualfs	
a. Typic	Indus (11A, 12B) Spooner (34A)
b. Aeric	Shooker (17C)
B. Boralfs	
1. Eutroboralfs	
a. Typic	Ontonagon (1A) Nebish (17A) Hibbing (49B, 50A)
b. Aquic	Taylor (11C, 12A) Baudette (34C) Unnamed (49A, 50B)
II. Entisols	
A. Aquents	
1. Fluvaquents	Unnamed (31A)
2. Psammaquents	
a. Humaqueptic	Newson (48B)
b. Mollic	Cormant (25A)
B. Psamments	
1. Udipsamments	
a. Typic	Shawano (25B) Menahga (26A)
b. Alfic	Cutfoot (26B)
c. Spodic	Nemadji (48A)

TABLE 4 contd.

	Series Affiliations
C. Orthents	
1. Udorthents	
a. Typic	Toivila (6B, 7A) Emment (41B)
III. Histosols	
A. Fibrists	
1. Sphagnofibrists	
a. Typic	Waskish (51A)
b. Hemic	Lobo (59B)
B. Hemists	
1. Borohemists	
a. Typic	Mooselake (17B, 58A) Greenwood (57A)
C. Saprists	
1. Borosaprists	Unnamed (31B)
IV. Inceptisols	
A. Aquepts	
1. Humaquepts	
a. Histic	Wildwood (11B, 12C)
2. Haplaquepts	
a. Aeric	Bergland (1B)
b. Mollic	Unnamed (34B)
B. Ochrepts	
1. Fragiochrept	
a. Typic	Ahmeek (4A) Newfound (5A) Conic (9A)

TABLE 4 contd.

	Series Affiliations
2. Dystrochrepts	
a. Typic	Cloquet (7C, 41A) Mesaba (8A, 35A)
b. Lithic	Barto (7B, 35B) Quetico (7C, 9C, 10A, 35C) Insula (9B)
V. Spodosols	
A. Orthods	
1. Haplorthods	
a. Typic	Unnamed (6A, 7B)

Table 6

SOIL ASSOCIATION

SOIL LANDSCAPE UNIT	0	5	6	7	8	26	35	57	49	50	62	58	59
0	6658	4	0	0	38	0	0	0	0	0	97	2	0
1	2	628	0	7116	1349	106	441	0	0	0	49	1301	0
2	2	6929	11	706	152	0	0	77	0	1	12	1513	0
3	4	5574	0	578	9897	0	80	0	0	0	1014	1517	0
4	1	346	0	1504	17467	0	274	0	0	0	39	537	0
5	0	155	0	0	0	0	0	0	0	0	0	25	0
6	6	1734	0	71	0	0	0	74	3	13	0	1533	0
7	1	1395	0	69	978	0	0	0	0	4	3	1341	0
8	8	2568	0	1007	1003	442	217	54	51	31	0	612	0
9	0	58	0	660	914	0	0	0	0	0	1	139	0
10	0	7	0	192	401	0	0	0	0	0	0	42	0
11	0	0	0	58	1	0	0	0	0	0	0	4	0
12	6	850	0	408	9	0	0	0	0	0	0	597	0
13	4	565	0	3175	688	0	19	0	0	0	0	663	0
14	0	0	0	83	0	0	0	0	0	0	0	83	0
15	0	0	0	161	23	0	0	0	0	0	0	7	0
16	1	113	0	14	1	0	0	0	0	0	0	138	0
17	0	159	0	252	844	0	56	0	0	0	0	236	0
18	0	33	0	16	317	0	0	0	0	0	0	21	0
19	20	5651	24	2877	3574	9	62	771	4	25	210	25502	521
20	3	9	0	30	167	6	0	0	0	0	2	5	0
21	59	8	0	6	53	0	8	0	0	8	1451	20	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	106	0	0	0	0	0	9	140	582	0	49	0
24	0	65	0	0	0	0	0	0	0	0	0	75	0
25	0	10	0	0	0	0	0	0	0	205	0	37	0

7. SUMMARY OF 1976 SOIL CHEMICAL ANALYSES

n	Percent of Area	Depth (in)	C.E.C. (meg./100g.)	Base Saturation - %	pH	$SO_4^=$ (ppm)	Ca^{++} (ppm)	Mg^{++} (ppm)	Fl ppm
	0.1	0-6 6-12	31.3-2-8.8* 21.6-1	28.2-2-7.1 14.7-1	5.0-2-0 5.3-1	16-2-14.3 23-1	1420-2-1.4 444-1	204-2-15.9 78-1	7.8-2 10.3-1
	13.5	0-6 6-12	23.4-19-4.5 15.2-9-6.0	41.3-19-4.5 22.3-9-13.9	5.4-20-1.1 5.7-10-2.1	17-20-6.0 14-10-7.6	1535-20-6.7 626-10-14.7	219-20-9.9 84-10-9.4	8 -22 7 -12
5	0.7	0-6 6-12	26.4-2-2.5 19.5-2-3.6	40.0-2-6.5 23.6-2-34.8	5.3-2-2.8 5.5-2-0	19-2-13.2 18-2-14.3	1780-2-10.1 758-2-42.5	222-2-5.0 104-2-22.7	9 -2- 9 -2-
7	11.2	0-6 6-12	23.6-16-5.9 17.9-13-10.8	28.9-16-5.9 22.7-13-9.1	5.5-16-1.0 5.8-10-1.0	18-16-10.3 18-13-21.6	1077-16-10.9 572-13-16.1	167-16-8.5 104-13-14.3	6 -16 6. -13-
3	12.7	0-6 6-12	28.4-2-2.3 23.1-1	21.8-2-0.9 30.2-1	5.0-6-1.7 5.3-1	20-6-13.7 19-1	950-6-4.5 347-1	159-6-4.4 64-1	7 6- 7. 1-(
0	0.3	0-6 6-12	24.7-3-20.0 17.9-1	32.4-3-9.9 23.9-1	5.1-4-3.3 5.2-2-0	22-4-21.6 24-2-60.0	1256-4-11.0 365-2-54.7	216-4-13.6 107-2-66.8	7. 4-2 7. 2-2
9	1.1	0-6 6-12	18.9-2-0 13.7-2-11.3	26.3-2-6.1 14.5-2-1.0	5.3-2-0.9 5.5-2-1.8	15-2-20.0 26-2-17.0	775-2-7.3 287-2-13.9	132-2-1.5 67-2-9.0	8. 2-9 9. 2-0
7	3.4	0-6 6-12	57-1 -	17.5-1 -	4.3-2-4.7 4.0-1	56-2-0.9 45-1	1755-2-8.3 1200-1	422-2-2.3 265-1	11 -1- 6. -0
58	18.9	0-6 6-12	79.8-9-10.5 119.1-1	56.1-9-7.7 62.7-1	5.5-10-0.7 5.6-5-2.1	105-10-15.9 97-5-19.4	4528-10-9.1 4806-5-16.7	2757-10-14.9 2940-5-27.9	8.0 0-1 8. -2

Values are: $\bar{x}$-n-

NOTE: n is number of analyses, most sites were sampled twice. Thus, for example $\bar{x}$'s for S.A. #49 were obtained by averaging values from one site that was sampled twice.

Fl ppm	Mn ppm	Cu ppm	Fe ppm	Zn ppm	Ni ppm	Cd ppm	Cr ppm	Pb ppm
7.8-2 10.3-1-0	22.7-2-57.4 2.1-1-0	.4-2-0 0.3-1-0	245-2-11.1 128-1-0	2.9-2 .4-1-0	.6-2 .4-1-0	0-2-0 0-1-0	0-2-0 0-1-0	2.1-2-90.8 0-1-0
8.8-22-5.4 7.7-12-7.1	46.4-22-16.1 5.5-12-36.1	.6-22-10.4 .3-12-18.2	177-22-9.2 74-12-12.0	5.7-22-18.4 0.4-12-20.0	.7-22-11.8 .1-12-28.1	.04-22-35.1 0.00-12-96.8	.1-22-30.6 0.005-12-60.0	1.6-22-.4 .2-12-5.8
9.3-2-3.2 9.3-2-3.2	24.1-2-0.4 6.8-2-	.5-2-16.7 .5-2-14.0	136-2-41.1 151-2-27.0	6.5-2-43.0 0.9-2-14.9	.5-2-33.3 .3-2-20.1	.10-2-100.0 0-2-0	0-2-0 .01-2-100	.8-2-6. .2-2-0
6.2-16-6.3 5.4-13-49.2	23.4-16-15.9 8.0-13-38.1	.3-16-8.7 .3-13-15.1	120-16-12.6 75-13-21.1	2.3-16-33.3 1.1-13-51.5	.3-16-16.1 .2-13-47.7	0-16-0 0-13-0	.2-16-37.5 .05-13-67.8	.7-16-1.1 .3-13-3.5
7.7-6-3.4 7.4-1-0	23.0-6-24.2 3.4-1-0	1.0-6-38.3 .2-1-0	183-6-9.2 115-1-0	2.3-6-33.0 0.4-1	.6-6-11.0 .3-1-0	0-6-0 0-1-0	.2-6-54.0 0-1-0	1.0-6-1.6 0-1-0
7.4-4-2.5 7.9-2-22.0	65.8-4-29.1 8.5-2-84.9	.6-4-20.2 .6-2-7.0	216-4-7.5 121-2-43.8	4.1-4-19.4 0.3-2-41.3	.8-4-8.1 .3-2-33.3	.03-4-100.0 0-2-0	.1-4-57.7 0-2-0	1.3-4-1.6 .2-2-33
8.8-2-9.1 9.6-2-0	42.8-2-8.9 1.75-2-82.9	.6-2-7.2 .4-2-28.7	160-2-5.4 140-2-17.6	3.1-2-16.2 0.3-2-20.1	.7-2-7.7 .2-2-50.2	0-2-0 0-2-0	.3-2-100 .35-2-100	.7-2-7. 0-2-0
11.9-1-0 6.2-1-0	23.7-2-26.9 0-1-0	1.7-2-87.7 0-1-0	710-2-43.8 0-1-0	7.3-2-85.9 0-1-0	1.9-2-31.5 0-1-0	.2-1-0 N.S.	.1-1-0 N.S.	3.1-2-1 0-1-0
8.0-10-11.8 8.2-4-24.3	151.0-9-78.1 15.6-4-48.0	2.7-9-25.2 2.5-4-27.7	1072-9-24.2 1192.8-4-38.4	4.3-9-27.2 2.9-4-52.5	4.5-9-19.4 4.6-4-23.8	.11-7-30.9 .15-4-43.0	0-7-0 0-4-0	2.5-9-2.2 .7-4-76

le 8. CHEM AL ANALYSIS SUMMARY FOR SOIL ASSOCIATIONS

...L.	Percent of Area	Depth (cm)	n	Cu (ppm)		Ni (ppm)		Mn (%)		Zn (ppm)		Fe (%)	
				$\bar{x}$	(SEM%)	$\bar{x}$	(SEM%)	$\bar{x}$	(SEM%)	$\bar{x}$	(SEM%)	$\bar{x}$	SEM
	13.5	Litter	11	14.2	(7.0)	9.5	(20.2)	948	(20.5)	120.5	(10.3)	11,930	(12.9)
		0-5	11	25.8	(6.2)	75.6	(12.0)	.080	(11.3)	71.0	(10.0)	4.43	(3.7)
		5-10	11	27.0	(3.3)	55.8	(10.1)	.063	(10.7)	66.9	(4.8)	4.78	(6.3)
	11.2	Litter	10	12.8	(4.2)	19.7	(14.4)	768	(11.7)	90.5	(12.3)	11,700	(11.3)
		0-5	10	26.4	(6.6)	154.3	(25.2)	.100	(7.6)	94.7	(6.4)	6.00	(4.7)
		5-10	10	29.8	(8.7)	115.3	(11.5)	.080	(3.6)	92.4	(5.3)	6.26	(2.4)
	12.7	Litter	13	13.1	(4.6)	7.6	(24.1)	986	(10.5)	97.6	(10.6)	10,800	(13.4)
		0-5	13	27.3	(13.4)	71.4	(13.8)	.076	(9.4)	77.6	(5.5)	5.22	(5.3)
		5-10	13	30.4	(13.3)	82.2	(10.9)	.064	(8.6)	80.1	(4.4)	5.45	(4.8)
5	3.6	Litter	3	11.1	(5.2)	9.1	(19.0)	2,080	(40.0)	95.4	(22.6)	15,490	(4.3)
		0-5	3	15.1	(10.7)	49.5	(35.1)	.061	(23.7)	67.8	(9.3)	2.89	(.4)
		5-10	3	16.2	(2.9)	28.2	(12.3)	.051	(14.7)	65.9	(7.8)	3.60	(5.8)
58	18.9	0-5	8	10.1	(6.8)	6.7	(18.2)	383	(18.2)	45.2	(6.8)	12,870	(26.5)
		5-10	8	8.7	(9.6)	7.0	(26.8)	286	(32.6)	33.7	(13.2)	9,830	(26.4)
		55-60	8	10.6	(22.5)	13.7	(12.7)	151	(37.4)	11.7	(16.3)	4,990	(19.2)
UPLAND COMBINED (5,7,8,50)	41.0	Litter	37	13.0	(2.5)	11.5	(12.1)	1,003	(10.5)	102	(6.2)	11,760	(6.6)
		0-5	37	25.6	(5.9)	93.2	(13.6)	82.5	(5.6)	78.7	(3.5)	5.00	(3.8)
		5-10	37	28.1	(6.0)	78.9	(8.4)	66.8	(4.8)	78.3	(3.4)	5.26	(3.5)

Table 8. Continued

Loc.	Percent of Area	Depth (cm)	Ca (%)		Mg (%)		P (%)		K (%)		n
			$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	$\bar{x}$	SEM	
	13.5	Litter	10,790	(8.7)	2,150	(9.7)	910	(4.1)	1,510	(10.5)	11
		0-5	2.03	(5.6)	1.22	(2.6)	.135	(11.0)	1.10	(2.8)	
		5-10	2.12	(6.5)	1.35	(3.8)	.129	(8.6)	1.14	(3.1)	
	11.2	Litter	11,970	(15.2)	3,330	(7.1)	696	(7.9)	1,230	(6.8)	10
		0-5	2.88	(9.9)	1.62	(5.7)	.163	(9.7)	.92	(3.8)	
		5-10	3.02	(6.1)	2.05	(14.5)	.164	(9.7)	.94	(2.7)	
	12.7	Litter	12,600	(17.2)	2,040	(6.5)	881	(7.1)	1,320	(9.6)	13
		0-5	2.31	(3.8)	1.48	(3.4)	.145	(7.0)	1.02	(4.9)	
		5-10	2.36	(5.3)	1.61	(3.3)	.154	(11.7)	1.03	(4.1)	
	3.6	Litter	5,700	(8.3)	2,150	(14.0)	817	(7.3)	1,520	(5.1)	3
		0-5	1.35	(6.4)	.99	(4.1)	.088	(3.3)	1.42	(2.4)	
		5-10	1.51	(6.4)	1.21	(2.9)	.120	(5.8)	1.42	(2.8)	
58	18.9	Litter	5,990	(18.2)	2,300	(15.3)	747	(10.2)	1,026	(6.7)	8
		0-5	6,290	(20.3)	2,280	(16.3)	720	(10.8)	794	(13.1)	
		5-10	6,490	(17.4)	1,820	(16.8)	534	(13.8)	286	(10.3)	
JPLAND		Litter	11,530	(8.1)	2,430	(5.4)	836	(3.8)	1,370	(5.1)	37
		0-5	2.23	(5.7)	1.40	(3.2)	.142	(5.3)	1.05	(2.9)	
		5-10	2.41	(5.6)	1.53	(2.8)	.146	(6.1)	1.07	(2.7)	

ble 9. Total element concentrations in soils of the RCNSA compared with world-wide average values.

	Aubert and Pinta (1977)		Cu-Ni Study Averages (ppm) Soil Association					
	Ave (ppm)	Range (ppm)	50	5	8	7	All	Depth (cm)
B	20-50	< 5-150						0-5
								5-10
Cr	100-300	t 3-4,000					117	0-5
							111	5-10
Co	10-15	.05-300					17	0-5
							19	5-10
Cu	15-40	t - 200-250	15	26	27	26	26	0-5
			16	27	30	30	28	5-10
Pb	15-25	t - 1,200						0-5
								5-10
Mn	500-1000	t - 10,000	610	800	760	1,000	825	0-5
			510	650	640	800	668	5-10
Ni	20-30	t - 500	50	76	71	154	93	0-5
			28	56	82	115	79	5-10
Zn	50-100	t - 900	68	71	78	95	83	0-5
			66	67	80	92	83	5-10

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GLOSSARY

albic horizon - A horizon from which clay and free iron oxides have been leached or in which oxides have been segregated to the extent that the color of the soil is determined by the color of the primary sand and silt particles.

aquic - An aquic moisture regime is one that implies a reducing regime virtually free of dissolved oxygen. It occurs in soil that is saturated by ground water or water of the capillary fringe.

cambic horizon - The cambic horizon is one that has been altered either physically or chemically and that has a texture, in the fine earth fraction, of very fine sand, loamy very fine sand, or finer. This horizon has lost, through leaching, sesquioxides or bases, including carbonates. The cambic horizon is a subsurface horizon.

cryic - A cryic temperature regime implies mean annual soil temperatures higher than 0°C (32°F.) and lower than 8°C (47°F.).

duripan - A duripan is a subsurface horizon that is cemmented to such a degree by silica that fragments from the air-dry horizon do not slake even after periods of prolonged soaking in water or HCl.

epipedon - An epipedon is a horizon that forms at the soil surface. To be considered an epipedon a horizon must have been either appreciably darkened by organic matter or elluviated or have rock structures that have been destroyed.

fragipan - A fragipan is a loamy or, occassionally, a sandy, brittle subsurface horizon that has a very low content of organic matter, has a high bulk density relative to horizons above it, and has a hard or very hard consistency.

frigid - A frigid soil temperature regime is one that has a mean annual soil temperature of less than 8°C (47°F) and a difference between mean winter and mean summer soil temperature that is more than 5°C (41°F.) at a depth of 50 cm (or at the base of the unconsolidated parent material whichever is shallower).

histic - A histic epipedon is a thin, surface horizon of peat or muck. Under natural conditions the horizon is saturated with water for 30 or more consecutive days during the year.

illuviation - Illuviation refers to the accumulation, in a horizon, of materials (e.g., clay, and iron and aluminum compounds) that have leached from horizons above.

lithic - A lithic contact represents a boundary between soil and coherent underlying material. Such a contact is diagnostic at the subgroup level if it is within 50 cm of the surface of a mineral soil.

mollic - A mollic epipedon is a relatively thick, dark colored, humus - rich surface horizon in which bivalent cations are dominant on the exchange complex and the grade of structure is moderate to strong.

mottle - This term means "marked with spots of contrasting colors". Mottled soil horizons are saturated with water at some period during the year and have a temperature >5°C during at least part of the time that they are saturated.

natric - Natric horizons are subsurface horizons. They are special kinds of argillic horizons that have high concentrations of sodium (over 15% of CEC). Because sodium affects the dispersion of clay, natric horizon soils have characteristic prismatic or columnar structures.

ochric - An ochric epipedon is a surface horizon that is light in color and contains <1 percent organic matter.

sequum - A sequum is a sequence of an eluvial horizon and its subjacent B (illuviated) horizon.

spodic - A spodic horizon is a subsurface horizon that has an illuvial accumulation of free sesquioxides and organic matter.

udic - A udic soil moisture regime applies to soils that, in most years, are not dry in any part for as long as 90 days (cummulative).

umbric - An umbric epipedon is similar to a mollic epipedon but is less than 50% base saturated.

xeric - A xeric moisture regime is found in Mediterranean climates. Soils dry in all parts for 45 or more consecutive days within the 4 months that follow the summer solstice in 6 or more years out of 10. They are moist in all parts for 45 or more consecutive days within the 4 months that follow the winter solstice in 6 or more years out of 10. Mean annual soil temperatures are lower than 22°C, and mean annual winter and summer temperatures differ by more than 5°C at a depth of 50 cm.

APPENDIX

Soil Survey Interpretations sheets for soil series in the Study Area.

Cathmeger

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Series: _____
STATE Minnesota
MLRA 92
Revised Draft GPN, PPL 2-72

This series consists of nearly level to hilly, well and moderately well drained soils formed in reddish brown clayey material. These soils are on lake plains. Native vegetation is forest. The surface layer is very dark gray silty clay loam about 3 inches thick. The subsoil is reddish brown, clay about 18 inches thick. The underlying material is reddish brown clay. Permeability is very slow. The available water capacity is moderate and organic matter content is low. The availability of phosphorous is low, and of potassium is low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.-				LL	PI	Permeability In./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	Silty clay loam	CL	A-6	0	99-100	99-100	95-100	90-98	30-40	10-20	0.2-0.6	.18-.20	4.5-6.0	Moderate
6-24	Clay	CH	A-7	0	100	99-100	99-100	90-98	65-90	35-55	0.06-0.20	0.10-0.14	5.0-7.8	High
24-60	Clay	CH	A-7	0	100	99-100	99-100	90-98	65-90	35-55	less than 0.06	0.10-0.14	7.4-8.0	High

Flooding: None — Hydrologic group: C

Depth to water table: Greater than 5 feet — Depth to bedrock: Greater than 5 feet

Corrosivity - uncoated steel: Moderate — Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: low bearing strength; high shrink-swell potential
Sand	Not suited
Gravel	Not suited
Topsoil	Poor: poor workability

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: very slow permeability
Sewage Lagoons	Slight: on 0-2 percent slopes Moderate: 2-6 percent slopes Severe: more than 6 percent slopes
Shallow Excavations	Severe: poor workability
Dwellings: With Basements	Severe: high shrink-swell potential
Sanitary Landfill (trench type)	Severe: poor trafficability and workability
Local Roads and Streets	Severe: low bearing strength
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Very slow permeability
Embankments, Dikes, and Levees	Low to medium shear strength; fair to poor compaction characteristics
Drainage of Cropland and Pasture	Very slow permeability
Irrigation	Slow infiltration rate; slow permeability
Terraces and Diversions	Poor workability
Grassed Waterways	Poor workability

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

Ontonagon

MN-SOILS-3
11-71
(File Code SOILS-12)
Ontonagon

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: very slow permeability and clayey surface textures
Picnic Areas	Severe: clayey surface textures
Playgrounds	Severe: very slow permeability and clayey textures
Paths and Trails	Severe: clayey surfaces textures

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
0-2% slopes	IIIs	.43	3-2	45	14		3.5	5.2	4.1
2-6% slopes	IIIe			45	12		3.5	5.2	4.1
6-12% slopes	IVe			40	12		2.7	4.0	3.3
2-12% slopes	IVe			40	12		2.7	4.0	3.3
12-25% slopes	VIe			--	--		---	---	---

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Fair	Fair	Good	Good	Good	Poor	Poor	Fair	Good	Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seedling Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3c	Red Pine Aspen White Pine White Spruce Northern Hardwood	45 55 45 45 55	Slight to Moderate 0-12% slopes Severe 12-25% slopes	Moderate to Severe	Moderate to Severe	Moderate to Severe	Red Pine White Spruce White Pine	White Spruce Red Pine White Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Berglund 395 Bergland
Series

STATE Minnesota
MLRA 92
Revised Draft RRL 2-72

This series consists of nearly level, poorly drained soils formed in reddish brown clayey material. These soils are on lake plains. Native vegetation is forest. The surface layer is black clay about 6 inches thick. The subsoil is dark reddish gray in the upper part and reddish brown in the lower part. Texture is clay about 19 inches thick. The underlying material is reddish brown clay. Permeability is very slow. The available water capacity is moderate and organic matter content is high. The availability of phospharous is low and of potassium is low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	Clay	CH	A-7	0	100	99-100	99-100	90-98	70-90	40-55	0.06-0.20	.13-.16	5.1-6.0	High
6-25	Clay	CH	A-7	0	100	99-100	99-100	90-98	70-90	40-55	0.06-0.20	0.10-0.14	6.0-7.3	High
25-60	Clay	CH	A-7	0	100	99-100	99-100	90-98	70-90	40-55	Less than 0.06	0.10-0.14	7.3 8.4	High

Flooding: Occasionally ponded

Hydrologic group: D

Depth to water table: Within 1 foot of the surface in early summer and late fall.

Depth to bedrock: Greater than 10 feet

Corrosivity - uncoated steel: Moderate

Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: low bearing strength; high shrink-swell potential
Sand	Not suited
Gravel	Not suited
Topsoil	Poor: poor workability

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: very slow permeability; high water table
Sewage Lagoons	Slight: very slow permeability
Shallow Excavations	Severe: poor workability
Dwellings: With Basements	Severe: seasonal high water table
Sanitary Landfill (trench type)	Severe: seasonal high water table; poor workability
Local Roads and Streets	Severe: low bearing strength; seasonal high water table
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Very slow permeability
Embankments, Dikes, and Levees	Low to medium shear strength; fair to poor compaction characteristics
Drainage of Cropland and Pasture	Very slow permeability
Irrigation	Slow infiltration rate
Terraces and Diversions	Generally not needed, nearly level
Grassed Waterways	Generally not needed, nearly level

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: very slow permeability and clayey surface texture; high water table
Picnic Areas	Severe: clayey surface textures; high water table
Playgrounds	Severe: high water table; very slow permeability and clayey textures
Paths and Trails	Severe: high water table; clayey surface texture

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage	Bluegrass Pasture	Legume - Grass Hay	Legume - Grass Pasture
				B/A	T/A	AUM	T/A	AUM
All	IVw	--	--	45	14	4.1	3.5	5.2

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3w	Black Spruce Black Ash	40-50 40-50	Slight	Severe	Severe	Severe	Tamarack Black Spruce Black Ash Elm	Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Ahmeek
Ahmeek

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES _____
STATE Minnesota
MLRA 90
GTR, RRL 2-72

This series consists of nearly level to steep, well and moderately well drained soils formed in sandy loam till. These soils are on moraines and broad drumlins. Native vegetation is forest. The surface layer is very dark brown silt loam about 2 inches thick. The subsoil is dark brown, very friable, fine sandy loam about 14 inches thick in the upper part. The lower part is reddish brown firm sandy loam about 44 inches thick. The underlying material is reddish brown fine sandy loam. Permeability is moderately slow. The available water capacity is low and organic matter content is low. The availability of phosphorous is moderate, and of potassium is moderate. These soils have very dense lower subsoils and underlying material. Cobbles are common throughout the profile.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-16	loam and fine sandy loam	ML	A-4	-	90-100	85-100	70-90	50-60	14-20	0-1	0.6-2.0	0.15-0.20	5.1-6.0	Low
16-60	fine sandy loam	SM	A-4 or A-2	0-4	85-100	75-95	65-90	30-40	14-20	0-1	0.2-0.6	0.07-0.13 2/	5.1-7.3	Low
60-75	fine sandy	SM	A-4 or A-2	0-4	85-100	75-95	65-90	30-40	14-20	0-1	0.6-2.0	07-0.11 2/	6.6-7.3	Low

Flooding: None
Hydrologic group: B
Depth to water table: Normally perched at depths of 20 inches or less in early spring on nearly level areas
Depth to bedrock: Greater than 10 feet
Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: medium shear strength; low to medium compressibility; low shrink-swell
Sand	Not suitable
Gravel	Not suitable
Topsoil	Fair: moderately thin

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: moderate slow permeability
Sewage Lagoons	Severe: on slopes more than 6 percent
Shallow Excavations	Slight: occasional large boulder; Moderate: 6-12% slopes; Severe: over 12% slopes
Dwellings: With Basements	Slight Moderate: 6-12 percent slopes Severe: over 12 percent slopes
Sanitary Landfill (Trench type)	Slight: 0-12 percent; coarse fragments are common; difficult to dig when dry. Moderate: 12-25 percent slopes
Local Roads and Streets	Severe: high susceptibility to frost heave
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Moderately slow permeability
Embankments, Dikes, and Levees	Low compacted permeability; low to medium compressibility; medium shear strength
Drainage of Cropland and Pasture	Generally not needed; well or moderately well drained
Irrigation	Moderate slow permeability; low available water holding capacity
Terraces and Diversions	Favorable on slopes less than 12 percent; subsoils low in fertility
Grassed Waterways	Moderately slow permeability; subsoil low in fertility

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

2/ Because of high bulk density that restricts root penetration, these layers supply very little moisture to plants

MN-SOILS-3
11-71
(File Code SOILS-12)
Ahmeek

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderately slow permeability; Severe: over 12 percent slopes
Picnic Areas	Slight: 0-6 percent slopes Moderate: 6-12 percent slopes Severe: over 12 percent slopes
Playgrounds	Moderate: moderately slow permeability Severe: over 6 percent slopes
Paths and Trails	Slight: 0-18 percent slopes Moderate: over 18 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats B/A	Corn Silage T/A	Bluegrass Pasture AUM	Legume-Grass T/A	Legume-Grass AUM
0-12% slopes	IIc	.37	3.2	80	14	5.3	4.5	6.7
2-6% slopes	IIe			80	12	5.3	4.5	6.7
6-12% slopes	IIIe			70	10	4.1	3.5	5.2
2-12% slopes	IIIe			70-80	10-12	4.1-5.3	3.5-4.5	5.2-6.7
12-18% slopes	IVe			---	---	3.5	---	
18-25% slopes	VIe			---	---	3.5	---	
12-25% slopes	VIe			---	---	3.5	---	

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-6%	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
6-12%	Fair	Fair	Good	Good	Good	Very Poor	Very Poor	Fair	Good	Very Poor
12-25%	Poor	Fair	Good	Good	Good	Very Poor	Very Poor	Fair	Good	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-12 % 12-25%	2d	Aspen Red Pine White Pine Jack Pine Northern Hardwoods	70 60 50 60	Slight Moderate to Severe	Slight Moderate	Slight Slight	Moderate to Severe Moderate to Severe	Red Pine Basswood Red Oak White Pine White Spruce Aspen	Red Pine Black Spruce White Spruce Basswood Red Oak	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Rozenstein

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 90
Revised Draft GDN, RPL 2-72

This series consists of slightly concave and nearly level, somewhat poorly drained soils formed in sandy loam till. These soils are on the base of slopes and level ground moraines. Native vegetation is forest. The surface layer is black silt loam about 4 inches thick. The subsurface layer is grayish brown silt loam about 7 inches thick. The subsoil is reddish brown sandy loam about 47 inches thick. The underlying material is dark reddish brown fine sandy loam. Permeability is moderately slow. The available water capacity is low and organic matter content is medium. The availability of phosphorous potassium is low. Subsoil is very dense. Most areas are used for forest and pasture. The major limitation to use is the hazard of wetness.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permea-bility in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-11	Silt loam	ML	A-4	0-5	95-100	95-100	85-95	50-65	15-25	1-3	0.6-2.0	0.20-0.24	5.1-6.0	Low
11-58	Fine sandy loam	SM	A-4	0-5	85-95	80-90	70-80	30-50	14-20	0-1	0.2-0.6	0.07-0.13	6.1-7.3	Low
58-60	Fine sandy loam	SM	A-4	0-5	85-95	80-90	70-80	30-50	14-20	0-1	0.2-0.6	2/	6.6-7.8	Low

Flooding: None
Hydrologic group: B

Depth to water table: Normally perched at depths of 2 feet or less except for parts of July, August & September during the growing season.
Depth to bedrock: Greater than 5 feet

Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: medium shear strength; low shrink-swell
Sand	Not suitable
Gravel	Not suitable
Topsoil	Fair: loamy material; few stones

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: somewhat poorly drained; seasonal high water table; moderate permeability
Sewage Lagoons	Severe: seasonal high water table; occasional ponding
Shallow Excavations	Severe: somewhat poorly drained
Dwellings: With Basements	Severe: somewhat poorly drained; seasonal high water table; occasional ponding
Sanitary Landfill (trench type)	Severe: seasonal high water table; occasional ponding
Local Roads and Streets	Moderate: somewhat poorly drained; moderate to high susceptibility to frost action
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Moderately slow permeability
Embankments, Dikes, and Levees	Low to medium piping resistence; medium to low compressibility and shear strength
Drainage of Cropland and Pasture	Somewhat poorly drained; seasonal high water table; moderately low permeability
Irrigation	Moderately slow permeability; high water table
Terraces and Diversions	Generally not needed, nearly level
Grassed Waterways	Generally not needed, nearly level

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

2/ Because of high bulk density that restricts root penetration, only the upper 2 feet of these horizons supplies moisture to plants.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

MN-SOILS-3
11-71
(File Code SOILS-12)
Ronneby

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: seasonally high water table; occasional ponding
Picnic Areas	Severe: seasonable high water table
Playgrounds	Severe: somewhat poorly drained; seasonable high water table
Paths and Trails	Moderate: somewhat poorly drained

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage	Bluegrass Pasture	Legume - Grass Hay	Legume - Grass Pasture
				B/A	T/A	AUM	T/A	AUM
All	IIIw	--	--	80	14	3.5	4.5	6.7

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	2W	Red Pine White Pine WhiteSpruce Northern Hardwoods	60 60 60 60-70	Slight	Moderate	Moderate	Moderate to Severe	White Pine White Spruce Northern Hardwoods	White Spruce Black Spruce Northern Hardwoods	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

New Found

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES _____
STATE Minnesota
MLRA 89, 90
Rev. DHP-ELP 11/71

This series consists of gently sloping to steep well drained soils formed in more than 40 inches of brownish, medium and strongly acid gravelly sandy loam over bedrock. At depths of 14 to 29 inches there occurs a well developed fragiran ranging in thickness from 10 to 35 inches or more. Percent of coarse fragment typically is 25 to 35 percent. The fragiran restricts root penetration. The terrain is sloping to hilly and is located in the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 16	Gravelly sandy loam	SM	A-2		50-75	40-65	30-55	20-35	10-20	0-4	2.0-6.3	0.10-0.14	4.5 - 6.0	Low
16 to 50 (fragipan)	Gravelly sandy loam	SM	A-2		50-75	40-65	30-55	20-35	10-20	0-4	0.06-0.2	.05-.09	5.1 - 6.0	Low

Flooding None
Hydrologic group: C
Depth to water table: Below 5 feet
Depth to bedrock: Below 5 feet
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good to fair: slopes to 25%; difficult to dig if dry
Sand	Poor
Gravel	Poor
Topsoil	Poor: high coarse fragment content

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability, shallow to fragiran
Sewage Lagoons	Severe: most slopes over 6 percent
Shallow Excavations	Moderate to severe: high coarse fragment content, difficult to dig when dry, slopes to 25%
Dwellings: With Basements Without Basements	Slight to severe: features favorable except for slope which ranges from 2 to 25 percen
Sanitary Landfill	Moderate: high content of coarse fragments; difficult to dig when dry, slopes to 25 percent
Local Roads and Streets	Slight to severe: features favorable except for slope
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High coarse fragment content, slope to 25 percent
Embankments, Dikes, and Levees	Stable fill, moderately pervious, high coarse fragment content.
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate to severe: slow permeability, sloping to hilly terrain
Picnic Areas	Moderate to severe: sloping to hilly terrain
Playgrounds	Severe: most slopes over 6 percent
Paths and Trails	Slight to moderate sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 18 percent slopes	VIe	.37	3,2				
18 to 25 percent slopes	VIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
	Poor	Fair	Fair	Fair	Fair	V. Poor	V. Poor	Poor	Fair	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		White birch Trembling aspen White pine Red pine White spruce	- - - - -	Slight to severe on steeper slopes	Slight to moderate	Slight	Moderate		Red pine Jack pine White spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Low potential porductivity. Moderate to low natural feritility; no native plants suitable for grazing. Watershed - Deep to bedrock; morhumus; permeability 0.06-0.2"/hr.; moderate runoff; well drained.

Newfound (wet)
Gunflint (wet)

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES _
STATE Minnesota
MLRA 89,90

SOIL SURVEY INTERPRETATIONS 1/

This series consists of slightly concave and nearly level, somewhat poorly and poorly drained soils formed in sandy loam glacial till under a mixed deciduous-coniferous forest. Typically they have black loam surface horizons; mottled dark brown and brown loam subsurface horizons; mottled dark brown sandy loam subsoil horizons and dark brown sandy loam underlying material. A fragipan typically begins at 18 inches. Slopes are less than 2 percent. Most areas are forested.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-11	GR-L	ML-CL	A-4	0-5	90-100	70-80	60-75	55-65	15-30	0-10	0.6-2.0	.16-.18	5.1-5.5	Low
11-45	GR-SL	SM	A-2	0-5	85-95	70-80	55-65	20-30	10-20	0-4	0.2-0.6	.08-.13	5.1-6.0	V.Low
45-60	GR-SL	SM	A-2	0-5	85-95	70-80	55-65	20-30	10-20	0-4	0.2-0.6	2/	5.1-6.0	V.Low

Flooding: None
Hydrologic group: C
Depth to water table: Normally perched at depths of 2 ft. or less except for parts of July-September.
Depth to bedrock: Greater than five feet.
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair to Poor - high water table
Sand	Poor
Gravel	Poor
Topsoil	Fair to Poor - small stones, high water table

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe - percs slowly, wet
Sewage Lagoons	Severe - wet
Shallow Excavations	Severe - wet
Dwellings: With Basements	Severe - wet
Dwellings: Without Basements	Moderate to severe - wet
Sanitary Landfill	Area: Severe - wet Trench: Severe - wet
Local Roads and Streets	Severe - wet, frost action
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Moderately slow permeability; somewhat poorly and poorly drained.
Embankments, Dikes, and Levees	Medium shear strength, medium to high susceptibility to piping
Drainage of Cropland and Pasture	Moderately slow permeability
Irrigation	Somewhat poorly and poorly drained; moderately slow permeability
Terraces and Diversions	Generally not needed
Grassed Waterways	Generally not needed

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

2/ Because of high bulk density that restricts root penetration, only the upper 2 ft. of these horizons supplies moisture to plants.

Page 1 of 3
8.8-29.760

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate to severe - wet
Picnic Areas	Moderate to severe - wet
Playgrounds	Moderate to severe - wet
Paths and Trails	Moderate to severe - wet

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS–(High level management)

Phases of Series	Capability	Soil Loss					
		K	T				
All	IIIw						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	2w	Aspen E. Wh. Pine N. Red Oak Red Pine		Slight	Moderate	Slight	Moderate to Severe	White Pine Aspen White Spruce	White Spruce Red Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

6a;7b

Unnamed (Typic Hapludalfs)

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES ____
STATE Minnesota
MLRA ____

This series consists of deep excessively drained soils formed in loamy material over stratified sand and gravel under deciduous and coniferous forest on plane and convex slopes of outwash plains, eskers, and kames. Typically, they have black, sandy loam surface layers 1 inch thick; dark grayish brown, sandy loam subsurface layers 2 inches thick; dark reddish brown and reddish brown, sandy loam subsoil 12 inches thick; and yellowish brown, gravelly very coarse sand underlying material. Slopes range from 1 to 60 percent. Most areas are forested.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.-				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	SL	SM	A-4	0-5	90-100	80-95	55-75	35-50	—	NP	0.6-2.0	.18-.24	4.5-6.5	Low
15-60	GR-COS	GW, GP, SP	A-1	0-10	40-85	35-75	10-45	0-5	—	NP	> 20	.02-.04	4.5-6.5	V.Low

Flooding None
Hydrologic group: B
Depth to water table: greater than five feet
Depth to bedrock: 40-120 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good
Sand	Good
Gravel	Good
Topsoil	Poor: thin layer, small stones

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	0-8%: slight 8-15%: moderate-slope 15+%: severe-slope
Sewage Lagoons	Severe: seepage
Shallow Excavations	0-15%: moderate-small stones; 15+%: severe-slope
Dwellings: With Basements / Without Basements	0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope
Sanitary Landfill (Trench and Area)	Severe: seepage
Local Roads and Streets	0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Seepage
Embankments, Dikes, and Levees	Seepage
Drainage of Cropland and Pasture	Not needed
Irrigation	Slope, seepage
Terraces and Diversions	Slope, too sandy
Grassed Waterways	Slope, droughty
Excavated Ponds Aquifer Fed:	Deep to water

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

6a;76

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	0-6%: slight; 6-15%: moderate-slope; 15+%: severe-slope
Picnic Areas	0-9%: slight; 9-15%: moderate-slope; 15+%: severe-slope
Playgrounds	0-2%: slight; 2-6%: moderate-slope; 6+%: severe-slope.
Paths and Trails	0-15%: slight; 15-25%: moderate-slope; 25+%: severe-slope

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
0-2%	3S						
2-6%	3E						
6-12%	4E						
12-18%	6E						
18-35%	7E						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-12%	Fair	Good	Good	Fair	Fair	V.Poor	V.Poor	Good	Good	V.Poor
12-35%	Poor	Poor	Good	Fair	Fair	V.Poor	V.Poor	Fair	Fair	V.Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-12%	3S	Red Pine	55	Slight	Slight	Moderate	Slight		Red Pine	
		E.Wh.Pine	55						Wh.Spruce	
		Jack Pine	60							
		Wh.Spruce	60							
12-35%	4S	Red Pine	55	Moderate	Moderate	Severe	Slight		Red Pine	
		E.Wh.Pine	55						Jack Pine	
		Jack Pine	60							

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor
0-12%	Northern White-Cedar, Red Pine, Russian-Olive, White Spruce, Jack Pine, Siberian Crabapple, Eastern Red Cedar, Hackberry, Silver Buffaloberry Siberian Peashrub, Bur Oak, Tatarian Honeysuckle	11,20,15 18,20,12 15,18,12 10,18,10	

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Toivola

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 89 & 90-2
D.F. RL 2-72

This series consists of nearly level to very steep, excessively drained soils formed in outwash material. These soils are on outwash eskers and ice-contact glacial deposits. Native vegetation was forest. The surface layer is dark reddish brown decomposed plant remains about 2 inches thick. The subsurface layer is gray very gravelly coarse sandy loam about 5 inches thick. The subsoil is strong brown, gravelly loamy sand about 10 inches thick. The underlying material is brown very gravelly coarse sand. Permeability is very rapid. The available water capacity is very low and organic matter content is low. These soils contain many cobbles and boulders.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Very Gravelly loamy sand	GW, GP or SP	A-1	0-10	20-60	10-50	4-30	0-5	NP	NP	Greater than 20.	0.03-0.05	5.1-6.5	Low
15-60	Very Gravelly loam sand	GW, GP or SP	A-1	5-20	20-60	10-50	4-30	0-5	NP	NP	Greater than 20.	0.02-0.04	5.1-6.5	Low

Flooding None
Hydrologic group: A
Depth to water table: Greater than 5 feet
Depth to bedrock: Normally greater than 6 feet
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good: high shear strength; low compressibility
Sand	Poor: quantity of sand is low
Gravel	Good: stones and boulders
Topsoil	Poor: coarse textured; stones and boulders

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Slight: very rapid permeability; moderate on 6 to 12 percent slopes; severe on slopes over 12 percent; hazard of polluting underground water
Sewage Lagoons	Severe: very rapid permeability; coarse textured
Shallow Excavations	Severe: stones and boulders; very gravelly
Dwellings: With Basements	Slight: on 0 to 6 percent slopes; moderate on 6 to 12 percent slopes; severe on more than 12 percent slopes
Sanitary Landfill (trench type)	Severe: very rapid permeability; coarse textured
Local Roads and Streets	Slight: on 0 to 6 percent slopes; moderate on 6 to 12 percent slopes; severe on more than 12 percent slopes.
Potential Frost Action	

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High compacted permeability
Embankments, Dikes, and Levees	High compacted permeability; low compressibility; high shear strength
Drainage of Cropland and Pasture	Not needed; excessively drained
Irrigation	Very low available water capacity
Terraces and Diversions	Coarse textured; stones and boulders
Grassed Waterways	Coarse textured; stones and boulders

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate; many coarse fragments at the surface; 0 to 12 percent slopes; severe on more than 12 percent slopes
Picnic Areas	Moderate: many coarse fragments at the surface; 0 to 12 percent slopes; severe on more than 12 percent slopes
Playgrounds	Severe: many coarse fragments at the surface
Paths and Trails	Moderate: many coarse fragments at the surface; 0 to 25 percent slopes; severe more than 25 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
0 to 12% slopes	VIs	.20	3	-	-	-	
12-18% slopes	VIs			No information at this time			
18-35% slopes	VIIs						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	very poor	poor	poor	very poor	very poor	very poor	very poor	poor	very poor	very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	4s	Jack Pine Trembling Aspen	40 or less 50 or less	Slight increases with steep	Moderate 0-12% slopes increases with steep slopes	Moderate to severe	Low	Jack Pine	Jack Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Cloquet

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES —
STATE Minnesota
MLRA 99
Revised Draft DP-RRL 12-72

SOIL SURVEY INTERPRETATIONS [1/]

This series consists of nearly level to steep, excessively drained soils formed in 1 to 2 feet of loamy material over stratified sand and gravel. These soils are on plane and convex slopes of outwash plains, eskers and kames. Native vegetation was forest. In a representative profile the surface layer is black sandy loam about 1 inch thick. The subsoil is dark brown, very friable, sandy loam about 13 inches thick. The underlying material is reddish brown gravelly coarse sand. Permeability is moderate in the upper part of the profile and very rapid in the lower part of the profile. The available water capacity is low and organic matter content is low. The availability of phosphorus is low, and of potassium is low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-8	sandy loam	SM	A-4	0-1	90-100	80-95	55-75	35-50	NP	NP	0.6-2.0	0.22-0.24	4.5-6.0	low
8-14	sandy loam	SM	A-4	0-1	90-100	80-95	55-75	35-50	NP	NP	0.6-2.0	0.18-0.21	4.5-6.0	low
14-60	gravelly coarse sand,	GW,GP or SP	A-1	0-10	40-85	35-75	10-45	0-5	NP	NP	Greater than 20	0.02-0.04	5.6-6.5	low

Flooding None
Hydrologic group: B
Depth to water table: More than 6 feet
Depth to bedrock: More than 6 feet
Corrosivity - uncoated steel: Very low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good: high shear strength; low compressibility; low shrink-swell
Sand	Fair: mixed with gravel; needs screening; deposits are generally thick.
Gravel	Good: stratified sand and gravel; some stones and boulders; water table is deep
Topsoil	Fair: upper 1 to 2 feet is sandy loam material; may have some coarse fragments.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Slight: very rapid permeability [2/] Moderate: 6-12 percent slopes [2/] Severe: on more than 12 percent slopes [2/]
Sewage Lagoons	Severe: very rapid permeability; coarse textured material
Shallow Excavations	Severe: many coarse fragments
Dwellings: With Basements	Slight: high shear strength; low shrink-swell; low compressibility; excessively drained Moderate: 6-12 percent slopes Severe: greater than 12 percent slopes
Sanitary Landfill (Trench type)	Severe: very rapid permeability [2/]
Local Roads and Streets	Severe: on more than 12 percent; good natural drainage; low susceptibility to frost heaving Slight: 0-6 percent slopes Moderate: 6-12 percent slopes
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	very rapid permeability
Embankments, Dikes, and Levees	High shear strength; good compaction characteristics; high compacted permeability low compressibility; good resistance to piping
Drainage of Cropland and Pasture	generally not needed, excessively drained
Irrigation	low available water holding capacity
Terraces and Diversions	Coarse textured material below depths of 1 to 2 feet; low available water holding capacity
Grassed Waterways	Coarse Textured material below depths of 1 to 2 feet; low available water holding capacity.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

2/ Pollution is hazard to water supplies.

7c;41a

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Slight: 0-6 percent slopes Moderate: over 6 percent slopes
Picnic Areas	Slight: 0-12 percent slopes Moderate: over 12 percent slopes
Playgrounds	Slight: 0-2 percent slopes Moderate: 2-6 percent slopes Severe: over 6 percent slopes
Paths and Trails	Slight: 0-6 percent slopes Moderate: slopes over 6 percent

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats Bu/Ac.	Corn Silage Ton/Ac	Bluegrass Pasture AUM	Legume-Grass Ton/Ac.	Legume-Grass AUM
0-2% slopes	IIIs	.24	2.2	70	8	4.0	3.5	5.0
2-6% slopes	IIIe			70	8	4.0	3.5	5.0
6-12% slopes	IVe			60	7	4.0	3.5	5.0
2-12% slopes	IVe			60-70	7-8	4.0	3.5	5.0
12-18% slopes	VIe			—	—	4.0	—	—
18-25% slopes	VIIe			—	—	4.0	—	—
12-25 % slopes	VIIe			—	—	4.0	—	—
25-35% slopes	VIIe			—	—	—	—	—

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-12%	Fair	Good	Good	Fair	Fair	Very Poor	Very poor	Good	Good	Very poor
12-35%	Poor	Poor	Good	Fair	Fair	Very poor	Very poor	Fair	Good	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seedling Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-12%	3s	Red Pine White Pine Jack Pine White Spruce	55 55 60 50	Slight:0-12% Moderate to Severe	Slight Moderate to Severe	Moderate Moderate	Slight to Moderate	Red Pine Jack Pine White Pine	Red Pine Jack Pine	
12-35 %										

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

8a;35a

Masaba 538 Mesaba

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota 9/71
MLRA 90, 90
Rev. DHP 11/71

This series consists of gently sloping to steep well drained soils formed in 20 to 40 inches of dark brown, medium acid, gravelly sandy loam glacial till that is underlain by bedrock. The dominated bedrock is gabbro and granite. Surface stones typically occupy less than 5 percent of surface and varies locally to 30 percent. Subsurface coarse fragment content typically is 25 percent. These soils occur on sloping to hilly terrain in the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 28	Gravelly sandy loam	SM	A-2		50-85	40-75	30-55	25-35	10-20	0-4	2.0 to 6.3	0.10 to 0.14	5.1 to 6.0	Low

Flooding None
Hydrologic group: C
Depth to water table: 20 to 40 inches
Depth to bedrock: 20 to 40 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: limited volume of material, poor on slopes over 18 percent
Sand	Poor
Gravel	Poor
Topsoil	Poor: low natural fertility; 25% coarse fragments

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: bedrock at 20 to 40 inches, sloping to hilly terrain
Sewage Lagoons	Severe: bedrock at 20 to 40 inches, sloping to hilly terrain
Shallow Excavations	Severe: bedrock at 20 to 40 inches
Dwellings: With Basements / Without Basements	Severe: bedrock at 20 to 40 inches; sloping to hilly terrain
Sanitary Landfill	Severe: bedrock at 20 to 40 inches; sloping to hilly terrain
Local Roads and Streets	Severe: bedrock at 20 to 40 inches, sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Bedrock at 20 to 40 inches, no or very few available sites
Embankments, Dikes, and Levees	Bedrock at 20 to 40 inches, high content of coarse fragments
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate to sloping to hilly terrain
Picnic Areas	Moderate to severe; sloping to hilly terrain
Playgrounds	Severe: sloping to hilly terrain
Paths and Trails	Slight to moderate: sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 18 percent slopes	VIe	.37	2,2				
18 to 35 percent slopes	VIIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Fair	Fair	Fair	Fair	V. Poor	V. Poor	Poor	Fair	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Jack pine Trembling aspen White pine White spruce Red pine	50-60 - - -	Slight to severe on steeper slopes	Slight to severe on steeper slopes	Slight	Moderate		Jack pine Red pine White spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential productivity is low. Moderate to low natural fertility; no native plants suitable for grazing. Watershed - Shallow to bedrock; erodibility class III; mor humus; *infiltration 0.15-0.3"/hr. permeability 2-6.3"/hr; moderate runoff; well drained. * Infiltration rates need further consideration.

Subject to change on completion of coordination between MLRA'S

Barto
555 Barto

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES _____
STATE Minnesota
MLRA 89,90
Rev. DHP-LLB 11/71

SOIL SURVEY INTERPRETATIONS 1/

This series consists of gently sloping to steep well drained soils formed in 8 to 20 inches of brownish and reddish gravelly coarse sandy loam, glacial till underlain by bedrock. Coarse fragment content typically is about 20 percent. Soils are subject to seasonal drouthiness. These soils occur on sloping to hilly terrain in the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Gravelly coarse sandy loam	SM	A-2		50-85	40-75	30-44	25-35	10-20	0-4	2.0 to 6.3	0.10 to 0.14	5.1 to 6.0	Low
15+	Bedrock													

Flooding None
Hydrologic group: B
Depth to water table: 5 feet
Depth to bedrock: 8 to 20 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair; limited volume of material; poor on slopes over 18 percent
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor; low natural fertility; shallow to bedrock

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: shallow to bedrock
Sewage Lagoons	Severe: shallow to bedrock; moderately rapid permeability; sloping to hilly terrain
Shallow Excavations	Severe: shallow to bedrock, sloping to hilly terrain
Dwellings: With Basements / Without Basements	Severe: shallow to bedrock, sloping to hilly terrain
Sanitary Landfill	Severe: shallow to bedrock, sloping to hilly terrain
Local Roads and Streets	Severe: shallow to bedrock, sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Shallow to bedrock, no or very few suitable sites
Embankments, Dikes, and Levees	Moderately rapid permeability, shallow to bedrock
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate or severe on slopes over 18%; shallow to bedrock; low natural fertility; subject to compaction; low natural carrying capacity for intensive use
Picnic Areas	Moderate, severe on slopes over 18 percent, shallow to bedrock; sloping to hilly terrain; low natural fertility
Playgrounds	Severe: sloping to hilly terrain; subject to compaction; low natural carrying capacity for intensive use
Paths and Trails	Slight, moderate on slopes over 18 percent: sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 18% slope	VIe	.37	2,2				
18-35% slope	VIIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Fair	Fair	Fair	Fair	V. Poor	V. Poor	Poor	Fair	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Jack pine Trembling aspen White spruce	50 50 45	Moderate to severe on steeper slopes	Slight to severe on steeper slopes	Slight	Slight		Jack pine Red pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential productivity is low. Low natural fertility. No native plants suitable for grazing. Watershed - shallow to bedrock; erodibility class III; morhumus; *infiltration 0.15 to 0.3"/hr.; permeability 2 to 6.3"/hr.; moderate runoff; well drained. *Infiltration rate needs further consideration.

8c; 9c; 10a; 35c

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Quetico #952 SERIES Quetico
STATE Minnesota
MLRA 90 90
Rev. DMP-ELP 11/71

This series consists of somewhat excessively drained soils formed in 4 to 8 inches of dark brown and strong brown, strongly and very strongly acid loam over bedrock. Bedrock outcroppings are common. The terrain is broken, irregular and sloping to hilly. These soils occur within the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 8	Loam	ML-CL	A-4		75-95	70-90	60-80	55-70	10-30	5-10	0.63 to 2.0	0.15 to 0.20	4.5 to 5.5	Low
8+	Bedrock													

Flooding: None
Hydrologic group: D
Depth to water table: Over 5 feet
Depth to bedrock: 8 inches or less
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: shallow soil, outcrops of bedrock are common
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: extremely shallow to bedrock

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: extremely shallow to bedrock; sloping to hilly terrain
Sewage Lagoons	Severe: extremely shallow to bedrock; sloping to hilly terrain
Shallow Excavations	Severe: extremely shallow to bedrock; sloping to hilly terrain
Dwellings: With Basements / Without Basements	Severe: extremely shallow to bedrock; sloping to hilly terrain; low clay content; well drained
Sanitary Landfill	Severe: extremely shallow to bedrock; sloping to hilly terrain
Local Roads and Streets	Severe: extremely shallow to bedrock; sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Shallow to bedrock, no suitable sites
Embankments, Dikes, and Levees	Shallow to bedrock, limited volume of material
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

8c; 9c; 10a; 35c

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: irregular, broken sloping to hilly terrain; extremely shallow soils; soils subject to compaction; low natural fertility
Picnic Areas	Severe: irregular, broken, sloping to hilly terrain
Playgrounds	Severe: irregular, broken, sloping to hilly terrain; extremely shallow soils
Paths and Trails	Moderate on 5 to 18 percent slopes and severe on slopes over 18 percent; irregular, broken, sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
5 to 18 percent slopes	VIIs	-	-				
18 to 35 percent slopes	VIIs						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
	V. Poor	Poor	Poor	Poor	Poor	V. Poor	V.Poor	Poor	Poor	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Jack pine	<40	Moderate to severe	Moderate to severe	Slight	Slight		Jack pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Watershed - Extremely shallow to bedrock; morhumus; permeability 0.63-2.0"/hr.; rapid runoff; low storage; somewhat excessively drained.

Conic

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES -
STATE Minnesota
MLRA 89, 90
Rev. DHP
Date: 2/72

This series consists of gently sloping to steep well drained soils formed in 20 to 40 inches of brownish medium to very strongly acid, gravelly sandy loam glacial till that is underlain by bedrock. Occurring at depths of 10 to 24 inches is a 5 to 16 inch thick fragipan. These soils occur in the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0 to 15	Gravelly sandy loam	SM	A2		50-75	40-65	30-55	20-35	10-20	0-4	2.0-6.3	0.10 to 0.14	4.0 to 6.0	Low
15 - 30 (Fragipan)	Gravelly sandy loam	SM	A2		50-75	40-65	30-55	20-35	10-20	0-4	0.06-0.2	.05-.09	4.5 to 6.0	Low

Flooding None
Hydrologic group: B
Depth to water table: Naturally well drained
Depth to bedrock: 20 to 40 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: Limited volume of material, poor on slopes over 12 percent
Sand	Poor
Gravel	Poor
Topsoil	Poor: Low natural fertility; high coarse fragment content; less than 40" to bedrock

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe bedrock at 20 to 40 inches; hardpan; sloping to hilly terrain
Sewage Lagoons	Severe bedrock at 20 to 40 inches, sloping to hilly terrain
Shallow Excavations	Severe bedrock at 20 to 40 inches, fifficult to dig if dry
Dwellings: With Basements / Without Basements	Severe bedrock at 20 to 40 inches; sloping to hilly terrain
Sanitary Landfill	Severe: bedrock at 20 to 40 inches, sloping to hilly terrain
Local Roads and Streets	Severe: bedrock at 20 to 40 inches seepage along hardpan; sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Bedrock at 20 to 40 inches, no or very few available sites
Embankments, Dikes, and Levees	Bedrock at 20 to 40 inches, high content of coarse fragments
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate to severe: sloping to hilly terrain
Picnic Areas	Moderate to severe; sloping to hilly terrain
Playgrounds	Severe: sloping to hilly terrain
Paths and Trails	Slight to moderate: sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 18 percent slope	VIe	.37	2,2				
18 to 35 percent slope	VIIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Fair	Fair	Fair	Fair	V. Poor	V. Poor	poor	fair	very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Trembling aspen Jack pine White spruce	50-60	Moderate to severe on hilly terrain	Slight to severe on hilly terrain	Slight	Moderate		Jack pine Red pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential productivity is low. Low natural fertility. No plants suitable for grazing.
Watershed - Shallow to bedrock; erodibility class III; mor humus; *infiltration 0.15-0.3"/hr. permeability 0.06-0.2"/hr.; moderate runoff; well drained. *Infiltration rates need further consideration

Insula

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 89, 90
Rev. DRP-ELB 11/71

This series consists of gently sloping to steep well drained soils formed in 8 to 20 inches of dark ellowish brown to dark brown, medium to strongly acid, gravelly sandy loam glacial till that is underlain by bedrock. Coarse fragments occupy about 25 percent of the soil material. These soils occur within the Laurentian Shield country of northeastern Minnesota.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Gravelly sandy loam	SM	A2		70-75	40-65	30-55	25-35	10-20	0-4	2.0 to 6.3	0.10 to 0.14	5.1 to 6.0	Low
15+	Bedrock													

Flooding None
Hydrologic group: B
Depth to water table: Below 5 feet
Depth to bedrock: 8 to 20 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: limited volume of material; poor on slopes over 18 percent
Sand	Poor
Gravel	Poor
Topsoil	Poor: natural low fertility; shallow to bedrock; 25 percent coarse material

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: shallow to bedrock
Sewage Lagoons	Severe: shallow to bedrock; moderately rapid permeability sloping to hilly terrain
Shallow Excavations	Severe: shallow to bedrock, sloping to hilly terrain
Dwellings: With Basements Without Basements	Severe: shallow to bedrock; sloping to hilly terrain
Sanitary Landfill	Severe: shallow to bedrock, sloping to hilly terrain
Local Roads and Streets	Severe: shallow to bedrock, sloping to hilly terrain
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Shallow to bedrock, no or very few suitable sites
Embankments, Dikes, and Levees	Moderately rapid permeability, shallow to bedrock
Drainage of Cropland and Pasture	
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

SUBJECT TO REVIEW

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate to severe: shallow to bedrock; sloping to hilly terrain; low natural fertility
Picnic Areas	Moderate to severe shallow to bedrock; sloping to hilly terrain; low natural fertility moderate to rapid permeability; subject to compaction
Playgrounds	Severe: sloping to hilly terrain; subject to compaction; low natural carrying capacity for intensive use
Paths and Trails	Slight to moderate: sloping to hilly terrain

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
2 to 18 percent slope	VIe	.37	2,2				
18 to 35 percent slope	VIIe						

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Fair	Fair	Fair	Fair	V. Poor	V. Poor	Poor	Fair	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All		Jack pine Trembling aspen	<50 <50	Moderate to severe on hilly terrain	Slight to severe on hilly terrain.	Slight	Slight		Jack pine Red pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential productivity is low. Low natural fertility. No plants suitable for grazing.
Watershed - Shallow to bedrock; erodibility class III; morbumus; *infiltration 0.15 to 0.3"/hr. permeabilit 2-6.3"/hr.; moderate runoff; well drained. *Infiltration rates need further consideration.

FOR INTERIM USE

Subject to change on completion of review

Correlation between NLRA'S

Bedrock outcrop

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Series
STATE Minnesota
MLRA 88, 89, [illegible], 92
Rev. RRL, 11-72

This land type consists of relatively impermeable hard igneous, metamorphic, and sedimentary bedrock in Northeastern Minnesota. Typically this type of land consists of bedrock outcrop that is in complex patterns with other deeper soils. The land is typically broken and irregular with nearly level to steep slopes.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
---	----	----	----	Hard bedrock, material is unclassified							----	----	---	----

Flooding: None

Hydrologic group: D

Depth to water table: Deeper than 10 feet

Depth to bedrock: 0 to 4 inches

Corrosivity - uncoated steel: Low

Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: hard bedrock
Sand	Unsuited
Gravel	Unsuited
Topsoil	Unsuited

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe, hard bedrock
Sewage Lagoons	Severe, hard bedrock
Shallow Excavations	Severe, hard bedrock
Dwellings: With Basements	Severe, hard bedrock
Sanitary Landfill	Severe, hard bedrock
Local Roads and Streets	Severe, hard bedrock
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	hard bedrock
Embankments, Dikes, and Levees	hard bedrock
Drainage of Cropland and Pasture	unsuited
Irrigation	unsuited
Terraces and Diversions	unsuited
Grassed Waterways	unsuited

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: hard bedrock
Picnic Areas	Severe: hard bedrock; includes nearly level areas that are suited for this use.
Playgrounds	Severe: hard bedrock
Paths and Trails	Slight: 0 to 18% slopes; Severe: 18 to 35% slopes; slippery when wet

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
All	VIII	--	--	Not suited for cultivated crops			

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	D	Jack Pine Red Pine Cedar	Very low	Severe	Severe	Severe	Severe		Jack Pine Juniper-shrub type	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

MRTSC Trial Form
File Code Soils-12
Rev. 9-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES —
STATE Minnesota
MLRA 88, 89
REV. ROP-ELB 8-71

These are deep, poorly and somewhat poorly drained, nearly level, clayey soils with slow permeability on glacial lake plains. The surface layer is black clay about 2 inches thick. The subsurface layer is dark gray clay loam about 4 inches thick. The subsoil is very firm dark gray and olive gray clay. The underlying material is olive and olive gray clay with mottles. Native vegetation was mixed deciduous and coniferous forest.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 In. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. In./In.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-5	Clay and clay loam	CH	A-7		100	95-100	85-95	70-90	50-70	30-50	.06-.20	.13-.16	5.6-6.5	Mod.-High
5-23	clay	CH	A-7		100	100	95-100	85-95	50-70	30-50	.06-.20	.10-.14	5.6-7.8	High
23-60	clay	CH	A-7		100	100	95-100	85-95	50-70	30-50	.06-.20	.09-.13	7.5-8.0	High

Flooding Slight — Hydrologic group: D

Depth to water table: Seasonsal high water table at 1 to 3 feet. — Depth to bedrock: Greater than 5 feet.

Corrosivity - uncoated steel: Very High — Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: poor shear strength, poor workability, high shrink-swell, high compressibility.
Sand	Not suitable.
Gravel	Not suitable.
Topsoil	Poor: fine textured, low organic matter.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability; fine soil texture; seasonal high water table at 1 to 3 feet; poorly and very poorly drained.
Sewage Lagoons	Severe: slow permeability; nearly level slopes; fine soil texture; but seasonal high water table at 1 to 3 feet.
Shallow Excavations	Severe: high water table; fine textured.
Dwellings:	Severe: Poor shear strength; high shrink-swell; high compressibility; seasonal high water table at 1 to 3 feet.
Sanitary Landfill	Severe: Poorly and very poorly drained; slow permeability; fine soil texture; poor workability; slippery when wet.
Local Roads and Streets	Severe: Poorly and somewhat poorly drained; fine soil texture; high shrink-swell potential.
Potential Frost Action	Moderate - Soil texture, poor and somewhat poor drainage

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Slow permeability; good resistance to piping.
Embankments, Dikes, and Levees	High compacted permeability; high compressibility; seasonal high water table at 1 to 3 feet; good resistance to piping; poor shear strength; high shrink-swell potential; poor workability.
Drainage of Cropland and Pasture	Fine textured material throughout; seasonal high water table at 1 to 3 feet; slow permeability; occasionally flooded or ponded.
Irrigation	Usually not considered because of the poor and somewhat poor soil drainage; slow permeability; very slow intake rate.
Terraces and Diversions	
Grassed Waterways	Fine textured material throughout; poor and somewhat poorly drained; usually nearly level topography; poor workability.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: Slow permeability; poorly and somewhat poorly drained; moderately fine and fine textured surface.
Picnic Areas	Severe: Poorly and somewhat poorly drained; moderately fine and fine textured surface.
Playgrounds	Severe: Slow permeability; poorly and somewhat poorly drained; moderately fine and fine textured surface.
Paths and Trails	Severe: Poorly and somewhat poorly drained; moderately fine and fine textured surface.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats Bu.	Alfalfa-Grass Tons	Altalfa-Grass Pasture AUM	Clover-Grass Tons	Clover-Grass Pasture AUM	Bluegrass Pasture AUM
0 to 2% slopes	IIIw	-	-	65	4.0	6.0	3.5	5.2	4.8

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
0 to 2% slopes	2w	Aspen	76	Slight	Moderate	Moderate	Severe		White spruce, White pine	
		White spruce	53							

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND

General productivity is moderate to high if the wetness hazard has been corrected and the lime and fertilizer requirements are met. Climate restricts the choice of crops. Snow cover is commonly continuous throughout the winter.

Wildwood

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES —
STATE Minnesota
MLRA 88-1
Rev. RRL 11-72

This series consists of very poorly drained clayey soils occupying concave slopes on glacial lake plains. Typically these soils have a mucky surface layer about 6 inches thick. The subsoil is mottled, dark gray, noncalcareous clay about 12 inches thick. The substratum is gray or olive gray calcareous clay. Most areas are irregular shaped and range from 5 to 15 acres in size.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract.	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. In./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO	>3 in. %	4	10	40	200						
0-6	Muck	--	A-8	--	Not suitable for engineering sieve analysis				--	--	.06-0.6	.35-.48	5.6-6.5	--
6-18	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.10-.14	5.6-7.3	High
18-60	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	7.4-8.4	High

Flooding: Occasionally ponded
Hydrologic group: D
Depth to water table: 0.5 - 2 ft. perched May to November
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high shrink-swell, low strength, wet
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: too clayey, wet

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: water moves through the soil too slowly, wet
Sewage Lagoons	Severe: too much organic matter in surface layer, wet
Shallow Excavations	Severe: wet, clayey
Dwellings: With Basements	Severe: wet, high shrink-swell, low strength
Sanitary Landfill: Trench type	Severe: wet, clayey
Local Roads and Streets	Severe: wet, clayey
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Favorable, slow permeability
Embankments, Dikes, and Levees	Low strength, high compressibility
Drainage of Cropland and Pasture	Slow permeability, clayey, wet
Irrigation	Not needed
Terraces and Diversions	Not needed
Grassed Waterways	Not needed

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: wet, poor trafficability
Picnic Areas	Severe: wet, poor trafficability
Playgrounds	Severe: wet, poor trafficability
Paths and Trails	Severe: wet, poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	OATS Bu/A	CORN SILAGE T/A	BLUEGRASS PASTURE AUM	LEGUME GRASS CROSS T/A	LEGUME GRASS AUM
All	IVw	--	--	55	14	4.1	3.5	5.2

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seedling Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5W	Black Ash Aspen Black Spruce	45 60	Slight	Severe	Moderate	Severe		Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Taylor

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 88
Rev. RRL 11-72

This series consists of well drained and moderately well drained clayey soils occupying nearly level to hilly slopes in glacial lake plains. Typically these soils have a silt loam surface layer about 6 inches thick. The subsoil is dark brown or dark grayish brown medium to slightly acid clay. The substratum is grayish brown calcareous silty clay. Most areas are irregular shaped but some areas are elongated ridges.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-6	Silt loam	ML	A-4	0	100	100	95-100	95-100	20-35	0-5	.63-2.00	.22-.24	5.6-6.5	Low
6-21	Clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.10-.14	5.6-6.5	High
21-60	Silty clay	CH	A-7	0	100	100	95-100	85-95	50-70	25-50	.06-.20	.09-.13	7.4-8.4	High

Flooding: None
Hydrologic group: D
Depth to water table: Greater than 5 feet
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: poor shear strength, poor workability, high shrink-swell
Sand	Unsuitable
Gravel	Unsuitable
Topsoil	Poor: friable material is thick, low organic matter

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability
Sewage Lagoons	Slight: 0-2 percent slopes; Moderate: 2 to 6 percent slopes; Severe: more than 6 percent slopes
Shallow Excavations	Severe; poor workability
Dwellings: With Basements	Severe; high shrink-swell
Sanitary Landfill (trench type)	Severe: poor workability
Local Roads and Streets	Severe; high shrink-swell, low bearing strength
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Slow permeability
Embankments, Dikes, and Levees	Low to medium shear strength; fair to poor compaction characteristics
Drainage of Cropland and Pasture	Usually not needed
Irrigation	Slow infiltration; slow permeability
Terraces and Diversions	Poor workability
Grassed Waterways	Poor workability

PRELIMINARY DRAFT REPORT. SUBJECT TO REVIEW.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: slow permeability; Severe: greater than 12 percent slopes
Picnic Areas	Slight: 0 to 6 percent slopes; Moderate: 6 to 12 percent slopes; Severe: greater than 12 percent slopes
Playgrounds	Moderate: slow permeability; Severe: greater than 6 percent slopes
Paths and Trails	Slight: 0 to 18 percent slopes; Moderate: 18 to 25 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
0-2% slopes	IIs	.43	3.2	70	14		4	6.6	5.4
2-6% slopes	IIe			70	12		4	6.6	5.4
6-12% slopes	IIIe			65	12		3.5	5.9	4.8
2-12% slopes	IIIe			65	12		3.5	5.9	4.8
12-25% Slopes	VIe			--	--		---	5.0	4.1

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seedling Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	10	Aspen Red Pine WhitePine White Spruce	79 55 50 58	Slight to Moderate 0 to 12% slopes; Severe ~~12 to 25% slopes~~	Moderate to Severe	Slight to Moderate	Moderate to Severe	W. Spruce Red Pine Basswood Aspen	W. Spruce Red Pine Basswood	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Nebish V

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES ____
STATE Minnesota
MLRA 88
Rev. Draft WJA 3-72

SOIL SURVEY INTERPRETATIONS 1/

This series consists of gently sloping to very steep, well drained soils formed in glacial till. These soils are on convex areas of ground and terminal moraines. Native vegetation was forest. In a representative profile, the surface layer is very dark gray loam about 3 inches thick. The subsurface layer is grayish brown sandy loam about 6 inches thick. The subsoil is dark yellowish brown to light olive brown, firm clay loam. The underlying material is light olive brown loam. The permeability is moderate to moderately slow. The organic matter content is low. The reaction is neutral. The inherent fertility is moderate.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-3	loam	ML	A-4		95-100	90-98	85-95	60-75	20-40	1-10	.6-2.0	.20-.22	6.6-7.3	Moderate
3-9	sandyloam	SM	A-4		95-100	90-98	50-75	35-50	25-40	1-7	2.0-6.0	.13-.15	6.6-7.3	Low
9-33	clay loam	CL	A-6 or A-7		95-100	90-98	85-95	70-85	30-45	15-25	0.2-2.0	.15-.19	6.1-6.5	Moderate
33-60	loam	CL	A-6		95-100	90-98	85-95	60-75	20-40	10-20	0.6-2.0	.17-.19	7.4-7.8	Moderate

Flooding None — Hydrologic group: B

Depth to water table: 5-10 feet seasonally high — Depth to bedrock: Over 10 feet

Corrosivity - uncoated steel: Low — Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: moderate shrink-swell; moderate frost action; a few stones; poor on slopes over 25%
Sand	Unsuitable
Gravel	Unsuitable
Topsoil	Poor: thin surface layer

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Moderate: moderate permeability in underlying material; severe on slopes over 12%
Sewage Lagoons	Moderate: moderate permeability in underlying material; severe on slopes over 6%
Shallow Excavations	Moderate: clay loam texture; severe on slopes over 12%
Dwellings: With Basements	Moderate: moderate shrink-swell; moderate frost action; severe on slopes over 12%
Dwellings: Without Basements	Moderate: moderate shrink-swell; moderate frost action; severe on slopes over 12%
Sanitary Landfill	Slight: on 0-12% slopes. Moderate: on 12 to 25% slopes. Severe: on slopes over 25%
Local Roads and Streets	Moderate: moderate shrink-swell potential; moderate frost action potential
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Moderate to moderately slow permeability; deep water table; 2-30% slopes
Embankments, Dikes, and Levees	Medium to low shear strength; medium compressibility; low compacted permeability; low to medium susceptibility to piping; fair to good compaction characteristics
Drainage of Cropland and Pasture	Not needed; well drained
Irrigation	High available water capacity; 2-30% slopes; medium water intake rate; a few stones; moderately slow permeability; hazard of water erosion
Terraces and Diversions	Slopes are often uneven and choppy; a few stones; loamy texture; moderate to moderately slow permeability
Grassed Waterways	Well drained; a few stones; 2-30% slopes; high available water capacity

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Slight: on 2-6% slopes; Moderate: on 6-12% slopes; Severe: on slopes over 12%; stones
Picnic Areas	Slight: on 2-6% slopes; Moderate: on 6-12% slopes; Severe: on slopes over 12%; stones
Playgrounds	Moderate: on 2-6% slopes; Severe: on slopes over 6%
Paths and Trails	Slight: on 2-18% slopes; Moderate: on 18-25% slopes; Severe: on slopes over 25%

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Bu.	Soybeans Bu.	Wheat Bu.	Oats Bu.	Alf. Grass Hay T.	Alf. Grass AUM	Bluegrass AUM
2-6% slopes	IIe	.37	4.3	55	25	45	75	4.5	6.7	5.0
6-12% slopes	IIIe			50	20	40	70	4.0	6.0	4.5
12-18% slopes	IVe			45	17	35	65	3.5	5.0	4.0
18-25% slopes	VIe			--	--	--	--	3.0	4.5	3.0
25%+ slopes	VIIe			--	--	---	--	--	--	2.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
2-6% slope	Fair	Good	Good	Good	Poor	Very Poor	Very Poor	Good	Good	Very Poor
6-12% slope	Fair	Good	Good	Good	Poor	Very Poor	Very Poor	Good	Good	Very Poor
12-18% slope	Poor	Fair	Good	Good	Poor	Very Poor	Very Poor	Fair	Good	Very Poor
18-25% slope	Poor	Fair	Good	Good	Poor	Very Poor	Very Poor	Fair	Good	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seedling Mortality	Plant Competition	Suitable Species: To Favor	To Plant	Other
2-12% slope	2o	Aspen	73± 2.8	Slight	Slight	Slight	Moderate	White Spruce	White Spruce	
		Red Pine	57 (55-62)					Red Pine	Red Pine	
		White Pine	55 (52-58)					Maple	Hardwoods	
		Jack Pine	63 (62-63)					Basswood		
		White Spruce	62 (60-64)					Aspen		
12%+ slope				Moderate	Moderate	Slight	Moderate			

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor
1	Spruce Spp., Pine Spp., Red Cedar, White Cedar	25, 27, 19, 19	Good
	Bur Oak, Green Ash, Hackberry, Poplar	25, 30, 30, 60	Good
	Siberian Crab Apple, Amar Maple	18, 20	Good
	Honeysuckle, Lilac	10, 12	Good

OTHER

Good productivity. Suitable for all crops common to the area. Corn and soybeans do not mature in the northern range of these soils because of climate. Workability is poor to fair because of the low organic matter content. Water erosion is a hazard on the longer, more sloping areas. Crops respond well to fertilization and management. Precipitation ranges from 18 to 24 inches with 3/4 of it falling during the growing season.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

FOR INTERIM USE

Subject to change upon completion of coordination between MLRA's

17b;58a

Moselake

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES

STATE Minnesota

MLRA 89-90

SOIL SURVEY INTERPRETATIONS 1/

Revised Draft GDN-RRL 1-73

These are medium to slightly acid deep very poorly drained organic soils. They consist of moderately decomposed dark reddish brown woody materials throughout most of the layers from 12 to 51 inches. Normally these soils occupy bogs ranging from 10 to more than 600 acres in size. White cedar, tamarack, black spruce and in places black ash are the major trees growing on these soils. Some areas are nearly treeless and have chiefly lowland brush. These soils have a high inherent fertility.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-60	Mucky Peat (hemic)	PT	A-3	0	Not suitable for engineering seive analysis				—	—	10-20	.48-.58	5.1-6.5	High 2/

Flooding: None

Hydrologic group: D

Depth to water table: Near surface during most of growing season

Depth to bedrock: Greater than 5 feet

Corrosivity - uncoated steel: High

Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: organic soils; low bearing capacity; high water table
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil; high water table.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter.
Shallow Excavations	Severe: high water table; very poorly drained; low resistance to sloughing
Dwellings: With Basements	Severe: high water table; very poorly drained
Sanitary Landfill (Trench type)	Severe: very poorly drained; high water table
Local Roads and Streets	Severe: high water table; high susceptibility to frost action; high shrink-swell potential more than 30 percent organic matter
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low shear strength
Drainage of Cropland and Pasture	High water table; very poorly drained; organic soil;
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable; nearly level bog
Grassed Waterways	Not applicable; nearly level bog

2/ Shrinkage is very high, but the pressure exerted upon swelling is rather low.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Bu. Oats	Tons-Corn Silage	AUM Pasture	Tons Legume-Grass	AUM
All	IVW	—	—	60	12	5.0 Bluegrass	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Good	Fair	Fair	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	5w	Black Spruce Tamarack White Cedar	30-40	Slight	Severe	Severe	Severe	Black Spruce Tamarack White Cedar	Black Spruce Tamarack White Cedar	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND

Potential yields are moderate for the commonly cultivated crops. The choice of crops is limited by climate, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Soil blowing and fire are special hazards.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

FOR INTERIM USE

Subject to change on completion of coordination between MLRA'S

Shoeker

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES -
STATE Minnesota
MLRA 57, 88-1, 88-2

SOIL SURVEY INTERPRETATIONS 1/

Initial Review Draft SCS - 3-73

This series consists of nearly level, poorly drained soils, formed in calcareous till. The native vegetation is mixed coniferous and deciduous forests. In a representative profile the surface layer is black or grayish brown sandy loam or loam about 12 inches thick. The subsoil horizon is grayish brown loam to clay loam about 24 inches thick. The underlying material is grayish brown loam. Permeability is moderate to moderately rapid. Moderate available water capacity. Inherent fertility is moderate. The reaction is neutral.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.-				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-12	Sandy loam, fine sandy loam, loam	SM ML	A-4 A-6		100	100	60-95	35-75	10-40	0-15	.6-6.0	.13-.22	6.6-7.3	Low
12-36	clay loam, loam, sandy clay loam	CL ML SC	A-7 A-6		100	100	80-100	35-80	10-50	0-25	.2-2.0	.15-.19	6.6-7.3	Mod.
36-60	loam, sandy loam	ML SM	A-6 A-4		100	100	60-95	30-75	10-40	0-15	.6-6.0	.11-.19	7.9-8.4	Mod.

Flooding: Occasionally ponded
Hydrologic group: C
Depth to water table: 1-5 feet seasonal high
Depth to bedrock: Over 10 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: Poorly drained
Sand	Unsuitable
Gravel	Unsuitable
Topsoil	Poor: Poorly drained, thin surface layer

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields
Severe: Seasonal water table 1 to 3 feet for extended periods, occasional ponding

Sewage Lagoons
Moderate: Seasonal water table 1 to 5 feet for extended periods, occasional ponding, moderate to moderately rapid permeability.

Shallow Excavations
Severe: Poorly drained, seasonal water table 1 to 3 feet for extended periods, occasional ponding.

Dwellings:
With Basements Severe: Poorly drained, seasonal water table 1 to 3 feet for extended periods, occasional ponding.
Without Basements Severe: Poorly drained, seasonal water table 1 to 3 feet for extended periods, occasional ponding.

Sanitary Landfill
Severe: Poorly drained, occasional ponding, moderate to moderately rapid permeability.

Local Roads and Streets
Severe: Poorly drained, occasional ponding.

Potential Frost Action High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Seasonal water table 1 to 3 feet for extended periods. Permeability moderate to moderately rapid.
Embankments, Dikes, and Levees	Medium to low shear strength, medium compressibility, low compacted permeability, low to medium susceptibility to piping.
Drainage of Cropland and Pasture	Poorly drained, seasonal water table 1 to 3 feet for extended periods, occasional ponding or flooding, moderate to moderately rapid permeability, fair to good compaction characteristics.
Irrigation	Moderate available water capacity, drainage needed, moderate to moderately rapid permeability.
Terraces and Diversions	Not applicable. nearly level.
Grassed Waterways	Erosive surface, poorly drained, few stones

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

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(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe - Poorly drained
Picnic Areas	Severe - Poorly drained
Playgrounds	Severe - Poorly drained
Paths and Trails	Severe - Poorly drained

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Silage	Oats	Clover-Grass	Alfalfa - Grass
All	IIw			Tons/A 13	Bu/A 75	Tons/A 3	Tons/A 4.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production
All		Reed Canarygrass 4 T/A, 6.0 AUM/A Garrison Creeping Foxtail 3.5 T/A, 5.2 AUM/A Big Bluestem, Switchgrass 3.5 T/A, 3.5 AUM/A Red Clover 3.0 T/A, 4.5 AUM/A

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Fair	Fair	Good	Good	Poor	Fair	Fair	Good	Good	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	2w	Aspen White Pine White Spruce	72 55 54	Slight	Moderate	Moderate	Severe	Aspen White Spruce White Pine	White Spruce White Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Suitable for most crops common to the area, but drainage is needed for maximum production. Water table seasonally 1 to 3 feet for extended periods. Soybeans and corn for grain are not recommended in the northern range of these soils. Fertilization and good management control erosion and increase production. The mean annual precipitation ranges from 19 to 24 inches with three-fourths of it falling during the growing season.

Initial Review Draft - WJA-1-72

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 88

This series consists of nearly level, poorly drained soils formed in lake laid sands. These soils are in 3 to 15 acre irregularly shaped slightly depressional areas. Native vegetation was forest. In a representative profile, the surface layer is black loamy fine sand about 6 inches thick. The underlying material is light brownish gray fine sand. The permeability is rapid. The available water capacity and inherent fertility are low. The organic matter content is medium. The surface reaction is neutral.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification: USDA Texture	Unified	AASHO	Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.-- 4	10	40	200	LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
0-6	loamy fine sand, fine sand, loamy sand	SM, SP-SM	A-2	-	95-100	85-95	80-90	5-35	NP	NP	6.0-20	.08-.12	6.1-7.3	Low
6-60	fine sand, sand, loamy fine sand	SP-SM, SP	A-3, A-2	-	95-100	85-95	80-90	1-12	NP	NP	6.0-20	0.06-0.10	6.1-7.8	Low

Flooding: Occasionally ponded.
Hydrologic group: D (B)
Depth to water table: 0 to 4 feet
Depth to bedrock: >60 inch
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: High seasonal water table, fair stability and workability.
Sand	Good: High seasonal water table during parts of the year makes excavation difficult.
Gravel	Unsuitable.
Topsoil	Poor: Loamy sand texture, low to medium organic matter content, low fertility.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: Poorly drained, high seasonal water table, sandy texture.
Sewage Lagoons	Severe: Rapid permeability, poor reservoir site material, high seasonal water table.
Shallow Excavations	Severe: Rapid permeability, low to medium resistance to piping, high seasonal water table, fair stability.
Dwellings: With Basements	Severe: Poorly drained, high seasonal water table.
Dwellings: Without Basements	Severe if not drained, poorly drained, high seasonal water table.
Sanitary Landfill	Severe: Poorly drained, high water table, rapid permeability, sandy texture.
Local Roads and Streets	Severe: Poorly drained.
Potential Frost Action	Moderate.

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Rapid permeability; low to medium resistance to piping; low to moderate organic matter in surface.
Embankments, Dikes, and Levees	Medium to high compacted permeability; low compressibility; low shrink-swell.
Drainage of Cropland and Pasture	High water table; poorly drained; rapid permeability.
Irrigation	Low available water capacity, rapid intake rate, high water table, rapid permeability, poorly drained.
Terraces and Diversions	Not applicable.
Grassed Waterways	Poorly drained, high erodibility, level, poor workability.

1/ Use in conjunction with Guide to Soil Survey Interpretation Series.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe if not drained; poorly drained, occasionally ponded, loamy sand surface.
Picnic Areas	Severe if not drained; poorly drained, occasionally ponded, loamy sand surface.
Playgrounds	Severe if not drained; poorly drained, occasionally ponded, loamy sand surface.
Paths and Trails	Severe if not drained; poorly drained, occasionally ponded, loamy sand surface.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats Bu.	Alf.-Grass Hay Tons	Perm. Reed Canary Past. (AUD)	
0-2% slope	IVw			45	2.5	200	

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Poor	Poor	Good	Good	Fair	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	2w	Aspen	74 ± 4.6	Slight	Moderate	Moderate	Moderate	Aspen Jack Pine	Red Pine White Pine White Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

CROPLAND - Below average productivity; suitable for most crops common to the area, but requires drainage. The rooting zone is restricted by the depth of the water table. It gets up to 1 to 3 feet. Moderate response to fertilization and management. Climate restricts choice of crops. Precipitation averages 22 to 25 inches with 3/4 of it coming during the growing season. Below average production for grasses unless adequately fertilized. May be too wet for some legumes.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Shewaee

MRTSC Trial Form
File Code Soils-12
Rev. 9-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 95

This series consists of excessively drained, sandy, nearly level to sloping soils, that formed in glacial outwash. They are rapidly permeable with low available water capacity.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-60	fs	SP	A-3	-	100	95-100	55-65	1-5	-	NP	6.0-20	08-.10	5.6-6.5	Low

Flooding None
Hydrologic group: A
Depth to water table: More than 6 feet.
Depth to bedrock: More than 6 feet.
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good
Sand	Good
Gravel	Unsuitable - little or no gravel.
Topsoil	Poor - drouthy; subject to blowing.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Slight for 0 to 6% slopes; moderate for steeper soils. danger of ground water contamination.
Sewage Lagoons	Severe - rapid permeability.
Shallow Excavations	Severe - caves easily.
Dwellings:	
With Basements	Slight for 0 to 6% slopes; moderate for steeper soils.
Without Basements	Slight for 0 to 6% slopes; moderate for steeper soils.
Sanitary Landfill	Severe - rapid permeability.
Local Roads and Streets	Slight for 0 to 6% slopes; moderate for steeper soils.
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Rapid permeability.
Embankments, Dikes, and Levees	High shear strength; low shrink-swell potential.
Drainage of Cropland and Pasture	Not needed.
Irrigation	Low available water capacity; rapid permeability.
Terraces and Diversions	Subject to blowing; rapid permeability.
Grassed Waterways	Subject to blowing; rapid permeability.
Golf Course Fairways	Poor trafficability.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate - poor trafficability; subject to blowing.
Picnic Areas	Moderate - poor trafficability; subject to blowing.
Playgrounds	Moderate - poor trafficability; subject to blowing.
Paths and Trails	Moderate - poor trafficability; difficult to maintain areas.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn grain (bu.)	Corn silage (T.)	Oats (bu.)	
0-6%	IVs3	.17		45	9	40	
6-12%	VIs3			-	-	-	

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production
0-6%	Cs1	Alfalfa-brome hay - 2.0 T/A; bluegrass pasture - 80 AUD.
6-12%		Alfalfa-brome hay - 1.5 T/A; bluegrass pasture - 80 AUD.

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-12%	Poor	Poor	Good	Poor	Poor	V. poor	V. poor	Poor	Poor	V. poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
0-12% 1/	2s1	red oak red pine white pine paper birch	67	Slight	Slight	Severe	Moderate	red oak red pine wh. pine	red pine wh. pine	
0-12% 2/				Slight	Slight	Severe	Severe			

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW
FOR INTERIM USE
Subject to change on completion of coordination between MLRA'S

Footnote:
1/ Hardwood

Meeker

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES ____
STATE Minnesota
MLRA 88, 90

SOIL SURVEY INTERPRETATIONS 1/

This series consists of deep excessively drained soils formed in glacial outwash under coniferous forest on outwash plains and valley trains. Typically they have black and very dark grayish brown loamy coarse sand 4 inches thick; dark brown, dark yellowish brown and brown coarse sand subsoils 20 inches thick; and pale brown coarse sand underlying material. Slopes range from 0 to 12 percent. Most areas are forested, a few cropped or pastured.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-4	LCOS	SM	A-2	-	95-100	85-100	60-80	10-30	-	-	6.0-20	0.10-0.12	4.5-6.0	Low
4-60	COS, S	SP	A-3	-	95-100	85-100	50-75	0-10	-	-	6.0-20	0.05-0.07	4.5-6.0	Low

Flooding: None
Hydrologic group: A
Depth to water table: greater than 6 feet
Depth to bedrock: greater than 60 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good
Sand	Good
Gravel	Unsuited
Topsoil	Poor - too sandy

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Hazard of pollution 0-8%: slight 8+%: moderate - slope
Sewage Lagoons	Hazard of pollution Severe - seepage
Shallow Excavations	Severe - cutbanks cave
Dwellings: With Basements Without Basements	0-8%: slight 8+%: moderate - slope
Sanitary Landfill	Hazard of pollution Severe - seepage
Local Roads and Streets	0-8%: slight 8+%: moderate - slope
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Seepage
Embankments, Dikes, and Levees	Seepage
Drainage of Cropland and Pasture	Not needed
Irrigation	Droughty, seepage
Terraces and Diversions	Erodes easily, too sandy
Grassed Waterways	Droughty

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheet

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate - too sandy
Picnic Areas	Moderate - too sandy
Playgrounds	0-6%: moderate - too sandy 6+%: severe - slope
Paths and Trails	Moderate - too sandy

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Silage (tons)	Oats (Bu)	Grass-Legume Hay (tons)	Kentucky Bluegrass (AUM)
0-12%	4s	.20	5	8	40	2.5	1.2

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Poor	Fair	Poor	Poor	V. Poor	V. Poor	Poor	Poor	V. Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3s	Red Pine White Pine Jack Pine White Spruce	56 54 60 59						Red Pine White Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor
Group 6	Eastern Red Cedar Red Pine Jack Pine Ponderosa Pine	15 20 21 20	

OTHER

Cutfoot

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES ____
STATE Minnesota
MLRA 88
PRCN, HHH

This series consists of deep excessively drained soils formed in sandy outwash under coniferous and deciduous forest on smooth and pitted plains. Typically they have organic layers 2 inches thick; very dark gray and dark grayish brown loamy sand surface layers 2 to 4 inches thick; dark brown loamy sand subsurface layers 10 inches thick; layered brown and yellowish brown coarse sand and dark brown loamy coarse sand subsoil 27 inches thick; and pale brown or brown sand or coarse sand underlying material. Slopes are 0 to 35 percent. The main use is for forestry.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-13	LS	SM	A-1,A-2	0-2	95-100	90-100	50-75	15-30		NP	6.0-20	.10-.12	5.1-6.0	V. Low
13-40	COS	SP,SM	A-1	0-5	80-100	75-100	40-70	0-10	--	NP	>20	.03-.05	5.1-6.0	V. Low
28-30	COS	SM,SP	A-1	0-5	80-100	75-100	40-70	10-20		NP	6.0-20	.05-.07	5.6-6.5	V. Low
40-60	S	SP,SM	A-1	0-5	80-100	75-100	40-70	0-10	--	NP	>20	.02-.04	5.6-7.8	V. Low

Flooding None
Hydrologic group: A
Depth to water table: > 6 feet
Depth to bedrock: > 60 inches
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Med., Med., low, low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good-area reclaim
Sand	Good
Gravel	Poor-excisive fines
Topsoil	Poor-too sandy

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields Potential hazard of pollution to water supplies, all slope phases.
0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope.

Sewage Lagoons
All: severe-seepage. Potential hazard of pollution to water supplies, all slope phases.

Shallow Excavations
All: severe-cutbanks cave

Dwellings:
With Basements 0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope.
Without Basements 0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope

Sanitary Landfill Potential hazrd of pollution to water supplies, all slope phases.
(Area) All: severe-seepage (Trench) All: severe-too sandy, seepage

Local Roads and Streets
0-8%: slight; 8-15%: moderate-slope; 15+%: severe-slope

Potential Frost Action Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Seepage
Embankments, Dikes, and Levees	Seepage, piping, erodes easily
Drainage of Cropland and Pasture	Not needed
Irrigation	Drouthy, fast intake
Terraces and Diversions	Too sandy, erodes easily, piping
Grassed Waterways	Drouthy, erodes easily, slope

Excavated Ponds Aquifer Fed: no water

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

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Cutfoot

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	0-15%: moderate-too sandy; 15+%: severe-slope.
Picnic Areas	0-15%: moderate-too sandy; 15+%: severe-slope.
Playgrounds	0-6%: moderate--too sandy, 6+%: severe-slope.
Paths and Trails	0-25%: moderate-too sandy; 25+%: severe-slope.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	CORN SILAGE (Tons)	OATS (Bu)	GRASS-LEGUME HAY (Tons)	BROMEGRASS ALFALFA (AUM)	GRASS-CLOVER (AUM)	KENTUCKY BLUEGRASS (AUM)
0-3%	4S			8	45	2.2	4.0	3.1	2.0
3-12%	4S			7.5	40	2.0	4.0	3.1	2.0
12-35%	7S			—	—	—	3.0	2.0	1.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-15%	Poor	Poor	Fair	Poor	Poor	V.Poor	V.Poor	Poor	Poor	V.Poor
15-35%	V.Poor	V.Poor	Fair	Poor	Poor	V.Poor	V.Poor	Poor	Poor	V.Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-12%	3S	RedPine	56	Slight	Slight	Severe	Slight		Red Pine	
		E.Wh.Pine	54						Wh.Spruce	
		Jack Pine	60						Jack Pine	
		Wh.Spruce	59							
12-35%	4S	Red Pine	52	Moderate	Moderate	Severe	Slight		Red Pine	
		E.Wh.Pine	50						Jack Pine	
		Jack Pine	57							
		Wh.Spruce	54							

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor
0-12%	E.RedCedar,N.Wh.Cedar,Wh.Spruce,RedPine,E.Wh.Pine, Russian-Olive,SiberianCrabapple,TatarianHoneysuckle, Siberian Pea Shrub	15,11,18,20,20, 15,12,10, 10	
12-35% North facing	E.RedCedar,Wh.Spruce,RedPine,Siberian Pea Shrub	18,22,25,12	
12-35% South facing	E.RedCedar,Wh.Spruce, Red Pine, Siberian Pea Shrub	12,0,15,10	

OTHER

B 0 to 12 percent slopes: windbreak suitability group 6. 12 to 35 percent slopes: windbreak suitability group 7.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Fluvaquents

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Series
STATE Minnesota
MLRA 88-92
Review Draft GEM, RAL 3-72

This level type consists of nearly level, wet soils formed in alluvial material. These soils are in lowlands adjacent to rivers and creeks. Native vegetation is chiefly alder thickets and lowland hardwoods. These soils are commonly variable in color and texture. These soils are subject to frequent flooding that greatly restricts their use.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
	Material is too variable to rate													

Flooding: Frequent
Hydrologic group: D
Depth to water table: Variable depending on stream flow and water level of adjacent streams
Depth to bedrock: More than 5 feet
Corrosivity - uncoated steel: Low to high
Corrosivity - concrete: Low to high

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor to Fair: variable soil texture; frequently flooded; high seasonal water table
Sand	Poor: sands occur in bands with finer textured material
Gravel	Not suitable
Topsoil	Poor: high seasonal water table

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: frequent flooding; hazard of polluting nearby streams
Sewage Lagoons	Severe: frequent flooding; high seasonal water table
Shallow Excavations	Severe: frequent flooding; poor stability of side slopes
Dwellings: With Basements	Severe: frequent flooding; high water table
Sanitary Landfill (trench type)	Severe: frequent flooding; high seasonal water table
Local Roads and Streets	Severe: frequent flooding; variable soil material; high frost action
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Not suitable; frequent flooding; high water table
Embankments, Dikes, and Levees	Variable soil material; generally low compacted permeability; low resistance to piping
Drainage of Cropland and Pasture	Variable texture; low stability; frequent flooding
Irrigation	High water table
Terraces and Diversions	Nearly level
Grassed Waterways	Frequent flooding; difficult to establish seedbed

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: subject to flooding; high seasonal water table
Picnic Areas	Severe: subject to flooding; high seasonal water table
Playgrounds	Severe: subject to flooding; high seasonal water table
Paths and Trails	Severe: subject to flooding; high seasonal water table

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				Native Pasture AUM
All	VIw	--	--	---	---	---	2.4

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Poor	Fair	Poor	Poor	Good	Fair	Poor	Poor	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	3w	Black Spruce Black Ash	40-50 40-50	Slight	Severe	Severe	Severe	Black Spruce Black Ash Tamarack	Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Beauspricks

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 88-90

Revised Draft, GDN-RHL 12-72

This series is extremely to very strongly acid, moderately deep very poorly drained organic soils. They consist of highly decomposed black or dark reddish brown herbaceous materials throughout most of the organic layers, and are underlain at depths of 16 to 50 inches by acid loamy material. Normally these soils occupy depressional bogs ranging from 10 to 80 acres in size. Black spruce along with a few tamarack, and in places, black ash are the major trees growing on these soils. Some areas are treeless and have chiefly lowland brush.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-36	Muck (Sapric)	PT		0	Not suitable for engineering seive analysis				--	--	6.0-10.0	.43	4.0-5.0	High2/
36-60	Loam	CL, ML, or SM	A-4 or A-2	0	75-100	65-100	55-95	25-75	15-24	0-6	.06-0.6	.11-.18	4.5-7.3	Low to Moderate

Flooding: Occasional flooding along streams
Hydrologic group: D
Depth to water table: Near surface during most of growing season
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: more than 30 percent organic matter overburden, 16-50 inches thick; high water table.
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone; fair to good when mixed with mineral soil; needs lime

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter
Shallow Excavations	Severe: high water table; very poorly drained; low resistance to sloughing
Dwellings: With Basements	Severe: high water table; very poorly drained; high potential frost action
Sanitary Landfill (Trench)	Severe: high water table; very poorly drained
Local Roads and Streets	Severe: high water table; more than 30 percent organic matter; high susceptibility to frost action; high shrink-swell potential;
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low shear strength; low compacted permeability
Drainage of Cropland and Pasture	High water table; occasional flooding
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable, depressional
Grassed Waterways	Not applicable, depressional

"PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

2/ Shrinkage is very high, but the pressure exerted upon swelling is rather low.

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MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats (BU)	Corn Silage (T/A)	Pasture Bluegrass AUM	Legume-grass Tons	AUM
All	IVW	--	--	60	12	5.0	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Poor	Poor	Poor	Poor	Good	Good	V.Poor	V.Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	To Plant	Other
All	5w	Black Spruce Tamarack	15-40	Slight	Severe	Severe	Severe	Black Spruce Tamarack	Black Spruce Tamarack	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND OTHER

Potential yields are moderate for the commonly cultivated crops. The choice is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Soil blowing and fire are special hazards.

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Spooner

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES
STATE Minnesota
MLRA 88 and 92
Revised Draft DDS 1-73

SOIL SURVEY INTERPRETATIONS 1/

This series consists of nearly level, poorly to somewhat poorly drained soils formed in silty lake laid sediment. These soils are slightly concave areas in glacial lake bottoms. Native vegetation was forest. In a representative profile, the surface layer is very dark gray, very fine sandy loam about 6 inches thick. The subsurface layer is light brownish gray loamy very fine sand about 9 inches thick. The subsoil is mottled olive gray friable loam about 7 inches thick. The underlying material is light olive gray silt loam. Permeability is moderate. The available water capacity is high to very high and the organic matter content is medium. The inherent fertility is medium. These soils are stone free.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-15	Very fine sandy loam	SM or ML	A-4	0	100	100	90-100	35-80	20-30	1-10	2.0-6.0	0.20-0.22	6.1-7.8	Low
15-22	Loam	ML or CL	A-4 or A-6	0	100	100	90-100	75-90	20-40	5-15	0.6-2.0	0.17-0.19	6.1 7.8	Low to Moderate
22-60	Silt loam	ML	A-4	0	100	100	90-100	75-90	20-30	1-10	0.6-2.0	0.20-0.22	7.4-8.4	Low

Flooding: Slight
Hydrologic group: C
Depth to water table: 1 to 3 feet
Depth to bedrock: Over 10 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high frost action; poorly to somewhat poorly drained; poor stability; ML material; low to moderate shrink-swell
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor: thin surface; poorly to somewhat poorly drained

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe:	high seasonal water table; moderate permeability
Sewage Lagoons	Severe:	high seasonal water table
Shallow Excavations	Severe:	high seasonal water table; poor stability; good workability; poorly to somewhat poorly drained
Dwellings: With Basements	Severe:	high seasonal water table; poorly to somewhat poorly drained; severe frost action
Without Basements	Severe:	high seasonal water table; poorly to somewhat poorly drained; severe frost action
Sanitary Landfill	Severe:	seasonal water table at depths of 1 to 3 feet; fair trafficability when wet; silty texture; poorly to somewhat poorly drained
Local Roads and Streets	Severe:	high susceptibility to frost action; high seasonal water table; poorly to somewhat poorly drained; ML material
Potential Frost Action	High	

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Permeability is moderate; organic matter content is medium
Embankments, Dikes, and Levees	Compacted permeability and compressibility are medium; water table seasonally high; piping resistance is poor; shear strength and shrink-swell is low
Drainage of Cropland and Pasture	water table is seasonally high; permeability is moderate; there are no stones present
Irrigation	High to very high available water capacity; medium water intake rate; moderate permeability; poorly to somewhat poorly drained; nearly level
Terraces and Diversions	Not applicable; nearly level
Grassed Waterways	Poorly to somewhat poorly drained; moderately erodible; nearly level; good to fair workability

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Picnic Areas	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Playgrounds	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.
Paths and Trails	Severe: if not drained; high seasonal water table; occasionally ponded; fair trafficability; stone free; level.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Silage	Oats	Bluegrass Pasture	Potatoes	Legume-Grass Hay	Legume-Grass Hay
				T/A	Bu	AUM	Cwt.	Tons	AUM
0-2% slopes	IIIw	-	-	14	90	5.0	500	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Fair	Fair	Poor	Good	Good	Fair	Fair	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	3w	Aspen Red Pine W. Pine W. Spruce	50-60 50-60 50-55 50-60	Slight	Moderate	Moderate	Severe	Aspen W. Spruce W. Pine	W. Spruce W. Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

CROPLAND

Moderate natural productivity. Choice of crops is restricted by the poorly drained condition of the soil and by soil temperatures. Workability is good; the rooting zone is deep. This soil must be drained for maximum production. Fertility must also be increased. High to very high available water capacity.

FOR INTERIM USE
Subject to change on completion of coordination between MLRA's

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

570,

Unnamed (Mollic Haplaquoll)

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES _____
STATE Minnesota
MLRA 83
P.N. 1974

This series consists of very poorly drained soil formed in silty sediments under lowland brush and swamp conifers in depressions on lacustrine plains. Typically they have black mucky silt loam surface layers about 7 inches thick; olive and pale olive silt loam subsoil layers about 25 inches thick; and gray and olive gray silt loam underlying material. Slopes are less than 2 percent. Most areas are in native vegetation. Some areas are in pasture or hay.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-7	SIL-SIL	ML	A-4	0	100	100	95-100	80-95	27-40	4-20	0.6-2.0	.25	5.1-6.5	Moderate
7-60	SIL	ML CL-ML	A-4 or A-6	0	100	100	95-100	80-90	10-35	4-20	0.2-0.6	.22	5.6-8.4	Moderate

Flooding: ocassionally flooded; often ponded
Hydrologic group: D
Depth to water table: 0-2 feet
Depth to bedrock: more than 60 inches
Corrosivity - uncoated steel: High
Corrosivity - concrete: Low

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high susceptibility to frost action; very poorly drained
Sand	Unsuited
Gravel	Unsuited
Topsoil	Poor: very poorly drained

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: floods, percs slowly, wet
Sewage Lagoons	Severe: wet, percs slowly, excess humus
Shallow Excavations	Severe: wet, excess humus
Dwellings: With Basements, Without Basements	Severe: wet, low strength
Sanitary Landfill	Trench: Severe - wet, percs slowly Area: Severe - wet
Local Roads and Streets	Severe: wet, frost action
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Favorable
Embankments, Dikes, and Levees	Low strength, compressible
Drainage of Cropland and Pasture	Wet
Irigation	Wet, floods
Terraces and Diversions	Not needed
Grassed Waterways	Not needed

1/ Use in conjunction with Guide to Soil Survey Interpretations Sheets

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: wet, floods
Picnic Areas	Severe: wet, floods
Playgrounds	Severe: wet, floods
Paths and Trails	Severe: wet, floods

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Alf-Grass Hay	Alf-Grass	Clover-grass Hay	Clover-grass	Perm. Pasture Reed Canary Grass
				Bu/A	Tons/A	AUM	Tons/A	AUM	AUM
Drained	4w	--	--	70	30	5	2.5	4	8

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	V. Poor	Poor	V. Poor	V. Poor	V. Poor	Fair	Fair	V. Poor	V. Poor	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
	4w	Black Ash	45	Slight	Severe	Severe	Severe	Black Ash Black Spruce	Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Drainage required to permit satisfactory growth and production of suitable crop species. Small grains and forage crops are the most commonly grown crops.

34 c

Initial Review Draft - WJA-2-72 Baudette

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES _____
STATE Minnesota
MLRA 88

This series consists of nearly level to sloping, moderately well to well drained soils formed in lake laid silts. These are generally on broad flat areas but are also on gentle sloping or sloping areas along drainage ways. Native vegetation was forest. In a representative profile, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is dark yellowish brown, friable clay loam about 7 inches thick. The underlying material is yellowish brown silt loam. Permeability is moderate. The available water capacity is high to very high. The inherent fertility is moderate. The organic matter content is low. Stone free.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-8"	loam	ML	A-4	0	100	100	95-100	75-90	20-40	1-10	0.6-2.0	0.20-0.22	6.6-7.3	Low
8-15"	clay loam	CL	A-6	0	100	100	95-100	75-90	20-40	10-20	0.2-0.6	0.15-0.19	6.1-7.3	Mod.
15-60"	silt loam	ML	A-4	0	100	100	95-100	75-90	20-40	1-10	0.6-2.0	0.20-0.22	7.4-8.4	Low

Flooding: Slight
Hydrologic group: B
Depth to water table: 3 to 6 feet
Depth to bedrock: Over 10 feet
Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Slight

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: Low to moderate shear strength and medium compressibility; moderate frost action.
Sand	Unsuitable.
Gravel	Unsuitable.
Topsoil	Good to fair: Surface texture is a silt loam with a low amount of organic matter.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: Moderate permeability; seasonal water table at 3 to 6 feet. Severe on slopes over 12%.
Sewage Lagoons	Moderate: Severe on slopes over 6%; permeability is moderate. There are no coarse fragments present and there is low organic matter content.
Shallow Excavations	Moderate: Poor to fair stability; seasonal water table at 3 to 6 feet; medium resistance to piping.
Dwellings:	Moderate frost action; severe on slopes over 15%.
With Basements	Moderate: Seasonal water table at 3 to 6 feet. Moderately well to well drained. /
Without Basements	Moderate: Moderate frost action; severe on slopes over 15%.
Sanitary Landfill	Moderate: Moderately well to well drained, seasonal water table at 3 to 6 feet.
Local Roads and Streets	Moderate: Moderate frost action; moderate on slopes over 12%. ML material.
Potential Frost Action	Moderate.

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Permeability and resistance to piping are medium; organic matter content is low.
Embankments, Dikes, and Levees	Compacted permeability and compressibility are medium; depth to the water table is 3 to 6 feet. Piping resistance is poor, poor stability, poor compaction characteristics.
Drainage of Cropland and Pasture	Not needed.
Irrigation	Available water capacity is high to very high. Intake rate rapid; moderate permeability and is moderately well to well drained; soils occupy nearly level to rolling areas.
Terraces and Diversions	Not applicable because of the shortness of the slopes.
Grassed Waterways	Moderately erodible; moderate slope limitation on 2 to 6% slopes; severe on slopes over 6%.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Slight - Good natural drainage and depth to water table is deep; permeability is moderate. Surface texture is a loam and no stones present; mod. on 6-12% slopes; severe on slopes over 12%.
Picnic Areas	Slight - Good natural drainage and depth to water table is deep. Surface texture is a loam and no stones present; moderate on 6-12% slopes; severe on slopes over 12%.
Playgrounds	Slight - Erosion increases with slope; natural drainage is moderately well to well and depth to water table is deep. Surface texture is loam; no stones present. Mod. on 2-6% slopes; Severe on 6-12% slopes.
Paths and Trails	Slight - Surface texture is a loam and there are no stones present; moderate on 12-18% slopes.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Corn Tons	Oats Bu.	Pasture AUD	Potatoes Bu.	Legume-Grass T/A
A 0-2% slope	IIc	.37	4.3	14	90	180	500	4.5
BC 2-12% slope	IIIe	.37	4.3	12	90	180	400	4.5
DE 12-25% slope	VIe	.37	4.3			120		

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-2%	Good	Good	Good	Good	Poor	Poor	Poor	Good	Good	Poor
2-6%	Fair	Good	Good	Good	Poor	Very poor	Poor	Good	Good	Very poor
6-12%	Fair	Good	Good	Good	Poor	Very poor	Very poor	Good	Good	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	1o	Aspen Red Pine White Pine	70-85 55-65 50-60	Slight Mod. on slopes over 12%	Slight Mod. on slopes over 12%	Slight	Severe	Red Pine White spruce Aspen White Pine	Red Pine White spruce Birch Basswood	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

CROPLAND: Above average general productivity. Choice of crops is restricted by cool soil temperatures. Workability is good; the rooting zone is deep; depth to water table is deep; susceptibility to erosion is great on the steeper slopes. Very responsive to proper fertilization and management. Generally has an effective snow cover over winter. High to very high available moisture capacity. Average annual precipitation ranges from 20 to 27 inches with 3/4 of it during the growing season.

FOR INTERIM USE
Subject to change on completion of correlation ...

Emmert

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES .
STATE Minnesota
MLRA 90
Revised Draft GDN, MRL 2-72

SOIL SURVEY INTERPRETATIONS [1/]

This series consists of nearly level to steep, excessively drained soils formed in gravelly sand. These soils are on outwash plains and fans having knob and basin topography. Native vegetation is forest. The surface layer is black gravelly coarse, sandy loam about 1 inch thick. The subsoil is dark brown to dark reddish brown very friable, gravelly loamy coarse sand about 2 inches thick. The underlying material is reddish brown very gravelly coarse sand. Permeability is very rapid. The available water capacity is very low and organic matter content is low. The availability of phosphorous is low, and of potassium is low. Most areas are used for forest. The major limitation to use is the hazard of drought.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-5	Gravelly sandy loam	SM	A-2	0-10	80-90	65-75	40-55	20-30	NP	NP	2.0-6	.06-.10	5.1-6.5	Low
5-60	Very gravelly coarse sand	GW, GP SP	A-1	0-10	35-60	25-40	10-25	0-5	NP	NP	20+	0.02-0.04	5.5-6.5	Low

Flooding None
Hydrologic group: A
Depth to water table: Greater than 10 feet
Depth to bedrock: Greater than 10 feet
Corrosivity - uncoated steel: Low
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Good: high shear strength; low compressibility; low shrink-swell
Sand	Good: mixed with gravel and needs screening; deposits are generally thick
Gravel	Good: stratified sand and gravel; some stones and boulders; water table is deep
Topsoil	Poor: gravelly sandy loam material about 5 inches; low organic matter; low fertility

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Slight: very rapid permeability; moderate on 6 to 12 percent slopes; Severe: on slopes over 12 percent; hazard of pollution to underground water
Sewage Lagoons	Severe: very rapid permeability; coarse textured material
Shallow Excavations	Moderate: gravelly texture; 6-12 percent slopes; Severe: over 12 percent slopes
Dwellings: With Basements	Slight: 0-6 percent slopes; excessively drained; low shrink-swell Moderate: 6-12 percent slopes Severe: over 12 percent slopes
Sanitary Landfill (trench type)	Severe: very rapid permeability for easy contamination of ground water
Local Roads and Streets	Slight: 0-6 percent slopes; Moderate on 6-12 percent slopes; Severe: slopes over 12 percent; good stability; good natural drainage, low frost heave potential
Potential Frost Action	Low

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Very rapid permeability
Embankments, Dikes, and Levees	High compacted permeability; low compressibility; good shear strength; high resistance to piping; good stability
Drainage of Cropland and Pasture	Very rapid permeability; deep to water table; excessively drained
Irrigation	Very low available water holding capacity; rapid intake rate; excessively drained
Terraces and Diversions	Unfavorable material at 5 to 12 inches; excessively drained; high content of coarse fragments; difficult on slopes over 12 percent; low fertility
Grassed Waterways	Unfavorable material at 5 to 12 inches; excessively drained; high content of coarse fragments; difficult on slopes over 6 percent; low fertility.

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: 20 to 30 percent coarse fragments; 6 to 12 percent slopes; severe slopes over 12%
Picnic Areas	Moderate: 20 to 30 percent coarse fragments; 6 to 12 percent slopes; severe slopes over 12%
Playgrounds	Severe: gravelly surface texture; slopes over 6 percent
Paths and Trails	Moderate: 20 to 30 percent coarse fragments in surface layer; slopes of 12 to 25 percent

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS—(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage	Pasture	Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A	AUM	T/A	AUM	AUM
0-2% slopes	IVs	.20	3.2	35	5	3	2.0		2.6
2-6% slopes	IVs			30	5	3	2.0		2.6
6-12% slopes	IVs			30	5	3	2.0		2.6
2-12% slopes	IVs			30	5	3	2.0		2.6
12-25% slopes	VIIs			--	-	2.25	---		1.8

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Very Poor	Very Poor	Very Poor	Very Poor	Poor	Very Poor	Very Poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	Suitable Species: To Favor	To Plant	Other
All	4s	Red Pine White Pine Jack Pine White Spruce	55 55 60 50	0-12% slopes Slight 12-25% slopes Moderate to severe	0-12% slopes Slight 12-25% slopes Moderate	Moderate	Slight to Moderate	Red Pine White Pine Jack Pine	Red Pine Jack Pine	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT; SUBJECT TO REVIEW
Subject to change on completion of coordination between MLRA'S

Newaldi

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES .
STATE Minnesota
MLRA 90
Revised Draft RRL 1-73

SOIL SURVEY INTERPRETATIONS 1/

This Series consists of nearly level, somewhat poorly drained soils formed in reddish brown fine and medium sands. These soils are on outwash plains and glacial lake benches. Native vegetation is forest. The surface layer is black loamy fine sand about 2 inches thick. The subsurface layer is reddish gray fine sand about 4 inches thick. The subsoil is dark reddish brown in the upper part, mottled reddish brown in the lower part. It is fine sand about 33 inches thick. The underlying material is reddish brown fine sand. Permeability is rapid. The available water capacity is few to very low and organic matter content is low. The availability of phosphorus is low, and of potassium is low. These soils have a high water table during part of the growing season.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-9	Fine Sand	SM	A-4 A-2	0	100	100	75-95	10-45	NP	NP	6.3-20	.06-.14	4.5-6.0	Low
9-60	Fine Sand	SM or SP	A-2 or A-3	0	100	100	45-95	2-10	NP	NP	6.3-20	.05-.07	5.1-6.0	Low

Flooding None

Hydrologic group: C

Depth to water table: Normally within 2 feet of the surface from spring to midsummer

Depth to bedrock: Greater than 10 feet

Corrosivity - uncoated steel: Moderate

Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: somewhat poorly drained; moderate susceptibility to frost action
Sand	Good: high water table makes removal difficult
Gravel	Unsuited
Topsoil	Poor: sand texture

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: seasonal high water table
Sewage Lagoons	Severe: seasonal high water table; rapid permeability
Shallow Excavations	Severe: somewhat poorly drained; seasonal high water table; poor sidewall stability
Dwellings: With Basements	Severe: seasonal high water table
Sanitary Landfill (Trench type)	Severe: rapid permeability; seasonal high water table
Local Roads and Streets	Moderate: somewhat poorly drained; seasonal high water table
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Rapid permeability; seasonal high water table
Embankments, Dikes, and Levees	Medium to high shear strength; medium to high susceptibility to piping
Drainage of Cropland and Pasture	Rapid permeability; high water table
Irrigation	Low to very low available water capacity; rapid intake rate; coarse material; somewhat poorly drained; usually level
Terraces and Diversions	Generally not needed; nearly level slopes
Grassed Waterways	Generally not needed; nearly level slopes

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

1/ For use in connection with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: seasonal high water table
Picnic Areas	Moderate: seasonal high water table
Playgrounds	Moderate: seasonal high water table
Paths and Trails	Moderate: seasonal high water table

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage	Bluegrass Pasture	Legume-Grass	
				Bu/A	T/A	AUM	T/A	AUM
All	IIIw	-	-	65	10	3.5	3.0	4.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seedling Mortality	Plant Competition	To Favor	To Plant	
All	2w	Red Pine White Pine White Spruce Northern Hardwoods	60 60 60 60-70	Slight	Moderate	Moderate	Moderate to Severe	White Spruce Northern Hardwoods White Pine	White Spruce Black Spruce Northern Hardwoods	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

MC-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Newfane

Series

STATE Minnesota

MLRA 90

Initial Review Draft RRL 2-72

This series consists of nearly level, poorly and very poorly drained soils formed in sandy material. These soils are on outwash plains and glacial lake basins. Native vegetation is forest. In a representative profile the surface layer is black mucky sand about 5 inches thick. The underlying material is grayish brown sand. Permeability is rapid. The available water capacity is low and organic matter content is high. The availability of phosphorous is low, and of potassium is low. These soils have a high water table during much of the growing season. The major limitation to use is the hazard of wetness.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-5	Mucky sand	PT	A-8	0	100	95-100	45-90	2-10	NP	NP	2.0-20	.07-.22	5.1-6.0	High
5-60	Sand	SM or SP	A-2 or A-3	0	100	95-100	45-90	2-10	NP	NP	6.3-20	.05-.07	5.1-6.0	Low

Flooding: Occasionally ponded

Hydrologic group: D

Depth to water table: Normally within 1 foot or less of the surface from spring to late summer

Depth to bedrock: Greater than 10 feet

Corrosivity - uncoated steel: Moderate

Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: high water table
Sand	Good: high water table makes removal difficult
Gravel	Unsuited
Topsoil	Poor: poorly drained, sand texture

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: seasonably high water table; occasional ponding
Sewage Lagoons	Severe: seasonably high water table; rapid permeability; occasional ponding
Shallow Excavations	Severe: seasonably high water table; occasional ponding organic and sandy soil
Dwellings: With Basements	Severe: seasonably high water table; occasional ponding
Sanitary Landfill (Trench type)	Severe: rapid permeability; occasional ponding; organic and sand soils; seasonably high water table
Local Roads and Streets	Severe: rapid permeability; occasional ponding; seasonably high water table
Potential Frost Action	Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Rapid permeability; high water table
Embankments, Dikes, and Levees	Medium to high shear strength; medium to high susceptibility to piping
Drainage of Cropland and Pasture	Rapid permeability; high water table
Irrigation	Low available water capacity; rapid intake rate; seasonable high water table
Terraces and Diversions	Generally not needed; nearly level slopes
Grassed Waterways	Generally not needed; nearly level slopes

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: poor and very poor drained; high water table; coarse textured surface
Picnic Areas	Severe: poor and poorly drained; high water table; coarse textured surface
Playgrounds	Severe: poor and very poorly drained; high water table; coarse textured surface
Paths and Trails	Severe: poor and very poorly drained; high water table; coarse textured surface

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats Bu/A	Corn Silage T/A	Bluegrass Pasture AUM	Legume-Grass T/A	Legume-Grass AUM
All	IVw	-	-	55	9	3.0	2.5	3.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for-- Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Potential for-- Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Poor	Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Equipment Limitations	Seedling Mortality	Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	3w	Black Spruce Black Ash	40-50	Slight	Severe	Severe	Severe	Black Spruce Black Ash Elm Tamarack		

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Selkirk (Agua Engrg)

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SERIES _____
STATE Minnesota
MLRA _____

SOIL SURVEY INTERPRETATIONS 1/

This series consists of deep, somewhat poorly and poorly drained soils formed in reddish brown clayey glacial till under a deciduous and coniferous forest on nearly level till plains and good moraine. Typically they have grayish brown, loam surface layers 9 inches thick; reddish brown clay subsoil layers 25 inches thick; reddish brown silty clay underlying material. Slopes range from 0 to 2 percent.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Frac.	Percentage less than 3 inches passing Sieve No.—				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO	>3 in. -%	4	10	40	200						
0-9	Loam	ML ML-CL	A-4	0	95-100	90-100	80-85	65-90	15-25	0-4	0.6-2.0	.20-.22	4.5-6.5	Low
9-36	Clay	CL MH-CH	A-7	0	95-100	90-100	80-85	65-90	40-60	20-35	.06-0.2	.10-.14	5.1-8.4	Mod.
36-60	Silty Clay	CL MH-CH	A-7	0	95-100	90-100	80-85	65-90	40-60	20-35	.06-0.2	.09-.15	7.4-8.4	Mod.

Flooding: Occassional - brief — Hydrologic group: C

Depth to water table: 1 to 3 feet, perched, Oct.-June — Depth to bedrock: Greater than five feet.

Corrosivity - uncoated steel: Moderate — Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: frost action, shrink-swell
Sand	Unsuited
Gravel	Unsuited
Topsoil	Fair: thin layer

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields
Severe: perco slowly

Sewage Lagoons
Slight: perco slowly

Shallow Excavations
Severe: floods, too clayey, wet

Dwellings:
With Basements
Severe: wet

Sanitary Landfill
(Trench) Severe: wet, too clayey, perco slowly, floods.

Local Roads and Streets
Severe: floods, wat

Potential Frost Action
Moderate

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas
Favorable

Embankments, Dikes, and Levees
Favorable

Drainage of Cropland and Pasture
Perco slowly, wet

Irrigation
Wet

Terraces and Diversions
Not needed

Grassed Waterways
Wet, perco slowly

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: perco slowly, wet
Picnic Areas	Severe: wet
Playgrounds	Severe: wet, floods
Paths and Trails	Moderate: floods, wet

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats (SU)	Corn Silage T/A	Bluegrass Pasture (AUM)	Legume-Grass Hay (T/A)	Pasture (AUM)
All	IIIw			80	14	5.0	4.5	6.5

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Poor	Fair	Good	Fair	Good	Good	Good	Fair	Good	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	2w	Red Pine E.Wh.Pine Wh.Spruce Northern Hardwoods	60 60 60 60-70	Slight	Moderate	Moderate	Moderate to Severe	Wh. Spruce E.Wh.Pine Northern Hardwoods	Wh. Spruce Northern Hardwoods	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

776;502

Hibbing

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE Minnesota
MLRA 90
Rev. GDN, RRL 2-72

This series consists of nearly level to hilly, well and moderately well drained soils formed in reddish brown clayey material. These soils are on moraines and lake plains. Native vegetation is forest. The surface layer is dark gray loam about 2 inches thick. The subsurface layer is grayish brown loam about 6 inches thick. The subsoil is reddish brown clay about 26 inches thick. The underlying material is reddish brown clay. Permeability is slow. The available water capacity is moderate and organic matter content is low. The availability of phosphorous is low, and of potassium is low.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. In./In.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-8	Loam	ML ML-CL	A-4	0	95-100	90-100	80-85	65-90	15-25	0-4	0.6-2.0	.20-.22	4.5-6.0	Low
8-34	Clay	CL or MH-CH	A-7	0	95-100	90-100	80-95	65-90	40-60	20-35	0.06-0.2	0.1-0.14	5.1-8.4	Moderate
34-60	Clay	CL or MH-CH	A-7	0	95-100	90-100	80-95	65-90	40-60	20-35	0.06-0.2	0.1-0.14	7.4-8.4	Moderate

Flooding None
Hydrologic group: C
Depth to water table: Greater than 5 feet
Depth to bedrock: Greater than 10 feet
Corrosivity - uncoated steel: Moderate
Corrosivity - concrete: Moderate

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Fair: low to medium shear strength; medium compressibility; fair to good workability
Sand	Not suitable
Gravel	Not suitable
Topsoil	Fair: moderately thick loamy material; low organic matter content

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: slow permeability
Sewage Lagoons	Slight: slow permeability; moderate: on slopes 2-6 percent; severe: on slopes over 6%
Shallow Excavations	Moderate: clayey material; severe: over 12 percent slopes
Dwellings: With Basements	Moderate: moderate shrink-swell; severe: over 12 percent slopes
Sanitary Landfill (Trench type)	Severe: poor workability
Local Roads and Streets	Severe: moderate to high susceptibility to frost action
Potential Frost Action	Moderate to high

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Slow permeability
Embankments, Dikes, and Levees	Medium to low shear strength; medium compressibility
Drainage of Cropland and Pasture	Generally not needed
Irrigation	Moderate available water capacity; slow permeability
Terraces and Diversions	Clayey material; slow permeability; poor workability
Grassed Waterways	Clayey material; slow permeability

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Moderate: slow permeability; Severe: on slopes over 12 percent
Picnic Areas	Slight: on nearly level slopes; Moderate: on slopes 6-12 percent; Severe: on slopes 12
Playgrounds	Moderate: slow permeability; Severe: on slopes over 6 percent
Paths and Trails	Slight: 0-12 percent slopes; Moderate: on slopes 12-25 percent slopes; Severe: over 25 percent slopes

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage	Bluegrass Pasture	Legume-Grass T	Legume-Grass AUM
				Bu.		AUM		
0-2% slopes	IIc	.43	3.2	80	14	5.0	4.5	6.5
2-6% slopes	IIe			80	14	5.0	4.5	6.5
6-12% slopes	IIIe			70	10	5.0	4.5	6.5
2-11% slopes	IIIe			70-80	10-14	5.0	4.5	6.5
12-25% slopes	VIe			-	-	4.0	-	-

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
0-12%	Good	Good	Good	Good	Good	Poor	Very Poor	Good	Good	Very Poor
12-25	Poor	Fair	Good	Good	Good	Very poor	Very poor	Fair	Good	Very poor

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
0-12%	2o	Aspen	70	Slight	Slight	Slight	Moderate to Slight	Red Pine	Red Pine	
		Red Pine	60					Basswood	Black Spruce	
		White Pine	50					Red Oak	White Spruce	
		Jack Pine	60		Moderate		Moderate	White Pine	Basswood	
12-25%		Northern Hardwoods	60	Moderate		Slight	Severe	White Spruce	Red Oak Aspen	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

Cutover wood

MN-SOILS-3
11-71
(File Code SOILS-12)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

Series - _____
STATE Minnesota
MLRA 88-90
Revised Draft GDN, RRL 2-72

These are extremely to very strongly acid deep organic soils. They consist of moderately decomposed dark brown or dark reddish brown herbaceous material throughout most of the layers from 12 to 51 inches. Normally these soils occupy bogs ranging from 10 to more than 600 acres in size. Black spruce along with a few tamarack are the major trees growing on these soils. The permeability is moderate to moderately rapid. The available water capacity is very high.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability in./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-20	Peat (fibric)	PT	A-8	0	Not suitable for engineering sieve analysis				--	--	6-20+	0.58-0.70	3.5-4.5	High
20-70	Peat (hemic)	PT	A-8	0					--	--	0.6-6.0	0.48-0.58	4.0-5.0	High

Flooding: None
Hydrologic group: D
Depth to water table: Near surface during most of growing season
Depth to bedrock: Greater than 5 feet
Corrosivity - uncoated steel: High
Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: organic soils; low bearing capacity
Sand	Not suitable
Gravel	Not suitable
Topsoil	Poor when used alone. Fair to good when mixed mineral soils; needs lime

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: high water table; very poorly drained
Sewage Lagoons	Severe: high water table; more than 30 percent organic matter
Shallow Excavations	Severe: high water table; poor side slope stability
Dwellings: With Basements	Severe: very poorly drained; high water table
Sanitary Landfill (trench type)	Severe: very poorly drained; high water table
Local Roads and Streets	Severe: high water table; high susceptibility to frost action; high shrink-swell potential more than 30 percent organic matter
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	High water table
Embankments, Dikes, and Levees	High water table; low compacted loaded permeability; poor stability more than 30 percent organic matter
Drainage of Cropland and Pasture	High water table; subsidence is common after drainage
Irrigation	High water table; very poorly drained
Terraces and Diversions	Not applicable; nearly level
Grassed Waterways	Not applicable; nearly level

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

MN-SOILS-3
11-71
(File Code SOILS-12)

Greenwood

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: high water table; poor trafficability
Picnic Areas	Severe: high water table; poor trafficability
Playgrounds	Severe: high water table; poor trafficability
Paths and Trails	Severe: high water table; poor trafficability

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T	Oats	Corn Silage		Legume - Grass Hay	Legume - Grass Pasture	Bluegrass Pasture
				B/A	T/A		T/A	AUM	AUM
All	IVW	--	--	60	12		4.5	6.7	5.3

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
530S	Very Poor	Very Poor	Poor	Very Poor	Poor	Poor	Good	Very Poor	Very Poor	Fair
530	Very Poor	Poor	Poor	Poor	Poor	Good	Good	Very Poor	Very Poor	Good

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity: Important Trees	Potential Productivity: Site Index	Woodland Management Hazards: Erosion Hazard	Woodland Management Hazards: Equipment Limitations	Woodland Management Hazards: Seeding Mortality	Woodland Management Hazards: Plant Competition	Suitable Species: To Favor	Suitable Species: To Plant	Other
All	5w	Black Spruce Tamarack	15-40	Slight	Severe	Severe	Severe	Black Spruce Tamarack	Black Spruce Tamarack	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

CROPLAND OTHER

Potential yields are moderate for the commonly cultivated crops. The choice of crops is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. Wind erosion and fire are special hazards.

Woskish

MRTSC Trial Form
File Code Soils-12
Rev. 9-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES _______
STATE MINNESOTA
MLRA 88, 89
REV. RRL 8-18-71

These soils are extremely acid, deep organic soils. They consist of slightly decomposed, reddish brown sphagnum fibers throughout most of the upper 5 feet. Normally they occupy areas within large bogs that have slightly convex surfaces. Mapped areas are usually circular or oblong and range from about 100 to more than 600 acres in size. Black spruce along with a few tamarack are the major trees growing on these soils.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (inches)	Classification			Coarse Fract. >3 in. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permea-bility In./hr.	Avail. Water Capac. in./in.	Soil Reac-tion pH	Shrink Swell Poten-tial
	USDA Texture	Unified	AASHO		4	10	40	200						
0-60"	Fibric	Pt	-		Not suitable for engineering sieve analysis				--	--	12-20	0.55-0.65	3.5-4.5	High

Flooding None

Hydrologic group: D

Depth to water table: 0 to 2 feet.

Depth to bedrock: 5 to many feet.

Corrosivity - uncoated steel: Very high.

Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor; organic soils; very low bearing capacity.
Sand	Not suitable.
Gravel	Not suitable.
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil; needs lime. High water table.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: High water table, organic material.
Sewage Lagoons	Severe: High water table; more than 30% organic matter.
Shallow Excavations	Severe: High water table, organic material.
Dwellings: With Basements Without Basements	Severe: High water table; low shear strength; high shrink-swell potential high compressibility; very low bearing values.
Sanitary Landfill	Severe: High water table; poor trafficability.
Local Roads and Streets	Severe: High water table; high susceptibility to frost action; high shrink-swell potential; more than 30% organic matter.
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Organic soil, high water table.
Embankments, Dikes, and Levees	High water table; poor stability; more than 30% organic matter.
Drainage of Cropland and Pasture	Water table at the surface or within 1-2 feet during the growing season; usually drained by open ditches.
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

USDA-SCS LINCOLN 1971

PRELIMINARY DRAFT REPORT, SUBJECT TO REVIEW

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: High water table; poor trafficability.
Picnic Areas	Severe: High water table; poor trafficability.
Playgrounds	Severe: High water table; poor trafficability.
Paths and Trails	Severe: High water table; poor trafficability.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
0 to 2% slope	VIIw	-	-				

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very Poor	Very Poor	Very Poor	Very Poor	Very Poor	Good	Good	Very Poor	Very Poor	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	5w	Black spruce	20-30	Slight	Severe	Severe	Severe		Black Spruce	

RANGE

Phases of Series	Range Site Name	Climax Vegetation and Productivity of Air-Dry Herbage (lb./ac.)

WINDBREAK

Group	Adapted Trees to Plant	Tree Height Prediction at 20 Years Age	Relative Vigor

OTHER

Potential yields are poor for the commonly cultivated crops. The choice of crops is limited by climate, low fertility, and a high water table. Crops that can withstand light frost and have a short growing season are best suited. These include carrots, cabbage, cauliflower, celery, potatoes, cultured sod, radishes, onions and the like. These peats are well suited for commercial peat harvesting.

Lobo

MRTSC Trial Form
File Code Soils-12
Rev. 5-10-71

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SURVEY INTERPRETATIONS 1/

SERIES
STATE MINNESOTA
MLRA 88, 89, 90
REV. 10-71

These are extremely acid, deep organic soils. They consist of slightly decomposed reddish brown sphagnum material throughout the upper three to four feet. Below this is moderately decomposed, dark reddish brown herbaceous material. These soils occur in relatively narrow bands around the outer edge of large raised bogs, and in circular or oblong areas in small bogs.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING

Major Soil Horizons (Inches)	Classification			Course Fract. >3 In. %	Percentage less than 3 inches Passing Sieve No.--				LL	PI	Permeability In./hr.	Avail. Water Capac. in./in.	Soil Reaction pH	Shrink Swell Potential
	USDA Texture	Unified	AASHO		4	10	40	200						
0-38	Fibric	Pt	-		Not suitable for engineering sieve analysis				-	-	6-20	0.55-0.65	3.4-4.5	High
38-60	Hemic	Pt	-						--	-	2.0-6.3	0.45-0.55	4.0-4.5	High

Flooding None

Hydrologic group: D

Depth to water table: 0 to 2 feet.

Depth to bedrock: 5 to many feet.

Corrosivity - uncoated steel: Very high.

Corrosivity - concrete: High

SUITABILITY OF SOIL AS SOURCE OF SELECTED MATERIAL AND FEATURES AFFECTING USE

Roadfill	Poor: Organic soils; very low bearing capacity.
Sand	Not suitable.
Gravel	Not suitable.
Topsoil	Poor when used alone. Fair to good when mixed with mineral soil; needs lime. High water table.

DEGREE AND KIND OF SOIL LIMITATION FOR SELECTED USES

Septic Tank Filter Fields	Severe: Highwater table; organic material.
Sewage Lagoons	Severe. High water table; more than 30% organic matter.
Shallow Excavations	Severe: High water table, organic material.
Dwellings: With Basements, Without Basements	Severe: High water table; low shear strength; high shrink-swell potential; high compressibility; very low bearing values.
Sanitary Landfill	Severe: High water table; poor trafficability.
Local Roads and Streets	Severe: High water table; high susceptibility to frost action; high shrink-swell potential; more than 30% organic matter.
Potential Frost Action	High

MAJOR SOIL FEATURES AFFECTING SELECTED USES

Pond Reservoir Areas	Organic soil, high water table.
Embankments, Dikes, and Levees	High water table; poor stability; organic material.
Drainage of Cropland and Pasture	Water table at the surface or within 1-2 feet during the growing season; usually drained by open ditches.
Irrigation	
Terraces and Diversions	
Grassed Waterways	

1/ Use in conjunction with Guide to Soil Survey Interpretation Sheets.

DEGREE OF SOIL LIMITATION AND MAJOR FEATURES AFFECTING RECREATION USES

Camp Areas	Severe: High water table; poor trafficability.
Picnic Areas	Severe: High water table; poor trafficability.
Playgrounds	Severe: High water table; poor trafficability.
Paths and Trails	Severe: High water table; poor trafficability.

CAPABILITY, SOIL LOSS FACTORS, AND POTENTIAL YIELDS--(High level management)

Phases of Series	Capability	Soil Loss K	Soil Loss T				
0 to 2% slopes	VIIw	-	-	--	--	--	--

PASTURELAND AND HAYLAND

Phases of Series	Group	Species, Yield in AUMs for Dryland (Irrigated) Forage Production

WILDLIFE HABITAT SUITABILITY

Phases of Series	Potential for--							Potential for--		
	Grain and Seed Crops	Grasses, Legumes	Wild Herbaceous Plants	Hardwood Trees and Shrubs	Coniferous Plants	Wetland Food and Cover	Shallow Water Devel.	Openland Wildlife	Woodland Wildlife	Wetland Wildlife
All	Very poor	Very poor	Very poor	Very poor	Very poor	Good	Good	Very poor	Very poor	Fair

WOODLAND SUITABILITY

Phases of Series	Ordination	Potential Productivity		Woodland Management Hazards				Suitable Species		Other
		Important Trees	Site Index	Erosion Hazard	Equipment Limitations	Seeding Mortality	Plant Competition	To Favor	To Plant	
All	5W	Black Spruce	20-40	Slight	Severe	Severe	Severe		Black Spruce	

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