SOIL SURVEY OF AREA ADJACENT TO PINEHURST LAKE, ALBERTA AND INTERPRETATION FOR RECREATIONAL USE

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PREFACE

A standard explanatory format, beginning with the section entitled "Preface" and ending with the section entitled "Glossary" has been written. Since the same explanatory remarks will pertain to reports written for each of the Alberta Provincial Parks and other areas surveyed, the same standard format will be presented at the beginning of each report.

INTRODUCTION

The growth in population and per capita income has and will continue to exert an unprecedented demand on the natural resources of Alberta. The nature of today's city living and working makes apparent the recreational value of Provincial Parks. Men and women often work in large factories and plants or in crowded offices, far removed from nature or a natural environment. The work week of forty hours or less, however, provides people with a relatively large amount of leisure time and prompts a constant search for off-time recreation to refresh the spirit. It is this trend in our civilization today that places high priority on comprehensive planning that will bring together the special interests in land use, watershed protection, wildlife, forestry and parks and recreation based on carefully determined requirements.

Soil being one of the basic resources which man manipulates in his land use activities, requires prudent use, protection and proper management in order to realize its inherent potential on a sustained yield basis (8). Recognition of natural phenomena and physical limitations is no less important in campground construction or septic tank location than it is in crop production. The kind of soil dictates to a large degree the type and location of recreational facilities (8). Some soils are not desirable sites for campgrounds, play areas, picnic grounds, cabin sites or nature study areas; other soils are very desirable sites for recreational uses. Knowledge of the soils of an area provides fundamental information needed in recreation planning. The soil information contained in the reports to follow is designed to be of assistance in planning future development in various Provincial Parks within the Province of Alberta.

Detailed and semi-detailed soil surveys were conducted in the following Provincial Parks during the summer of 1974: Chain Lakes, Winagami Lake, Gregoire Lake, Long Lake and Cross Lake. Also included were areas in the vicinities of Lake Newell, the Wildcat Hills, and Pinehurst Lake. The total area surveyed was approximately 29,400 acres.

ACKNOWLEDGMENTS

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Mrs. Pal Foster typed and assisted in compiling and proof reading the reports. Mr. Z. Widtman drafted the final soil map, while Mr. J. Beres determined the physical properties of the soils. The soil chemical analyses were determined by the Alberta Soil and Feed Testing Laboratory.

Able field assistance was given by Mr. E. Marchuk.

Special acknowledgment is given to the Park Wardens who co-operated by allowing soil investigations to be conducted throughout the parks and also invariably offered assistance.

SUMMARY

The mapped area is situated around parts of the southern, eastern and northern shores of Pinehurst Lake; which in turn is located about 35 km (22 miles) southeast of the town of Lac La Biche, or 51 km (32 miles) by road. The total area studied comprises about 1600 ha (4000 acres). The study area lies within the Eastern Alberta Plains of the Third Prairie Steppe; and the topography ranges from gently undulating and undulating in the eastern and northern portions, to gently and strongly rolling in the southern portion. The predominant surficial deposit is till, and beach sand occurs along the lakeshore at various locations. One area of shallow sand deposits overlying till occurs, and organic deposits of variable extent occur throughout the mapped area.

A continental type climate prevails, and has generally warm summers and cold winters. The study area lies within the Mixedwood Section of the Boreal Forest Region.

Ten Map Units were recognized in the mapped area. The key profile types consist of Orthic Gray Luvisols, Gleyed Gray Luvisols, Degraded Eutric Brunisols, Gleyed Regosols, Rego Gleysols, Mesisols and Humisols. They are distributed over the landscape in relation to parent material, landform and drainage. Map Units consist of single soil series or groupings of series; and their distribution is shown on the Soils Map.

Soil interpretations are made for each Map Unit for camp areas, picnic areas, intensive play areas, paths and trails, lawns and landscaping, permanent buildings, septic tank absorption fields, sanitary landfills - trench type, reservoir sites, road location and sources of roadfill, sources of topsoil and sources of sand or gravel.

In the mapped area, the soils most suitable for recreational development are those of Map Units 1 and 6. They have moderate limitations for lawns and landscaping due to the lack of Ah horizons; and for various construction purposes due to high clay content of the subsoils, moderate permeability, susceptibility to frost heave and moderate shrink-swell potential. Excessive slope is also a limiting factor in some locations. These soil areas can be located by careful study of the Soils Map and Table 4 (interpretations table).

A soil survey properly interpreted is a useful guide for general recreation planning and in site selection. However, all soil differences which occur in the field cannot be shown on a soils map. Thus, for design and construction of specific recreational facilities, an on-site investigation is often needed.

METHODS

The areas surveyed were traversed by motor vehicle along all roads and negotiable trails, and on foot along cut-lines and non-negotiable trails. Soil pits were dug at frequent intervals to depths of 2 to 4 feet, to examine and describe soil horizons and classify the soils. Detailed field soil descriptions were made. Soil boundaries were drawn on aerial photographs with the aid of a pocket stereoscope.

Representative surface and shallow subsurface soil samples were collected for chemical analyses and subsurface samples were collected at depths of 4 to 6 feet for physical analyses.

GENERAL SOIL MAP

The soils were classified according to the System of Soil Classification for Canada (4). The areal extent of each different kind of soil is indicated on the soil map. An explanation of the map symbols follows:

Example:

$$\frac{1}{C4}$$

1 ← map unit
4 ← surface stoniness rating (Table 2)
C ← topographic class (Table 1)

The map units generally refer to single soil series or soil associations. A soil series is a grouping of all soils which are similar in the number, color, texture, structure, relative arrangement, chemical composition, and thickness of horizons, as well as in the geology of the soil parent material (3). A soil association simply consists of a number of soil series occurring together in characteristic patterns.

Where a map unit consists of a single series, other soil series may be found in close association. However, the dominant series makes up to 80 to 90% of the map unit; the other series are present in such minor amounts that their presence is not considered significant enough to affect the use of a particular map unit for recreation.

Where a mpa unit consists of a soil association, it was not possible to outline each separate series in the time available to complete the soil survey. However different series in an association generally possess very similar properties. The approximate percentage of each series comprising the association is indicated in the soil report. Minor insignificant amounts of other series may be present but are not mentioned in the definition of the association.

Other miscellaneous symbols appearing on the soil map are defined or explained in the soil report.

The topographic classes and stoniness rating are defined in Tables 1 and 2, which follow:

Table 1. Topographic classes and symbols (3)

	Simple topography Single slopes (regular surface)		Complex topography Multiple slopes (irregular surface)	Slope %
A	depressional to level	a	nearly level	0 to 0.5
B	very gently sloping	b	gently undulating	0.5 to 2
C	gently sloping	c	undulating	2 to 5
D	moderately sloping	d	gently rolling	5 to 9
E	strongly sloping	e	moderately rolling	9 to 15
F	steeply sloping	f	strongly rolling	15 to 30
G	very steeply sloping	g	hilly	30 to 60
H	extremely sloping	h	very hilly	60

Table 2. Stoniness ratings (5)

Stony 0 - (stone-free land)	too few stones to be of any hindrance to recreation
Stony 1 - (slightly stony land)	some stones, only slight to no hindrance to recreation
Stony 2 - (moderately stony land)	enough stones to cause some interference with recreation
Stony 3 - (very stony land)	enough stones to constitute a serious handicap to recreation - some clearing is required
Stony 4 - (exceedingly stony land)	enough stones to prevent recreational use unless considerable clearing is done
Stony 5 - (excessively stony land)	too stony to permit any recreational use (boulder or stone pavement)

SOIL CHARACTERISTICS AND INTERPRETATIONS FOR RECREATIONAL USE

Soil surveys provide for classifying, defining and delineating each kind of soil and making predictions of soil behaviour under specific management (8). The soils within an area are mapped and classified without regard for existing or expected land ownership boundaries, or types of use. Each delineated soil is defined so that the information is available for planning different kinds of land use.

Each kind of soil has its own peculiar set of characteristics and qualities which are described in terms that can be observed (8). These include soil texture; color; structure; consistence; depth (to rock, hardpan, water table, etc.); kind and amount of coarse fragments; kind, thickness and sequence of soil layers; organic matter content; reaction; and slope. When accurately defined a specific soil can be distinguished from all other kinds of soil.

Most soils can be used for recreational activities of some kind. Some have no soil limitations for specific kinds of recreational uses; others have moderate to severe limitations for certain uses. Many soil properties affect the use limitations of soils for recreation, and the effects of a given soil property often vary with different uses (2).

The soil properties affecting most recreational uses include susceptibility to flooding, wetness, slope, and surface stoniness (2). Other soil properties also having an effect include: depth to sand and gravel, an impeding horizon and surface soil texture, as they affect permeability and erodibility; texture and plasticity, as they affect shrink-swell potential, and susceptibility to frost heaving; soluble sulphate content, as it affects concrete corrosion hazard; and salinity of the topsoil.

Soils that are subject to flooding during the season of use are considered to have severe limitations for recreation facilities such as camping areas, building sites, and roads. Such areas require permanent design considerations (2,8). These soils should not be developed for campsites or building sites unless they are protected by dikes, levees or other flood prevention structures, which may be uneconomical. These soils may be better suited for hiking or nature study areas, or for greenbelt open space, if the flooding is not too frequent (8). Montgomery and Edminster (8) suggest one or two floodings during the season of use consitiutes only a moderate limitation for picnic areas, playground areas and hiking trails. These are the less permanent facilities that can be moved with relative ease. Thus, the soils can be managed to a high level without maintenance costs rising beyond the financial capacity of the administration (2).

Soils that are wet all year, even if not flooded, have severe limitations for campsites, roads, hiking trails, playgrounds and picnic areas (8). The economic feasibility of installing subsurface drainage in these soils is questionable (2). Soils that are wet only part of the year or those with a water table that fluctuates without actually reaching the surface are not easily detected. These soils are considered to have moderate to severe limitations for most recreational uses, and if possible should be avoided for the more permanent facilities such as camping areas and building sites. With careful planning, design, and management, however, these soils can be used for most recreational facilities. Soils that dry out slowly after rains also present problems where intensive use is contemplated. The soils that are dry during the season of use and have a water table greater than 3 feet from the surface are considered to have slight to no limitations for most recreational uses (2).

Droughty or very rapidly drained soils also have limitations for many recreational uses. On such sites grass cover needed for playing fields is difficult to establish and maintain. Access roads may be excessively dusty. Vehicles are easily mired down in sandy soils and soil blowing is common. Knowledge of these soil problems enables planners to use corrective conservation practices, such as irrigation, or to choose alternative locations (8).

The ability of a soil to support a load is important in many kinds of recreational activities. Some soils when wet fail to support structures such as access roads, trails and buildings (8).

Slope affects the use of soils for recreation (2,8). Generally, slopes of less than 2% offer no limitations for use as playgrounds, campsites, sites for recreation buildings, roads and trails. Slopes greater than 9% constitute a severe limitation for playground areas, since levelling costs would become prohibitive. Slopes of more than 15% constitute a severe limitation for camping areas, picnic areas and some building sites for the same reason. The smaller areas required for these facilities as compared to playground areas, account for the greater tolerance. On the other hand, steeply sloping soils are essential for ski runs and are desirable for hiking areas and scenic values. Hiking trails are not limited unless slopes are greater than 30%. Of course steep, gently sloping and moderately sloping soils can be levelled for campsites, playgrounds and building sites, where the cost is justified (8). Where this is done it is especially urgent that effective soil conservation practices be applied and maintained, based on the specific conditions at hand.

Permeability is an important property affecting the recreational use of soils (2). Since no permeability measurements were made, it has been estimated from a consideration of texture, structure and depth to an impeding horizon in the profile (9). Soils with very rapid to moderately rapid permeability have no limitations, and soils with slow and very slow permeability have severe limitations(8). The same classes apply to suitability for road subgrade material but are reversed when considering suitability for reservoir sites. Soils are rated for this purpose on their capacity to hold water without allowing seepage. It should be noted that the degree of limitation due to permeability will vary with climate. In high rainfall areas permeability is much more important than in low rainfall areas (2).

Surface stoniness limits the use of some soils for recreational facilities (2). Generally the non-stony (class 0) to slightly stony (class 1) land offers no limitation for recreational facilities. Very stony (class 3) to excessively stony (class 5) land offers severe limitations for camping areas, playground areas and building sites. The expense of removing the stone hazard is considered prohibitive (2). The very stony (class 3) land is considered to constitute only a moderate limitation for picnic areas and hiking trails because of the lesser areal intensity of use associated with these facilities. In some instances it is feasible to remove the stones, thus eliminating the hazard (8). Rounded gravels and stones present hazards on steeply sloping soils used for foot trails.

Surface texture is an important soil property to consider (2,8). High clay or sand content in the surface horizon constitutes a severe limitation for playgrounds, campsites or other uses that involve heavy foot traffic by people or horses. Soils high in clay become sticky and slippery when wet and dry out slowly after rains. On the other hand loose sandy soils are undesirable as they are unstable when dry, making it difficult to establish sod grasses capable of withstanding concentrated foot traffic. Generally, sandy loam and loam surface soil textures are the most desirable for recreational uses involving heavy use by people.

Soil depth affects many uses (8). Soils underlain by bedrock or sand and gravel at shallow depths cannot be levelled for playgrounds except at high cost. Roads, trails, basements and reservoirs are very difficult to construct on soils with shallow bedrock, and soils with shallow sand and gravel are undesirable sites for reservoirs. It is difficult to establish vegetation on shallow soils overlying impervious soil layers, rock or sand and gravel, thus making them poor locations for playing fields and other intensive use areas.

Sewage disposal is also an important consideration in designing recreation areas (2). Some soils absorb septic effluent rapidly and other soils absorb it very slowly (8). Soils that are slowly or rapidly permeable, poorly drained, subject to flooding, shallow to rock, or steeply sloping all have severe limitations for septic tank filter fields. These include soils of high clay content, sandy soils and Gleysolic soils. The most desirable soils for sewage disposal have a moderate permeability, are well drained and are situated in nearly level areas (2). The most desirable soils for sewage disposal are also the most desirable soils for sanitary land fills. In some cases where soils cannot handle the volume of waste involved, sewage lagoons can be used (8). These also are feasible only in soils that meet the special requirements for sewage lagoons.

Shrink-swell potential is inferred from Atterberg limits (2). Soils with low to medium shrink-swell potential are considered to have no to slight limitations for recreational facilities. Soils with a very high shrink-swell potential are considered to constitute severe limitations for building sites and road subgrade material as these soils tend to be unstable with changing moisture conditions. Soils with a high shrink-swell potential offer moderate limitations for use and thus should be avoided if possible.

The suitability of the underlying soil material for road subgrade depends upon the additional property of susceptibility to frost action(2). Generally soils high in silt content are highly susceptible to frost action. Other factors, such as the availability of water, also affect this parameter. The availability of water is dependent upon climatic conditions and depth to water table. Thus, soils high in silt content may not necessarily undergo appreciable frost heaving unless they are imperfectly or poorly drained, or subject to high rainfall shortly before freezing. This is especially true in Alberta.

The soluble sulphate content of the underlying soil material is an important factor for buildings with concrete foundations, as well as for underground conduits (2). The U. S. Bureau of Reclamation (14) has established classes for sulphate attack on concrete. Soils with 0 to 0.1 % soluble sulphate content are considered to have no limitations for standard concrete foundations, and soils with 0.1 to 0.2% are considered to have slight limitations. Soils with 0.2 to 0.5% soluble sulphate content are considered to have moderate limitations, and foundations may require sulphate resistant concrete. Soils with greater than 0.5% soluble sulphate are considered to have severe limitations and should be avoided (2).

Salinity and depth of topsoil affect soil suitabilities for lawns and landscaping, and sources of topsoil. An electrical conductivity of less than 1 (mmhos./cm.) and a depth of topsoil of more than 6 inches offer no limitations. An electrical conductivity of more than 3 (mmhos./cm.) and a depth of topsoil of less than 3 inches render severe limitations.

Productive capacity of soils for vegetation of different kinds is closely related to the feasibility of many recreational enterprises (8). The ability of soils to grow sods that can take concentrated human traffic has already been noted as a factor in such areas as playgrounds and campsites. The development of such vegetative conservation practices as shade tree plantings, living fences, plant screens, and barriers to trespass is guided by soil conditions. The capacity of an area to produce economically harvestable crops of game is dependent in part upon the productive ability of its soils (8).

Thus we find that basic soil qualities and characteristics are closely associated with the various types of outdoor recreational activities (8). By knowing the characteristics and qualities of the different kinds of soils and their behaviours, and with the aid of a soil map, soil scientists and other specialists can develop soil interpretations for recreational uses. Interpretations for recreation can best be made locally by those familiar with the soils and conditions in the area (8).

EXPLANATION OF SOIL INTERPRETATIONS

Soil limitation or suitability ratings are for evaluating each soil for a particular use(9). Interpretations are based on evaluation of the soil to a depth of about 40 inches; however, some interpretations can be made below the 5 foot depth. These interpretations are made largely from detailed soil descriptions obtained during the field soil mapping program. The limited time, resources and trained personnel available did not permit such determinations as bulk density and percolation rate. Only surface and shallow subsurface soil samples were collected for routine chemical analyses, while only limited numbers of deeper subsurface samples were collected for engineering tests. Engineering properties of some map units sampled were extrapolated to other map units not sampled, where soils of the different map units were developed on the same or very similar parent materials.

It is important that the proper perspective be placed on the use of soil interpretations in recreation planning (8). The interpretations are for soils in the natural state only and not for disturbed areas. Nor do they include other factors, such as location, aesthetic values, and nearness to population centres. A soil survey properly interpreted is a useful guide for general recreation planning and in site selection.However, all soil differences which occur in the field cannot be shown on a general soil map. Thus for design and construction of specific recreational facilities, an "on-site" investigation is often needed.

The soils are grouped into 3 categories according to their limitations or suitabilities for specific uses. They are evaluated by considering the interaction of the various properties to give an overall degree of limitation or suitability to each map symbol. The 3 categories of limitations are as follows:

(1) S - None to slight soil limitations - Soils relatively free of limitations that affect the intended use, or the limitations are easy to overcome.

(2) M - Moderate soil limitations - Soils having limitations that need to be recognized but can be overcome with correct planning, careful design and good management.

(3) V - Severe soil limitations - Soils with limitations severe enough to make the proposed use questionable. It does not mean the soil cannot be used for a specific use but it does mean that careful planning and design, and very good management are needed. This often includes major soil reclamation work. In many cases the limitations will not be economically feasible to correct.

The soils are rated as good (G), fair (F), or poor (P) as sources of topsoil, or sand and gravel. These suitability ratings correspond to the limitations of none to slight (S), moderate (M), and severe (V) respectively and the definitions are essentially the same. The soils may also be rated "unsuitable" as sources of topsoil, or sand and gravel.

Interpretations are not included for wildlife use. However, it is recognized that all soils are suited for some form of wildlife and that this is an important use which is compatible with certain other uses.

DEFINITION OF SELECTED USES

(1) Camp Areas are considered to be used intensively for tents, truck campers and small camp trailers with the accompanying activities of outdoor living (9). It is assumed that little site preparation will be done other than shaping and levelling for tent and parking areas. The soils should be suitable for heavy foot traffic and for limited vehicular traffic. Flooding hazard, depth to water table, slope, permeability, stoniness and surface texture affect suitability for this use. Soil suitability for growing and maintaining vegetation is not rated but is an item to consider in final evaluation of the site (see ratings for lawns and landscaping).

(2) Foundations for Low Buildings (with or without basements)- Interpretations indicate limitations for construction and maintenance of homes and small buildings (9). They are affected by soil characteristics such as flooding hazard, wetness, slope, stoniness, depth to bedrock, shrink-swell potential, sulphate content, and depth to sand and gravel. (Limitations for on-site sewage disposal is rated separately.)

(3) Play Areas for recreation apply to soils that are to be used intensively for organized games such as football, baseball, volleyball, horseshoes and other similar organized games (9). They are subject to heavy foot traffic. A level surface, good drainage, and a surface soil texture and consistence that gives a firm surface which is not slippery and sticky when wet is generally required. Soils that are sloping, very stony, very shallow, subject to blowing, subject to flooding, or have seasonally high water tables or slow permeability are rated as having severe limitations.

(4) Paths and Trails - Uses are local and crosscrountry footpaths, and bridle paths. It is assumed that these areas will be used as they occur in nature and that little or no soil will be moved (excavated or filled)(9). Soil features, such as surface texture and structure, that affect trafficability, dust, and design and maintenance of trafficways should be given special emphasis. Soils that flood frequently, are poorly drained or very stony, or have clay or sand surface textures or steep slopes are rated as having severe limitations.

(5) Picnic Areas are considered to be extensively used as park-type picnic grounds and are subject to heavy foot traffic (9). It is assumed that most vehicular traffic will be confined to access roads and parking areas. Flood hazard, wetness, slope, permeability, surface stoniness and surface texture affect suitability for this use. Soil suitability for growing vegetation is not rated but is an item to consider in final evaluation of the site. (See ratings for lawns and landscaping.)

(6) Septic Tank Filter Fields - Successful operation of the system depends upon the ability of the soil to absorb and filter the liquid or effluent passed through the tile field (9). Filter fields are influenced by the ease of downward movement of effluent through the soil. Soils with slow permeability are rated severe. Other soil properties that affect septic tank filter fields are flooding hazard, seasonal high groundwater, slope, depth to bedrock, and depth to sand and gravel. Clean sands and gravels with rapid permeability may constitute a hazard for groundwater contamination.

(7) Road and Parking Location and Suitability for Subgrade Material - These uses are based on features that affect performance for the location of roads, streets and parking areas (9). The main factors considered are flooding hazard, shrink-swell potential, depth to bedrock and susceptibility to frost heave.

(8) Lawns and Landscaping - The soil is rated on the assumption that it will be used for lawn turf, shrubs and trees without need for adding topsoil for good establishment, and also that irrigation is provided (9). Soil characteristics affecting this use are flooding hazard, depth to seasonal high water table, slope, stoniness, surface soil texture, depth of topsoil, salinity and depth to bedrock or sand and gravel.

(9) Sanitary Land Fills are disposal areas for trash and garbage. A good sanitary land fill should be usable all year and should operate without contaminating water supplies or causing a health hazard (9). Soil factors considered in rating the limitations for use are flood hazard, seasonal high water table, slope, permeability, depth to bedrock and depth to sand and gravel.

(10) Reservoir Sites are rated on the adequacy of the soil material to prevent seepage from the reservoir (9). Soil properties most important are slope, permeability, depth to bedrock and depth to sand and gravel. Depth to

water table influences the depth of water in dugouts, pits, etc. in all kinds of soil materials so is not rated for this use.

(11) Suitability as a Source of Topsoil - Topsoil is considered to be used for establishing lawns (9). A rating of "good" means the soil provides a good source of topsoil for removal and transfer to another place, or it can be used in place. Soils are rated on flooding hazard, wetness of the surface layer of undisturbed soils, slope, stoniness, surface texture, depth of topsoil and salinity.

(12) Suitability as a Source of Sand and Gravel - A particular area outlined on the soil map can be identified as predominantly sand or predominantly gravel by consulting the soil report for a description of the map unit under consideration. Only the suitability as a source for sand and gravel is rated (9). No attempt is made to rate the quality of the sand and gravel for specific uses such as road base, concrete, etc. Quality determinations should be made at the site of the source, since both grain sizes and shapes of sand and gravel determine suitability for specific uses (9). Soil limitations considered at the site of the source are flooding hazard, wetness, depth to bedrock (influences thickness of sand and gravel deposit), and depth to sand and gravel (determines thickness of overburden that must be removed to reach sand and gravel deposit).

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GLOSSARY

Atterberg limits - Various moisture contents of a soil at which it changes from one major physical condition to another. The Atterberg limits which are most useful for engineering purposes are liquid limit and plastic limit.

The liquid limit is the moisture content at which a soil passes from a plastic to a liquid state.

The plastic limit is the moisture content at which a soil changes from a semi-solid to a plastic state.

Plasticity index (P.I.) is defined as the numerical difference between liquid limit and plastic limit.

bedrock - The solid rock underlying the regolith in depths ranging from zero (where exposed by erosion) to several hundred feet.

bulk density, soil - The mass of dry soil per unit bulk volume.

coarse fragments - Rock or mineral particles greater than 2.0 mm. in diameter.

consistence - (a) The resistance of a material to deformation or rupture. (b) The degree of cohesion or adhesion of the soil mass.

droughty soil - Sandy or very rapidly drained soil.

electrical conductivity, soil - Measurement on a saturated soil paste or a water extract of the soil, made to estimate the salt content of the soil.

engineering tests - Laboratory tests made to determine the physical properties of soils that affect their uses for various types of engineering construction.

erodibility - Susceptibility to erosion.

erosion - The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

fertile soil - A soil with an abundant supply of available elements necessary for plant growth.

fertilizer - Any organic or inorganic material of natural or synthetic origin that is added to a soil to supply certain elements essential to the growth of plants.

field capacity (field moisture capacity) - The percentage of water remaining in a soil 2 or 3 days after having been saturated and after free drainage has practically ceased.

frost heave, in soil - The raising of a surface caused by ice formation in the underlying soil.

Gleysolic soil - soil developed under wet conditions resulting in reduction of iron and other elements and in gray colors and mottles.

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

ground water - That portion of the total precipitation which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

hardpan - A hardened soil layer, in the lower A or in the B horizon, caused by cementation of soil particles with organic matter or with materials such as silica, sesquioxides, or calcium carbonate.

impeding horizon - A horizon which hinders the movement of water through soils under the influence of gravity.

irrigation - The artificial application of water to the soil for the benefit of growing crops.

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

pedogenic - Pertaining to the origin, morphology, genesis, distribution, and classification of soils.

permeability, soil - The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil.

productive capacity, soil - The capacity of a soil, in its normal environment, for producing a specified plant or sequence of plants under a specified system of management. The "specified" limitations are necessary since no soil can produce all crops with equal success nor can a single system of management produce the same effect on all soils.

regolith - The unconsolidated mantle of weathered rock and soil material overlying solid rock.

seepage, soil - (a) The escape of water downward and laterally through the soil. (b) The emergence of water from the soil along an extensive line of surface in contrast to a spring where the water emerges from a local spot.

shrink-swell potential - Tendency of soils to undergo volume changes with changes in water content.

soil blowing - Soil erosion by wind.

soil conservation - (a) Protection of the soil against physical loss by erosion or against chemical deterioration; that is, excessive loss of fertility by either natural or artificial means. (b) A combination of all management and land use methods which safeguard the soil against depletion or deterioration by natural or by man-induced factors.

soil drainage classes - The soil drainage classes are defined in terms of (a) actual moisture content in excess of field moisture capacity, and (b) the extent of the period during which such excess water is present in the plant-root zone. The soil drainage classes are defined as follows:

1. Rapidly drained - The soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions.

2. Well drained - The soil moisture content does not normally exceed field capacity in any horizon (except possibly the C) for a significant part of the year.

3. Moderately well drained - The soil moisture in excess of field capacity remains for a small but significant period of the year.

4. Imperfectly drained - The soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year .

5. Poorly drained - The soil moisture in excess of field capacity remains in all horizons for a large part of the year.

6. Very poorly drained - Free water remains at or within 12 inches of the surface most of the year.

soil horizon - A layer of soil or soil material approximately parallel to the land surface; it differs from adjacent genetically related layers in properties such as colour, structure, texture, consistence, and chemical, biological and mineralogical composition.

soil organic matter - The organic fraction of the soil; includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

soil reaction - The degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: extremely acid, 4.5; very strongly acid, 4.5 - 5.0; strongly acid, 5.1 - 5.5; moderately acid, 5.6 - 6.0; slightly acid, 6.1 - 6.5; neutral, 6.6 - 7.3; slightly alkaline, 7.4 - 7.8; moderately alkaline, 7.9 - 8.4; strongly alkaline, 8.5 - 9.0; and very strongly alkaline, 9.0.

soil salinity - The amount of soluble salts in a soil, expressed in terms of percentage, parts per million, or other convenient ratios.

soil structure - The combination or arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades.

soil texture - The relative proportions of the various soil separates (sand, silt and clay) in a soil as described by textural classes. The textural classes may be modified by adding suitable adjectives when coarse fragments are present in substantial amounts; for example, "stony silt loam", or "silt loam, stony phase". The sand, loamy sand, and sandy loam classes are further subdivided on the basis of the proportions of the various sand separates present (fine, medium, coarse). The various classes and subclasses and abbreviations are listed in order from coarse to fine as follows: coarse sand (CS), sand (S), fine sand (FS), very fine sand (VFS), loamy coarse sand (LCS), loamy sand (LS), loamy fine sand (LFS), loamy very fine sand (LVFS), coarse sandy loam (CSL), sandy loam (SL), fine sandy loam (FSL), very fine sandy loam (VFSL), loam (L), silt loam (SiL), silt (Si), sandy clay loam (SCL), clay loam (CL), silty clay loam (SiCL), sandy clay (SC), silty clay (SiC), clay (C), heavy clay (HC). The textural classes can also be grouped as follows:

(a) Coarse-textured group
1) Very coarse textured: CS, S, FS, VFS, LCS, LS, LFS, LVFS.
2) Moderately coarse textured: CSL, SL, FSL, VFSL.
(b) Medium-textured group
1) Medium textured: L, SiL, Si.
2) Moderately fine textured: SCL, CL, SiCL.
(c) Fine-textured group
1) Fine textured: SC, SiC, C.
2) Very fine textured: HC (more than 60% clay).

soluble sulphate - Water-soluble sulphate found in soil.

solum - The upper horizons of a soil in which the parent material has been modified and in which most plant roots are contained. It usually consists of A and B horizons.

subsurface drainage - Removal by artificial means of excess water below the soil surface.

topsoil - (i) The layer of soil moved in cultivation. (ii) The A-horizon. (iii) The Ah-horizon. (iv) Presumably fertile soil material used to topdress roadbanks, gardens, and lawns.

trafficability - The capacity of a soil to withstand traffic by people, horses, or vehicles.

watershed - A drainage area containing a few thousand acres, from which water drains toward a single channel.

water table - The upper surface of ground water or that level below which the soil is saturated with water.

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SOIL REPORT

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LOCATION AND SIZE

The mapped area is situated around parts of the southern, eastern and northern shores of Pinehurst Lake; which in turn is located about 35 km (22 miles) southeast of the town of Lac La Biche, or 51 km (32 miles) by road. In 65-10-4, the mapped area includes sections 13 to 15, 22 and 24 to 26. In 65-9-4 it includes sections 18 to 20, 29 and 30. Considerable portions of many of these sections are occupied by the lake, so that the total land area mapped comprises about 1600 ha (4000 acres).

PHYSIOGRAPHY AND SURFICIAL DEPOSITS

The mapped area lies within the Eastern Alberta Plains of the Third Prairie Steppe (Kocaoglu 1975). The topography ranges from gently undulating and undulating in the eastern and northern portions of the area, to gently rolling and strongly rolling in the southern portion. The surface elevation throughout most of the area is approximately 610 m(2000 feet) above sea level. Drainage is into Pinehurst Lake, which in turn is drained by Punk Creek to the southeast. This creek flows into the Sand River, which flows into the Beaver River about 35 km (22 miles) southeast of Pinehurst Lake. The Beaver River drains to the east.

Till is the predominant surficial deposit found throughout the mapped area. Beach sand occurs along the lake shore at various locations; namely sections 13 and 26 in 65-10-4, and sections 18 and 19 in 65-9-4. Also, shallow deposits of sand overlying till are found in S½ 18-65-9-4. Organic deposits of various extent are found throughout the area.

CLIMATE

A continental type climate prevails in the mapped area, and is characterized generally by warm summers and cold winters (Kocaoglu 1975). Weather records kept at the Lac La Biche airport, about 40 km (25 miles) northwest of the mapped area at an elevation of 560 m (1835 feet) show the following statistics over the 10 year period of 1964 through 1973 (Env. Canada): a mean annual temperature of 0.7°C, mean annual precipitation of 50 cm with 71% falling as rain, and an average frost free period of 100 days. The coldest month of the year is January with a mean temperature of -19°C, and July is the warmest month with a mean temperature of 16.2°C. For comparison, the following statistics were obtained from records kept over the same time period at a weather recording station near Iron River, about 32 km (20 miles) southeast of the mapped area at an elevation of 550 m (1800 feet): a mean annual temperature of 0.5°C, mean annual precipitation of 44.2 cm with 75% falling as rain, and an average frost free period of 106 days. January is the coldest month of the year with a mean temperature of -22.2°C, and the warmest month is July with a mean temperature of 16.3°C.

VEGETATION

This area is situated within the Mixedwood Section of the Boreal Forest Region (Rowe 1972). Some of the common plant species observed in association with different soils are listed in the Map Unit descriptions under the section entitled "Soils". The common and scientific names of these are as follows: aspen (Populus tremuloides), balsam poplar (Populus balsamifera), white birch (Betula papyrifera), white spruce (Picea glauca), balsam fir (Abies balsamea), jack pine (Pinus banksiana), black spruce (Picea mariana), willow (Salix sp.), alder (Alnus sp.), saskatoon-berry (Amelanchier alnifolia), blueberry (Vaccinium myrtilloides), bog cranberry (Vaccinium vitis-idaea var. minus), grass (various species), slough grass (Beckmannia syzigachne), common cattail (Typha latifolia), Labrador tea (Ledum groenlandicum), horsetail (Equisetum sp.), arrow-leaved coltsfoot (Petasites sagittatus), marsh marigold (Caltha palustris), sphagnum sp. and other mosses, reindeer lichen (Cladonia sp.).

SOILS

Ten Map Units were recognized in the mapped area. The soils of four of these belong to the Organic Order; the soils of three belong to the Luvisolic Order; and soils of the remaining three belong to the Brunisolic, Regosolic and Gleysolic Orders of the Canadian soil classification system (CDA 1974). The pertinent features of the various Map Units are summarized in Table 3.

Different Map Units are set up to indicate different soil series, different combinations of series or different soil associations (see pages 4 and 5). Justification for delineating the various Map Units is their differing properties that have significant

TABLE 3. KEY TO THE SOILS

Map Unit	Classification	Parent Material	Surface Texture	Slope (class & gradient)	Surface Stoniness	Drainage	Comments and Limitations
1	Orthic Gray Luvisol	moderately fine-textured till	L to SL	b,c,d,e,f (0.5+ to 30%)	1	well drained	occasional overlay of sandy loam to loamy sand-textured material; slight to severe limitations - excessive slope, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential, lack of Ah horizon.
2	Degraded Eutric Brunisol	sand overlying moderately fine-textured till	S	b,c,d (0.5+ to 9%)	0	sandy solum rapidly drained underlying till well to moderately well drained	perched water table common; slight to severe limitations - sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard, susceptibility to frost heave of subsoil, moderate shrink-swell potential of subsoil, lack of Ah horizon, thin deposit of sand.
3	Gleyed Regosol	beach sand	S	b,c,d (0.5+ to 9%)	0	imperfectly drained	water table common; slight to moderate limitations - seasonally high groundwater table, sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard, lack of Ah horizon.
4	Rego Gleysol	beach sand	S	b,c,d (0.5+ to 9%)	0	poorly drained	high water table; severe limitations - seasonally high groundwater table or surface ponding, sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard, lack of Ah horizon, excessive slope.
5	Gleyed Gray Luvisol	moderately fine-textured till	L to SL	b (0.5+ to 2%)	1	imperfectly drained	occasional overlay of sand, which is usually mottled; moderate to severe limitations - seasonally high groundwater table, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential, lack of Ah horizon.
6	Orthic Gray Luvisol - 70% Gleyed Gray Luvisol - 30%	moderately fine textured till	L to SL	c (2+ to 5%)	1	orthic subgroup - well drained, gleyed subgroup, imperfectly drained	gleyed soils occur in low areas, well drained soils on more elevated portions of landscape; occasional overlay of sandy loam to sand-textured material; slight to severe limitations - seasonally high groundwater table, excessive slope, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential, lack of Ah horizon.
M	undifferentiated Mesisol	moderately decomposed peat	organic	a (0 to 0.5%)	0	very poorly drained	severe limitations - organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential, lack of Ah horizon.
TM	Terric Mesisol	moderately decomposed peat overlying undifferentiated mineral material	organic	a (0 to 0.5%)	0	very poorly drained	severe limitations - organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential, lack of Ah horizon.
H	undifferentiated Humisol	highly decomposed peat	organic	a (0 to 0.5%)	0	very poorly drained	severe limitations - organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential, lack of Ah horizon.
TH	Terric Humisol	highly decomposed peat overlying undifferentiated mineral material	organic	a (0 to 0.5%)	0	very poorly drained	these soils are very wet, water table at or slightly below organic soil surface; severe limitations - organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential, lack of Ah horizon

effects on their suitabilities for different recreational or engineering uses. In the following soil descriptions, illustrations of the extreme variability commonly found in soils, can be seen by the wide variations in horizon thicknesses.

Common names are employed to list the dominant plant species. These are not intended as complete or exhaustive species lists.

Map Unit 1

Classification: Orthic Gray Luvisol .

Parent Material: moderately fine-textured till .

Slope: gently undulating to strongly rolling (0.5+ to 30%).

Surface Stoniness: slightly stony (1).

Drainage: well drained.

Vegetation: predominantly aspen with scattered white birch and balsam poplar, occasional small patches of white spruce. Some more extensive stands of white spruce occur on the north side of the lake, and occasional small patches of young balsam fir occur here as understory. Mature mixed forest occurs on the two islands within the mapped area, and it consists of white spruce, white birch and balsam fir.

Profile Description:

Orthic Gray Luvisol

Horizon	Thickness in	Thickness cm	Field Texture	Structure	Consistence
L-H	2-5	5-12.5	leaf litter		
Ae	2-5	5-12.5	L to SL	platy	very friable, moist
Bt1	15-25	38-63	C	coarse blocky	very firm, moist
Bt2	10-20	25-50	C	fine blocky	firm, moist
Cca	at 30-40	at 75-100	CL to C	amorphous, breaking to subangular blocky	very firm to firm, moist

Comments: An overlay of sandy loam to loamy sand-textured material (Ae horizon), 12 to 14 inches (30 to 35 cm) in thickness, is occasionally found and this is sometimes very stony (S3). Also, occasional small sand pockets are found in the B and C horizons.

Limitations: slight on suitable topography for camp and picnic areas, playing fields, paths and trails, buildings without basements and reservoir sites; moderate on suitable topography for lawns and landscaping, buildings with basements, septic tank absorption fields, sanitary landfills - trench type, road location and source of roadfill; poor source of topsoil; unsuitable as source of sand or gravel. Specific limitations include excessive slope, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential and lack of Ah horizon.

Map Unit 2

Classification: Degraded Eutric Brunisol

Parent Material: sand, overlying moderately fine-textured till.

Slope: gently undulating to gently rolling (0.5+ to 9%).

Surface Stoniness: stone-free (0).

Drainage: the sandy solum is rapidly drained, and the underlying till is well to moderately well drained.

Vegetation: sparse forest cover of aspen, and some jack pine; understory of grass, reindeer lichen, bog cranberry, blueberry and low-growing saskatoon-berry (1 to 2 feet or 30 to 60 cm in height).

Profile Description:

Degraded Eutric Brunisol

Horizon	Thickness in	cm	Field Texture	Structure	Consistence
L-H	1-1.5	2.5-4	leaf litter		
Ae	2-4	5-10	S	single grain	loose, moist
Bm	32-34	80-85	S	single grain	loose, moist
IICca	at 36	at 90	CL	amorphous	firm, moist

Comments: A perched water table is often found at a depth of about 30 inches (75 cm). Also, occasional pockets of gravel occur in the soil solum.

Limitations: slight for buildings without basements; moderate for camp and picnic areas, buildings with basements, road location and source of roadfill; severe for playing fields, paths and trails, lawns and landscaping, septic tank absorption fields, sanitary landfills - trench type and reservoir sites; unsuitable as source of topsoil; fair source of sand. Specific limitations include sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard, susceptibility of subsoil to frost heave, moderate shrink-swell potential of subsoil, lack of Ah horizon, and thin deposit of sand.

Map Unit 3

Classification: Gleyed Regosol.

Parent Material: beach sand .

Slope: gently undulating to gently rolling (0.5+ to 9%).

Surface Stoniness: stone-free (0).

Drainage: imperfectly drained.

Vegetation: aspen, white spruce, reindeer lichen.

Profile Description:

Gleyed Regosol

Horizon	Thickness in	cm	Field Texture	Structure	Consistence
L-H	2-5	5-12.5	leaf litter		
C	14-18	35-45	S	single grain	loose, moist
Cg	at14-18	at 35-45	S	single grain	loose, moist
	- continues to a depth of greater than 4 feet (1.2 m)				

Comments: A water table is often found at a depth of 30 inches (75 cm).

Limitations: slight for buildings without basements; moderate for camp and picnic areas, buildings with basements, road location and source of roadfill; unsuitable as source of topsoil; good source of sand. Specific limitations include seasonally high groundwater table, sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard and lack of Ah horizon.

Map Unit 4

Classification Rego Gleysol.

Parent Material: beach sand (sometimes gravelly).

Slope: gently undulating to gently rolling (0.5+ to 9%).

Surface Stoniness: stone-free (0).

Drainage: poorly drained.

Vegetation: willow, aspen, grass.

Profile Description:

Rego Gleysol

Horizon	Thickness in	cm	Field Texture	Structure	Consistence
L-H	2-3	5-7.5	leaf litter		
Cg	at surface		S	single grain	loose, moist
	- continues to a depth of greater than 4 feet (1.2 m).				

Comments: A water table occurs at a depth of 16 inches (41 cm) or less. Gravel is sometimes found at a depth of 20 inches.

Limitations: severe for all uses; unsuitable as a source of topsoil; poor source of sand. Specific limitations are seasonally high groundwater table or surface ponding, sandy surface texture, erosion hazard, shallow depth to sand, rapid permeability, groundwater contamination hazard, lack of Ah horizon and excessive slope.

Map Unit 5

Classification: Gleyed Gray Luvisol.

Parent Material: moderately fine-textured till.

Slope: gently undulating (0.5+ to 2%).

Surface Stoniness: slightly stony (1).

Drainage: imperfectly drained.

Vegetation: dominantly aspen; numerous patches of white spruce, balsam poplar and alder.

Profile Description:

Gleyed Gray Luvisol

Horizon	Thickness in	Thickness cm	Field Texture	Structure	Consistence
L-H	3-4	7.5-10	leaf litter		
Ae	2-5	5-12.5	L to SL	platy	very friable, moist
Btg	20-30	51-76	CL to C	subangular blocky	firm, moist
Ccag	at 24-32	at 61-81	CL	amorphous	firm to very firm, moist

Comments: A surface overlay of sand (Ae horizon), 10 to 30 inches (25 to 76 cm) in thickness, is occasionally found. This horizon is generally mottled, except for the uppermost 2 to 3 inches (5 to 7.5 cm).

Limitations: moderate for camp and picnic areas, playing fields, paths and trails, lawns and landscaping, buildings without basements, septic tank absorption fields, reservoir sites, road location and source of roadfill; severe for buildings with basements and sanitary landfills - trench type; poor source of topsoil; unsuitable as source of sand or gravel. Specific limitations are seasonally high groundwater table, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential and lack of Ah horizon.

Map Unit 6

Classification: Orthic Gray Luvisol - 70%
Gleyed Gray Luvisol - 30%

Parent Material: moderately fine-textured till.

Slope: undulating (2+ to 5%).

Surface Stoniness: slightly stony (1).

Drainage: Orthic subgroup - well drained.
Gleyed subgroup - imperfectly drained.

Vegetation: dominantly aspen, with patches of white spruce, balsam poplar, alder and scattered white birch.

Profile Description:

Orthic Gray Luvisol

Horizon	Thickness in	Thickness cm	Field Texture	Structure	Consistence
L-H	2-5	5-12.5	leaf litter		
Ae	2-5	5-12.5	L to SL	platy	very friable, moist
Bt1	15-25	38-63	C	coarse blocky	very firm, moist
Bt2	10-20	25-50	C	fine blocky	firm, moist
Cca	at 30-40	at 75-100	CL to C	amorphous, breaking to subangular blocky	very firm to firm, moist

Gleyed Gray Luvisol

Horizon	Thickness in	Thickness cm	Field Texture	Structure	Consistence
L-H	3-4	7.5-10	leaf litter		
Ae	2-5	5-12.5	L to SL	platy	very friable, moist
Btg	20-30	51-76	CL to C	subangular blocky	firm, moist
Ccag	at 24-32	at 61-81	CL	amorphous	firm to very firm, moist

Comments: Soils of the two subgroups comprising this Map Unit are randomly intermixed in areas of insufficient extent to delineate separately at the scale of mapping employed. The gleyed soils occur in the lower areas, while the well drained soils are found on the more elevated portions of the landscape.

A surface overlay of sandy loam to sand-textured material (Ae horizon), 10 to 30 inches (25 to 76 cm) in thickness, is occasionally found, and this is sometimes very stony (S3). In soils of the gleyed subgroup, this horizon is generally mottled, except for the uppermost 2 to 3 inches (5 to 7.5 cm). Also, occasional small sand pockets are found in the B and C horizons.

Limitations: slight to moderate on suitable topography for camp and picnic areas, playing fields, paths and trails, buildings without basements and reservoir sites; moderate on suitable topography for lawns and landscaping, septic tank absorption fields, road location and source of roadfill; moderate to severe for buildings with basements and sanitary landfills - trench type; poor source of topsoil; unsuitable as source of sand or gravel. Specific limitations include seasonally high groundwater table, excessive slope, high clay content of subsoil, moderate permeability, susceptibility to frost heave, moderate shrink-swell potential and lack of Ah horizon.

M (Organic soil)

Classification: undifferentiated Mesisol.

Parent Material: moderately decomposed peat.

Slope: nearly level (0 to 0.5%).

Surface Stoniness: stone-free (0).

Drainage: very poorly drained.

Vegetation: black spruce, Labrador tea, sphagnum moss, patches of reindeer lichen.

Profile Description:

Mesisol

Horizon	Thickness in	Thickness cm	Horizon Description
Of	12-18	30-46	undecomposed peat
Om	32-36	81-101	semidecomposed peat
Oh	at 44-54	at 112-137	highly decomposed peat

Limitations: severe for all uses; unsuitable as source of topsoil, sand or gravel. Specific limitations include organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential and lack of Al horizon.

TM (Organic soil)

Classification: Terric Mesisol

Parent Material: moderately decomposed peat overlying undifferentiated mineral material.

Slope: nearly level (0 to 0.5%).

Surface Stoniness: stone-free (0).

Drainage: very poorly drained.

Vegetation: black spruce, Labrador tea, slough grass, horsetail, some willow.

Profile Description:

Terric Mesisol

Horizon	Thickness in	cm	Horizon Description
Of	6	15	undecomposed peat
Om	32	81	semidecomposed peat
Oh	6	15	highly decomposed peat
IIC	at 44	at 112	undifferentiated mineral material

Comments: It may be assumed that the mineral material underlying the organic soil has properties similar to those of the parent material of adjacent mineral soils.

Limitations: severe for all uses; unsuitable as a source of topsoil, sand or gravel. Specific limitations include organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential and lack of Ah horizon.

H (Organic soil)

Classification: undifferentiated Humisol.

Parent Material: highly decomposed peat.

Slope: nearly level (0 to 0.5%).

Surface Stoniness: stone-free (0).

Drainage: very poorly drained.

Vegetation: alder, grass, horsetail, mosses, arrow-leaved coltsfoot, marsh marigold; patches of white spruce, white birch and Labrador tea.

Profile Description:

Humisol

Horizon	Thickness in	cm	Horizon Description
Oh	more than 54	more than 137	highly decomposed peat.

Limitations: severe for all uses; unsuitable as a source of topsoil, sand or gravel. Specific limitations include organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential and lack of Ah horizon.

TH (Organic soil)

Classification: Terric Humisol.

Parent Material: highly decomposed peat overlying undifferentiated mineral material.

Slope: nearly level (0 to 0.5%).

Surface Stoniness: stone-free (0).

Drainage: very poorly drained.

Vegetation: predominantly slough grass; scattered clumps of willow, alder, marsh marigold and arrow-leaved coltsfoot.

Profile Description:

Terric Humisol

Horizon	Thickness in	cm	Horizon Description
Oh	20-40	51-102	highly decomposed peat
IIC	at 20-40	at 51-102	undifferentiated mineral material

Comments: These soil areas are very wet, with the water table commonly found at or slightly below the organic soil surface. Near the boundaries of the Terric Humisol soil areas, the thickness of organic material overlying mineral material is often less than 16 inches (40 cm). These soils are classified as Gleysols - peaty phase.

It may be assumed that the mineral material underlying the organic soil has properties similar to the parent material of adjacent mineral soils.

Limitations: severe for all uses; unsuitable as a source of topsoil, sand or gravel. Specific limitations include organic soil, seasonally high groundwater table, groundwater contamination hazard, high shrink-swell potential and lack of Ah horizon.

MISCELLANEOUS LAND TYPES

(1)  This symbol indicates marshy areas. They are generally inundated, and are characterized by the growth of hydrophytic vegetation such as sedge, cattail, slough grass, willow and others. The limitations are severe for all uses because of the extreme wetness.

(2)  This symbol indicates escarpments. They have severe limitations for all uses because of extreme slopes.

SOIL INTERPRETATIONS

Soil interpretations are predictions of soil performance under different uses, not recommendations for land use (Greenlee 1974). They do not eliminate the need for land use planning; rather they are valuable tools that can be used to assist the planner. They indicate limitations and suitabilities of the various kinds of soil for any particular use. The planner can then predict the type and degree of problem likely to be encountered, and plan the kind and amount of on-site investigation needed to determine corrective measures. However the actual number of on-site investigations can be reduced considerably by the use of a soil survey map.

Using the basic soil survey data of an area, it is possible to make soil performance predictions, based on soil morphology and the associated soil physical and chemical properties. Soils in the provincial parks are used mainly for recreational pursuits, and as construction.materials.

In the mapped area, the soils most suitable for recreational development are those of Map Units 1 and 6. They have moderate limitations for lawns and landscaping due to the lack of Ah horizons; and for various construction purposes due to high clay content of the subsoils, moderate permeability, susceptibility to frost heave and moderate shrink-swell potential. Excessive slope is also a limiting factor in some locations. Similar limitations affect Map Unit 5 soils, as well as the added factor of seasonally high groundwater tables. This is considered a severe limitation for buildings with basements and sanitary landfills - trench type. The soils of Map Units 2 and 3 have moderate to severe limitations for most uses due to sandy surface textures, erosion hazard, shallow depths to sand, rapid permeabilities (droughtiness) and groundwater contamination hazard. Also, seasonally high groundwater tables pose further limitations to Map Unit 3 soils for some uses. Map unit 4 soils have severe limitations for all uses, due to seasonally high groundwater tables or surface ponding. The Organic soils also have severe limitations for all uses, mainly because of their excessive wetness. Other limitations include high shrink-swell potential, groundwater contamination hazard and lack of Ah horizon. Severe limitations of soils for recreational development and construction purposes don't necessarily prevent their use. However, these limitations result in higher costs of development than would be incurred if more suitable soils were used. Careful construction and conservation practices are required.

Sources of topsoil and gravel were not found in the mapped area. Map Unit 3 soils could constitute a good source of sand, but the extent of these soils is limited. Larger areas of Map Unit 2 soils are present, but the sand deposits are thin. Map Unit 4 soils constitute a poor source of sand due to wetness, and their limited extent.

The limitations and suitabilities of the various soils for selected uses are shown in Table 4. The ratings were determined on the basis of soil morphological, physical, and chemical properties, as well as steepness of slope. The principal limiting properties are indicated by numerals which correspond to those listed beneath the table. The limiting properties are generally listed in decreasing order of importance in the table.

In Table 4, the soil limitations for various uses have been designated as slight (S), moderate (M), and severe (V). As a source of topsoil or as a source of sand and gravel the soils are simply rated as good (G), fair (F), poor (P), and unsuitable (U).

Map[2] Symbol	Limitations For: Camp Areas	Picnic Areas	Playing Fields	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Ab-sorption Fields	Sanitary Landfills-Trench Type	Reservoir Sites	Road Location & Source of Roadfill	Suitability as a Source of: Topsoil[1]	Sa o Gra
1/b1	S	S	S	S	M18	M14	S	M10	M7[3]	S	M22,14	U	U
1/c1	S	S	M3	S	M18	M14	S	M10	M7[3]	M3	M22,14	U	U
1/d1	S	S	V3	S	M18	M14	S	M10	M7[3]	M3	M22,14	U	U
1/e1	M3	M3	V3	S	M18,3	M14,3	M3	M10,3	M7[3]	V3	M22,14	U	U
1/f1	V3	V3	V3	M3	V3,18	V3,14	V3	V3,10	M7,3[3]	V3	V3,22,14	U	U
2/b0	M5,25	M5,25	V8,5, 25	V5,25	V8,9,5	M14	S	V8,9,12	V8,9,12	V8,9	M14,22	U	F2
2/c0	M5,25	M5,25	V8,5, 25	V5,25	V8,9,5	M14	S	V8,9,12	V8,9,12	V8,9	M14,22	U	F2
2/d0	M5,25	M5,25	V8,3,5	V5,25	V8,9,5	M14	S	V8,9,12	V8,9,12	V8,9,3	M14,22	U	F2
3/b0	M5,25, 2	M5,25	V8,5, 25	V5,25	V8,9,5	M2	S	V9,2,12	V9,2,12	V8,9,2	M2	U	G
3/d0	M5,25, 2	M5,25	V8,3,5	V5,25	V8,9,5	M2	S	V9,2,12	V9,2,12	V8,9,2	M2	U	G
4/b0	V2,5, 25	V2,5,25	V2,8,5	V2,5, 25	V2,5,18	V2	V2	V2,9,12	V2,9,12	V8,9,2	V2	U	P2
4/d0	V2,5, 25	V2,5,25	V2,8,3	V2,5, 25	V2,5,18	V2	V2	V2,9,12	V2,9,12	V8,9,2	V2	U	P2
5/b1	M2	M2	M2	M2	M2,18	V2,14	M2	M2,10	M2,7	M2	M2,22,14	U	U
6[4]/c1	S	S	M3	S	M18	M14	S	M10	M7[3]	M3	M22,14	U	U

Legend: S – none to slight, M – moderate, V – severe, G – good, F – fair, P – poor, U – unsuitable

1 Topsoil being considered here is Ah horizon or its equivalent (see Glossary)

2 Example: Map unit ⟶ 6
topography ⟶ d 3 ⟵ surface stoniness

Note: for definitions, see section entitled "General Discussion of Soil Map"

3 Probably moderate to 12 feet.

4 These ratings are for soils of the Orthic subgroup which comprise 70% of Map Unit 6. Soils of the Gleyed subgroup, which comprise 30%, are rated the same as Map Unit 5 soils.

LIMITING SOIL PROPERTIES AND HAZARDS

1. Flooding hazard (overflow)
2. Seasonally High Groundwater Table or Surface Ponding
3. Excessive slope
4. Surface Stoniness
5. Sandy Surface Texture
6. Slippery or Sticky When Wet
7. High Clay Content
8. Shallow Depth to Sand or Gravel
9. Rapid Permeability (Droughtiness)
10. Moderate Permeability
11. Slow Permeability
12. Groundwater Contamination Hazard
13. High Shrink-Swell Potential
14. Susceptibility to Frost Heave
15. Surface Soil Salinity
16. High Lime Content (Soil Nutrient Imbalance)
17. Shallow Depth to Bedrock
18. Thin Ah Horizon
19. Organic Soil
20. Organic Surface Layer More Than 6 Inches Thick
21. Thick Overburden above Gravel or Sand
22. Moderate Shrink-Swell Potential
23. Possible Concrete Corrosion Hazard (Soluble Sulphate)
24. Thin Deposit of Sand or Gravel
25. Erosion Hazard
26. Solonetzic Soil
27. Excessive Coarse Fragments

Map[2] Symbol	Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Playing Fields	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Ab-sorption Fields	Sanitary Landfills-Trench Type	Reservoir Sites	Road Location & Source of Roadfill	Topsoil[1]	Sand or Grav
M	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2, 13	V19,2,12	V19,2, 12	V19,2	V19,2,13	U	U
TM	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2, 13	V19,2,12	V19,2, 12	V19,2	V19,2,13	U	U
H	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2, 13	V19,2,12	V19,2, 12	V19,2	V19,2,13	U	U
TH	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2, 13	V19,2,12	V19,2, 12	V19,2	V19,2,13	U	U

Legend: S - none to slight, M - moderate, V - severe, G - good, F - fair, P - poor, U - unsuitable

[1] Topsoil being considered here is Ah horizon or its equivalent (see Glossary)

[2] Example: Map unit → 6
topography → d 3 ← surface stoniness

Note: for definitions, see section entitled "General Discussion of Soil Map"

LIMITING SOIL PROPERTIES AND HAZARDS

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APPENDIX

Chemical Analyses of the Soils

The chemical analyses carried out on representative soil samples are presented in Table 5. The samples analyzed are surface and subsoil samples, taken of the Map Units at representative sites. Surface samples are taken from the 0 to 6 inch depth, and the subsoil samples from the 6 to 12 inch depth. Each surface sample consists of five separate samples taken at random locations and bunched together into one composite sample. A brief explanation of the significance of each chemical analysis follows.

1. Nitrogen.

Plant growth in regions where rainfall is adequate is determined more by soil nitrogen than by any other mineral element supplied by the soil (USDA 1957). Nitrogen is of special importance because plants need it in rather large amounts and it is easily lost from the soil.

Soil nitrogen can be markedly affected by climatic conditions, native vegetation, and soil texture.

In humid areas, where forests predominate, the higher rainfall causes much leaching and the removal of most soil nitrogen from upper horizons. In contrast, in areas of somewhat limited rainfall where grass predominates, much more nitrogen remains near the soil surface.

A clay or clay loam soil commonly contains two to three times as much nitrogen as does a very sandy soil under the same type of climatic conditions. Poorer aeration and less leaching favour the retention of nitrogen in the finer textured soils.

In general, low soil nitrogen levels will likely occur in virgin soils, in soils low in organic matter, and in soils that are cold or poorly drained.

General soil test ratings for supplies of available nitrogen, expressed in pounds per acre, are: low, zero to 20; medium, 21 to 50; and high 51 or more.[1]

The primary natural source of soil nitrogen is air. Important artificial sources are fertilizers, animal manures, green manures, and various crop residues.

[1] Alberta Soil and Feed Testing Laboratory

TABLE 5. CHEMICAL ANALYSES OF SELECTED MAP UNITS *

Map Unit	Sample Depth (in.)	Pounds per Acre			Sodium**	Sulphur**	Soil Reaction (pH)	Cond. (mmhos/cm.)	Organic Matter**	REMARKS
		Nitrogen (N)	Phosphorus (P)	Potassium (K)						
1	0-6	1	241	390	L-	M-	5.6	0.2	L	aspen forest
1	6-12	0	95	400	L-	L-	5.6	0.2	L	
2	0-6	0	246	245	L-	L-	5.1	0.1	L-	blueberry, grass; sparse aspen and white spruce
2	6-12	0	247	270	L-	L-	4.9	0.1	L-	
3	0-6	0	65	110	L-	L+	4.6	0.2	L-	grass, blueberry, shrubs; sparse white birch, white spruce, aspen
3	6-12	0	13	25	L-	L-	4.1	0.1	L-	
5	0-6	1	42	365	L-	L+	6.6	0.2	L	white spruce, balsam poplar, alder
5	6-12	1	6	250	L-	-	6.7	0.2	L	

* Chemical Analyses done by Alberta Soil and Feed Testing Laboratory.

** These tests are rated into four categories: high (H), medium (M), low (L), and none (-). The degree within each category is indicated by a plus or minus sign. The tests for organic matter are estimates only.

2. Phosphorus.

Phosphorus is present in all living tissue. It is particularly concentrated in the younger parts of the plant, and in the flowers and seed (USDA 1957). As phosphorus does not move appreciably in the soil, accumulations are found primarily in the first foot of soil.

Most of the total phosphorus supply is tied up chemically in a form that is not usable by plants; it is not available to the growing plant. The available soil phosphorus originates from the breakdown of soil minerals and soil organic matter or from the addition of phosphate fertilizer. The available soil phosphorus is usually only about 1% of the total soil phosphorus.

Soil tests show that a majority of Alberta soils are low in available phosphorus.[1] Plants respond markedly to phosphate fertilizer on deficient soils.

General soil test ratings for supplies of available phosphorus, expressed in pounds per acre, are: low, zero to 30; medium, 31 to 70; and high, 71 or more.

3. Potassium.

Plants need large amounts of potassium, one of the three major plant nutrients (USDA 1957). It is supplied to roots by soil minerals, artificial fertilizers, manures and crop residues.

Most Alberta soils contain adequate amounts of potassium.[1] Deficiencies occur most frequently in peat soils or poorly drained soils.

General soil test ratings for supplies of available potassium, expressed in pounds per acre, are: low, zero to 150; medium, 151 to 300; and high, 301 or more.

4. Sulphur.

Sulphur is essential to life (USDA 1957). Many plants use about as much sulphur as they do phosphorus. Plants obtain sulphur from the soil, rain and irrigation water, artificial fertilizers, and the atmosphere.

General soil test ratings for supplies of available sulphur are: low (L), medium (M), high (H), and none (nil). The degree within each category is indicated by a + or - sign.[1]

1 [illegible]

The soil test determines whether adequate amounts of sulphur are available for normal plant growth. Where the sulphur test is low, a sulphur containing fertilizer should be applied; where it is medium, a field test using sulphur and non-sulphur fertilizers should be conducted. Plant responses to sulphur fertilizer can vary considerably within very small areas.

5. Soil Reaction (pH).

This test measures soil acidity or alkalinity. Acid soils have pH values of less than 6.6; decreasing pH values indicating soil acidity. Neutral soils have pH values of 6.6 to 7.3; alkaline soils have pH values of more than 7.3. Increasing pH values indicate increasing soil alkalinity.

The best pH range for most crops in Alberta is 5.5 to 7.5.[1]

6. Soil Salinity and Conductivity Test.

Conductivity is a measure of the total soluble salt concentration in a soil. Soluble salts are present in soils at all times; however, when the salt concentration is high, plant growth is reduced and the soil is considered "saline". Sulphates and sodium are determined to identify specific salts commonly causing salinity.

In general, lawn growth is affected on soils having conductivity readings as follows:[1]

0 to 1, negligible salt effects

1.1 to 3, lawn growth noticeably restricted

3.1 or more, lawn growth considerably restricted.

The sulphate and sodium tests are rated in four categories: high (H), medium (M), low (L), and none (nil). The degree within each category is indicated by a + or - sign.

A high sodium test may indicate a solonetzic soil which is characterized by poor physical structure and requires special management. A high sulphate test may indicate a hazard of sulphate attack on concrete, indicating a need for sulphate resistant concrete to be used in constructing foundations and underground conduits.

1 Alberta Soil and Feed Testing Laboratory

7. Organic Matter and Free Lime.

These tests are visual estimates of the amounts contained in soil samples. Results are rated into four categories: high (H), medium (M), low (L), and none (nil). The degree within each category is indicated by a + or - sign.

Organic matter influences physical and chemical properties of soils far out of proportion to the small quantities contained therein (Brady 1974). It commonly accounts for at least half the cation exchange capacity of soils and is responsible, perhaps more than any other single factor, for the stability of soil aggregates. Furthermore, it supplies energy and body building constituents for the soil micro-organisms.

Free lime is present in some soils and may reduce nutrient availability to plants in the following ways:

(a) Deficiencies of available iron, manganese, copper or zinc may be induced.

(b) Phosphate availability may decrease due to the formation of complex and insoluble calcium phosphates.

(c) The uptake and utilization of boron may be hindered.

(d) The high pH, in itself, may be detrimental.

Free lime cannot be readily removed from the soil. The only practical way to counteract its effect is to increase soil organic matter content.

Engineering Properties of the Soils

Engineering test data determined on a representative soil sample are presented in Table 6. The sample analyzed was taken from the subsoil of Map Unit 1 at a representative site. Depth of sampling was between 4 and 5 feet below the surface. A brief description of the significance of each analytical parameter follows:

1. Field Moisture Percentage.

This is a determination of the natural moisture content of the soil as it occurs in the field.

For any potential borrow material, it is essential to know in advance of construction whether, for the compaction procedure likely to be specified, the

TABLE 6. PHYSICAL ANALYSES OF SELECTED MAP UNITS *

Map Unit	Depth (feet)	Field moisture (%)	Mechanical Analysis: Percentage Passing Sieve: 1 inch	3/4 inch	5/8 inch	#4 (4.7 mm.)	#10 (2.0 mm.)	#40 (0.42 mm.)	#200 (0.074 mm.)	Percentage Smaller than: 0.05 mm.	0.005 mm.	0.002 mm.	0.001 mm.	Liquid Limit	Plasticity Index	Optimum Moisture % **	Maximum Dry Density lb/ft^3 **	Classification: AASHO	Unified	USDA
1	4-5	12	100	100	100	99	98	89	64	63	40	30	23	32	14	17	107.5	A-6 (8)	CL	CL

* Map Units developed on similar parent material: 1, 5 and 6.

** These values are obtained from charts worked out by the Highways Testing Laboratory, Alberta Department of Highways.

moisture content in the field is excessive or deficient with respect to the optimum value for that procedure (Terzaghi and Peck 1967).

2. Particle Size Analysis.

The particle size distribution within a soil is determined by laboratory tests, usually referred to as the particle size analysis of the soil (PCA 1962). The amounts of the gravel and sand fractions are determined by sieving, while the silt and clay contents are determined by sedimentation techniques. The amount of each soil separate contained in a soil determines its texture.

Where soil texture is known, approximations and estimates can be made of soil properties, such as permeability, water holding capacity, shrink-swell potential, bearing value, susceptibility to frost heave, adaptability to soil cement construction, etc.

3. Plasticity.

In soil mechanics, plasticity is defined as that property of a material which allows it to be deformed rapidly, without rupture, without elastic rebound, and without volume change (Means and Parcher 1964).

Tests have been devised to determine the moisture content of a soil at which it changes from one major physical condition to another (PCA 1962). These tests, conducted on the material passing the number 40 sieve (0.42 mm), have been used as key factors in classifying soils for structural purposes.

The tests used for estimating plasticity are plastic limit, liquid limit, and plasticity index. The plastic limit is the moisture content at which the soil passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid and plastic limits. This parameter gives the range in moisture content at which a soil is in a plastic condition. A small plasticity index, such as 5, indicates that a small change in moisture content will change the soil from a semisolid to a liquid condition. A large plasticity index, such as 20, shows that a considerable amount of water can be added before a soil changes to a liquid condition.

4. Moisture - Density Relationships.

The purpose of every laboratory compaction test is to determine a moisture density curve comparable to that for the same material when compacted in the field by means of the equipment and procedures likely to be used (Terzaghi and Peck 1967). Most of the current methods are derived from the procedure known as the "Standard Proctor Test". The "optimum moisture content", according to the Standard Proctor Test, is the water content at which the dry density is a maximum ("maximum dry density").

5. Soil Classification.

In order that soils may be evaluated, it is necessary to devise systems or methods for identifying soils with similar properties and then to follow this identification with a grouping or classification of soils that perform in a similar manner when their densities, moisture contents, textures, etc., are similar (PCA 1962). A brief description of three widely used soil classification systems follows:

(a) AASHO Soil Classification System.

The American Association of State Highway Officials system is an engineering property classification based on field performance of highways. In the AASHO system, soil material is classified into seven basic groups with each group having about the same general load carrying capacity and service. The groups are designated A-1 to A-7; the best soils for road subgrades are classified as A-1, the next best A-2, etc., with the poorest soils being classified as A-7 .

These seven basic groups are further divided into subgroups with a group index that was devised to approximate within group evaluations. Group indexes range from 0 for the best subgrades, to 20 for the poorest.

(b) Unified Soil Classification System.

In this system, the soils are identified according to their textures and plasticities, and are grouped according to their performance as engineering construction materials. Soil materials are divided into coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils are subdivided into eight classes; the fine grained soils into six classes; and there is one class of highly organic soils.

Coarse grained soils are those that have 50% or less of material passing the number 200 sieve; fine grained soils have more than 50% of material passing the number 200 sieve. The letters G, S, C, M, and O stand for gravel, sand, clay, silt, and organic materials respectively. The highly organic soils are designated by the symbol "pt". Additional letters used in the secondary divisions of the fine grained soils are L and H, meaning relatively low liquid limit and relatively high liquid limit, respectively.

The designation CL for example, indicates inorganic clays of low to medium plasticity; SW indicates well graded sands; and SC indicates clayey sands and sand-clay mixtures.

(c) United States Department of Agriculture Soil Classification System.

The system of textural soil classification, used by Canadian soil scientists, is known as the USDA system. It is defined under "soil texture" in the glossary. There is some variation in the particle size limits between the USDA system and the two engineering systems just described, but the differences are not great. A comparison of the different systems is given in the PCA Soil Primer (1962).

GLOSSARY

adsorption complex - The group of substances in the soil capable of adsorbing water and nutrients.

aeration, soil - The process by which air in the soil is replaced by air from the atmosphere.

aggregate, soil - A group of soil particles cohering so as to behave mechanically as a unit.

available nutrient - That portion of any element or compound in the soil that can readily be absorbed and assimilated by growing plants.

base saturation percentage - The extent to which the adsorption complex of a soil is saturated with exchangeable cations other than hydrogen and aluminum.

beach - The relatively thick and temporary accumulation of loose water-borne material (usually well sorted sand and pebbles accompanied by mud, cobbles, boulders, and smoothed rock and shell fragments) that is in active transit or deposited between the limits of low and high water along the shore of a body of water.

Brunisolic - An order of soils whose horizons are developed sufficiently to exclude the soils from the Regosolic order, but that lack the degrees or kinds of horizon development specified for soils of the other orders. These soils, which occur under a wide variety of climatic and vegetative conditions, all have Bm or Btj horizons.

cation - An ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium and hydrogen.

cation exchange - The interchange between a cation in solution and another on the surface of any surface-active material such as clay or organic matter.

cation exchange capacity - The total amount of exchangeable cations that a soil can adsorb.

consistence, soil - (1) The resistance of a material to deformation or rupture.
(2) The degree of cohesion or adhesion of the soil mass. Terms used for describing consistence at various soil moisture contents are:

firm - Consistence at which moist soil material crushes under moderate pressure between the thumb and forefinger, but resistance is distinctly noticeable.

loose - Consistence at which dry or moist soil material is noncoherent.

very firm - Consistence at which moist soil material is crushable between the thumb and forefinger, but strong pressure is required.

very friable - Consistence at which moist soil material is crushed under very gentle pressure, but coheres when pressed together.

degraded - A leached and weathered state of a soil, usually indicated by morphological features such as an eluviated, light colored A (Ae) horizon.

drainage - The removal of excess surface water or groundwater from land by natural runoff and percolation, or by means of surface or subsurface drains.

eluvial horizon - A soil horizon that has been formed by the process of eluviation.

eluviation - The transportation of soil material in suspension or in solution within the soil by the downward or lateral movement of water.

Eutric Brunisol - A great group of soils in the Brunisolic order. The soils may have mull Ah horizons less than 5 cm (2 inches) thick, and they have Bm horizons in which the base saturation (NaCl) is 100%.

fibric horizon - A horizon composed of organic soil material containing large amounts of weakly decomposed fiber whose botanical origin is readily identifiable.

frost free period - The period or season of the year between the last spring frost and the first autumn frost.

gleyed soil - Soil affected by a soil-forming process, operating under poor drainage conditions, which results in the reduction of iron and other elements; and in gray colors, and mottles.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have dull colors, or prominent mottling, or both, in some horizons.

gravel - Rock fragments 2 mm to 7.5 cm (3 inches) in diameter.

Gray Luvisol - A great group of soils in the Luvisolic order occurring in moderately cool climates, where the mean annual temperature is usually lower than 5.5°C (42° F). The soils have developed under deciduous and coniferous forest cover, and have an eluviated light colored surface (Ae) horizon, a brownish illuvial B (Bt) horizon, and usually a calcareous C horizon. The solum is base saturated (NaCl extraction). The Ahe horizon, if present, is less than 5 cm (2 inches) thick.

great group - A category in the Canadian system of soil classification. It is a taxonomic grouping of soils having certain morphological features in common and a similar pedogenic environment.

green manure - Plant material incorporated into the soil to improve it, while the plant material is still green.

horizon, soil - A layer of mineral or organic soil or soil material, approximately parallel to the land surface with characteristics affected by processes of soil formation. It differs from adjacent layers in properties such as color, structure, texture, consistence; and chemical, biological and mineralogical composition. A list of the designations and some of the properties of soil horizons and layers follows.

Mineral horizons and layers contain less than 17% organic carbon (about 30% organic matter) by weight.

A - This is a mineral horizon formed at or near the surface, in the zone of leaching or eluviation of materials in solution or suspension, or of maximum in situ accumulation of organic matter, or both.

B - This is a mineral horizon characterized by enrichment in organic matter, sesquioxides or clay; by the development of soil structure; or by a change in color denoting hydrolysis, reduction or oxidation.

C - This is a mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, except gleying; and the accumulation of calcium and magnesium carbonates, and more soluble salts.

Roman numerals are prefixed to horizon and layer designations to indicate parent material discontinuities in the profile. Roman numeral I is understood for the uppermost material, and therefore is not written. Subsequently contrasting materials are numbered consecutively in the order in which they are encountered downward, that is, II, III and so on.

For transitional horizons, designations such as AB or BC are used if the transition is gradual; and A and B or B and C if the horizons are interfingered. Dominance of horizons may be shown by order, such as AB or BA, etc.

Organic horizons contain more than 17% organic carbon (approximately 30% organic matter) by weight. Two groups are recognized; O horizons; and L, F and H horizons.

O - This is an organic horizon developed mainly from mosses, rushes and woody materials. It is divided into the following sub-horizons:

Of - This is the least decomposed organic horizon, consisting dominantly of well-preserved fibers that are readily identifiable as to botanical origin, and called the fibric horizon.

Om - This is an organic horizon at a stage of decomposition intermediate between fibric and humic materials, and called the mesic horizon. The material is partly altered both physically and biochemically.

Oh - This is the most decomposed organic horizon, containing the lowest amount of raw fiber and called the humic horizon.

L, F and H (commonly abbreviated to L-H) - These are organic horizons developed primarily from the accumulation of leaves, twigs and woody materials with or without a minor component of mosses.

L - The original structures of the organic material are easily discernible.

F - The accumulated organic material is partly decomposed, and some of the original structures are difficult to recognize.

H - An accumulation of decomposed organic material in which the original structures are indiscernible.

Lowercase Suffixes - These are used to designate subhorizons of the major horizons.

ca - A horizon of secondary carbonate enrichment in which the concentration of lime exceeds that in the unenriched parent material.

e - An A horizon characterized by the eluviation of clay, iron, aluminum or organic matter alone or in combination, and usually lighter colored when dry than an underlying B horizon.

g - A horizon characterized by gray colors, or prominent mottling, or both; indicative of permanent or periodic intense reduction.

m - A B horizon slightly altered by hydrolysis, oxidation, solution or all three; to give a change in color, structure or both.

t - A B horizon enriched with silicate clay.

humic horizon - A horizon of highly decomposed organic soil material containing little fiber.

Humisol - A great group of soils in the Organic order that are saturated for most of the year. The diagnostic layer is composed dominantly of humic material.

humus - (1) The fraction of the soil organic matter that remains after most of the added plant and animal residues have decomposed. It is usually dark colored. (2) Humus is also used in a broader sense to designate the humus forms referred to as forest humus. (3) All the dead organic material on and in the soil that undergoes continuous breakdown, change and synthesis.

hydrophyte - A plant that grows in water, or in wet or saturated soils.

illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension as a layer of accumulation.

leaching - The downward movement within the soil of materials in solution.

lime (in soil) - A soil constituent consisting principally of calcium carbonate; and including magnesium carbonate, and perhaps the oxide and hydroxide of calcium and magnesium.

Luvisolic - An order of soils that have eluvial (Ae) horizons, and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils have developed under forest or forest-grassland transition in a moderate to cool climate.

mesic horizon - An organic horizon at a stage of decomposition between that of the fibric and humic horizons.

Mesisol - A great group of soils in the Organic order that are saturated for most of the year. The diagnostic layer is composed dominantly of mesic material.

morphology, soil - The physical constitution, particularly the structural properties, of a soil profile as exhibited by the kinds, thickness and arrangement of the horizons in the profile; and by the texture, structure, consistence and porosity of each horizon.

mottling - Spotting or blotching of different color or shades of color interspersed with the dominant color.

order, soil - A category in the Canadian system of soil classification. All the soils within an order have one or more characteristics in common.

Organic - An order of soils that have developed dominantly from organic deposits. The majority are saturated for most of the year unless artificially drained.

orthic - A subgroup referring to the modal or central concept of various great groups in the Brunisolic, Chernozemic, Cryosolic, Gleysolic, Luvisolic, Podzolic, and Regosolic orders of the Canadian system of soil classification.

particle size distribution - The amounts of the various soil separates in a soil sample, usually expressed as weight percentages.

peat - Unconsolidated soil material consisting largely of undecomposed, or only slighly decomposed, organic matter.

peaty phase (of soil) - Any mineral soil having a surface horizon of 15 to 60 cm (6 to 24 inches) of fibric moss peat or 15 to 40 cm (6 to 16 inches) of other kinds of peat.

ped, soil - A unit of soil structure such as a prism, block or granule, which is formed by natural processes.

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

rego - A subgroup referring to soils that lack a B horizon, in various great groups of the Chernozemic and Gleysolic orders in the Canadian system of soil classification.

Regosolic - An order of soils having no horizon development, or development of the A and B horizons insufficient to meet the requirements of the other orders.

separates, soil - Mineral particles, less than 2.0 mm in equivalent diameter, ranging between specified size limits. The names and size limits of separates recognized by soil pedologists in Canada and the United States are: very coarse sand, 2.0 to 1.0 mm; coarse sand, 1.0 to 0.5 mm; medium sand, 0.5 to 0.25 mm; fine sand, 0.25 to 0.10 mm; very fine sand, 0.10 to 0.05 mm; silt, 0.05 to 002 mm; and clay, less than 0.002 mm.

soil - The naturally occurring, unconsolidated mineral or organic material, at least 10 cm (4 inches) thick, that occurs on the earth's surface and is capable of supporting plant growth.

structure, soil - The combination or arrangement of primary soil particles into secondary particles, units or peds. The peds are characterized and classified on the basis of type (amorphous, blocky, columnar, etc.), class or size (fine, medium, coarse, very coarse) and grade or distinctness (weak, moderate, strong). The types of soil structure are described as follows:

amorphous (massive) - A coherent mass showing no evidence of any distinct arrangement of soil particles.

blocky (angular blocky) - Soil particles are arranged around a point and bounded by flat surfaces, faces rectangular, vertices sharply angular.

platy - Soil particles are arranged around a horizontal plane and generally bounded by relatively flat horizontal surfaces, horizontal planes more or less developed.

single grain - Loose, incoherent mass of individual particles, as in sands.

subangular blocky - Soil particles are arranged around a point and bounded by flat surfaces, faces subrectangular, vertices mostly oblique or subrounded.

subgroup, soil - A category in the Canadian system of soil classification. These soils are subdivisions of the great groups, and therefore each soil is defined more specifically.

subsoil - The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow.

terric layer - An unconsolidated mineral substratum underlying organic soil material.

till - Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel and boulders intermingled in any proportion.

topography - The physical features of a district or region, such as those represented on a map, taken collectively; especially the relief and contours of the land.

water table - The upper surface of groundwater or that level below which the soil is saturated with water.

SOILS MAP OF AREA ADJACENT TO PINEHURST LAKE, ALBERTA

Tp. 65, R. 9-10, W. 4th

Soil Classification:

MAP UNIT	SOIL ORDER	SOIL SUBGROUP	SOIL PARENT MATERIAL
1	Luvisolic	Orthic Gray Luvisol	moderately fine-textured till
2	Brunisolic	Degraded Eutric Brunisol	sand overlying moderately fine textured till
3	Regosolic	Gleyed Regosol	beach sand
4	Gleysolic	Rego Gleysol	beach sand
5	Luvisolic	Gleyed Gray Luvisol	moderately fine textured till
6	Luvisolic	Orthic Gray Luvisol - 70% Gleyed Gray Luvisol - 30%	moderately fine textured till
M	Organic	undifferentiated Mesisol	moderately decomposed peat
T M	Organic	Terric Mesisol	moderately decomposed peat overlying undifferentiated mineral material
H	Organic	undifferentiated Humisol	highly decomposed peat
T H	Organic	Terric Humisol	highly decomposed peat overlying undifferentiated mineral material

LEGEND:

- marshy area
- escarpment
- soil line
- boundary of mapped area
- Ω open water

Map Symbol

1 ← map unit
d 1 ← surface stoniness rating
← topographic class

APPROXIMATE SCALE:

660 0 660 1320 1980 Feet

Compiled from uncontrolled mosaic

Mapped and Compiled by:
G. M. Greenlee, P. Ag.
Soils Division
1977

Alberta RESEARCH COUNCIL

1977-12