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SOIL SURVEY OF BUCK LAKE STUDY AREA AND INTERPRETATION FOR RECREATIONAL USE

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PREFACE

This report is one of a series describing detailed, semi-detailed, and reconnaissance soil surveys which have been conducted in Alberta provincial parks and recreation areas. As well as the Buck Lake study area, soil surveys were conducted in the Dillberry Lake Provincial Park Study area southeast of Chauvin, and Midland Provincial Park west of Drumheller during the summer of 1978. The total area mapped was approximately 2370 ha. Also during 1978, soil profiles at 24 sites in the Cypress Hills of Alberta were described and samples collected for laboratory analyses. The purpose at 19 sites was to classify and characterize the soils associated with different plant communities; and at 5 sites to document any observable differences between soils in heavy use and non-use recreation areas.

A general guidebook has been prepared to accompany soil survey reports written for Alberta provincial parks and recreation areas (Greenlee, 1981). It includes general discussions of the following: soil formation; the Canadian soil classification system; soil characteristics and other factors that affect the use of soils for recreational and related purposes; Luvisolic, Organic, and Solonetzic soils; soil erosion, methodology; soil and landform maps that accompany the soil survey reports; an explanation of soil interpretations and guidelines for developing them; chemical and physical properties of soils; and the landform classification system used by Canadian soil pedologists. Also included is a glossary. Specific results and interpretations for the areas covered by this study are presented in the ensuing report.

ACKNOWLEDGEMENTS

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SUMMARY

The mapped area comprises about 385 ha, and is located about 13 km south and 18 km west of Breton; which in turn is located about 75 km southwest of Edmonton. Most of the study area is covered by moderately fine textured till, and a thin veneer of very coarse textured glaciolacustrine sediments (sand) overlies the till along a narrow band bordering most of the lakeshore. Several organic soil deposits occur in depressional locations.

This region has a cold snow-forest climate with humid winters, characterized by frozen ground and a snow cover of several months duration. Summers are cool and short with less than four months where the average temperature is above 10°C, and the average temperature of the coldest month is below -3°C. The mapped area is situated in the lower foothills section of the boreal forest region, where the distinctive tree species are trembling aspen, balsam poplar, and lodgepole pine.

Seven map units were recognized in the study area. The key profile types are Orthic Gray Luvisols, Gleyed Gray Luvisols, Gleyed Dark Gray Luvisols, Orthic Humic Gleysols, Orthic Gleysols, Terric Humisols, Terric Mesisols, and Gleyed Eutric Brunisols. These are distributed over the landscape in relation to landform, parent material, and drainage. The map units consist of soil series, complexes, and in one case a catena; and their distribution is shown on the soil map.

Soil interpretations of each map unit are made for fully serviced campgrounds, picnic areas, paths, lawns and landscaping, buildings, septic tank absorption fields, trench type sanitary landfills, road location, source of roadfill, and source of sand or gravel.

Soils of Map Units 1, 4, and 5 have moderate limitations for recreational development, and collectively they cover most of the study area. Other soils have moderate to severe limitations. Soils of all map units have severe limitations for road construction. Map Units 1 and 2 constitute poor and very poor sources of sand, respectively; however a source of gravel was not found in the study area. Careful study of the soil map and Tables 6 to 16 inclusive (soil limitation and suitability tables) will reveal areas suitable for particular uses.

A soil survey properly interpreted can be one of the most useful tools management has in making a proper design for a recreational area. However, all soil differences which occur in the field cannot be shown on the soil map. Thus for design and construction of specific recreational facilities, an on-site investigation is usually required.

INTRODUCTION

SIZE AND LOCATION

The mapped area comprises about 385 ha, and is located about 13 km south and 18 km west of Breton; (Figure 1) which in turn is located about 75 km southwest of Edmonton. It is adjacent to the eastern side of Buck Lake, and includes the northwest quarter of section 19 and part of the southwest quarter of section 30, township 46, range 5; and the northwest quarter of section 13, the east half and part of the west half of section 24, and part of the south half of section 25, township 46, range 6; west of the 5th meridian.

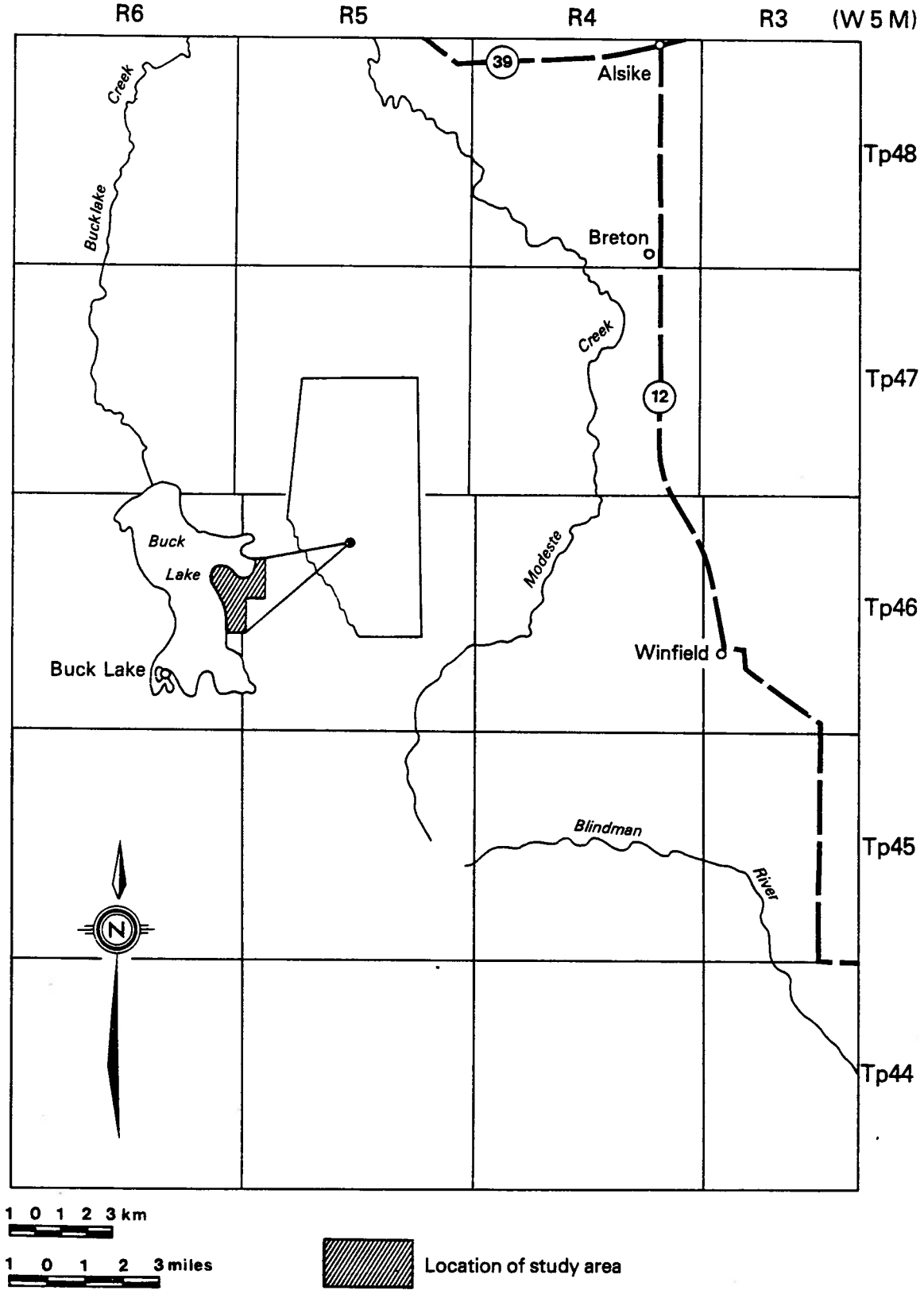

Figure 1. Map showing location of the study area.

PHYSIOGRAPHY AND SURFICIAL DEPOSITS

The study area is situated in the Western Alberta Plains division of the Interior Plains physiographic region (Government and the University of Alberta, 1969). The bedrock has been classified as the Paleocene and Upper Cretaceous Paskapoo Formation, which is nonmarine in origin (Green, 1972). Surface elevation is relatively uniform throughout the study area at approximately 900 m, and only a very slight decrease occurs from east to west. The area is drained into Buck Lake, which is drained by Bucklake Creek via Modeste Creek into the North Saskatchewan River to the north.

Most of the study area is covered by moderately fine textured till. Also, a thin veneer of very coarse textured glaciolacustrine sediments (sand) overlies the till along a narrow band bordering most of the lakeshore. One patch of medium to very coarse textured fluvial sediment (sand) parallels the creek that runs into Buck Lake in the northeastern corner of the study area. Several organic soil deposits occur in depressional locations throughout the study area, and one small patch of fine textured lacustrine sediments is found near the northeastern corner of the study area.

CLIMATE

The climate of the mapped area is designated as humid microthermal in Koppen's climatic classification (Trewartha and Horn, 1980). This is described as a cold snow-forest climate with humid winters, characterized by frozen ground and a snow cover of several months duration. Summers are cool and short, with less than four months where the average temperature is about 10°C. The average temperature of the coldest month is below -3°C.

Weather records for 1951 through 1980, at Rocky Mountain House, about 65 km south and 10 km west of the study area and at an elevation of 1015 m, show the following values (Environment Canada, 1982): a mean annual temperature of 2.6°C, July is the warmest month of the year with a mean temperature of 15.3°C, and January is the coldest month with a mean temperature of -13.0°C. The mean annual precipitation is 556 mm and 66% falls as rain. The average frost-free period is 100 days. Slightly higher average temperatures might be expected in the study area than at Rocky Mountain House since the surface elevation is about 100 m lower in the study area. For example, meteorological data over a recent 5 year period at Drayton Valley, only 25 km north and 15 m west of the study area, and at an elevation of 853 m, show an average frost-free period of 115 days.

VEGETATION

The mapped area is situated in the lower foothills section of the boreal forest region as classified by Rowe (1972). The distinctive tree species is lodgepole pine which, with trembling aspen and balsam poplar, has assumed a dominant position over much of the area in the wake of fire. In older forest stands, white spruce is important and black spruce is also frequently present. White birch and larch are scattered on well drained or poorly drained sites respectively. Both balsam fir and alpine fir are common locally in the main body of the forest section.

Aspen is the predominant vegetation throughout most of the study area. Scattered variable proportions of balsam poplar, white spruce, and white birch also occur. Balsam poplar is the most prevalent in Terric Humisol soil areas, and black spruce is dominant in Terric Mesisol soil areas. The Outdoor Recreation Planning Branch of Alberta Recreation and Parks conducts biological studies of provincial parks and recreation areas, so the vegetation is not extensively discussed in this report. However, some of the common plants observed growing on different soils are indicated as part of the map unit descriptions, and these are listed as follows (Moss, 1959; Cormack, 1967; Cummingham, 1975):

aspen (Populus tremuloides), balsam poplar (Populus balsamifera), white birch (Betula papyrifera), white spruce (Picea glauca), black spruce (Picea mariana), willow (Salix spp), alder (Alnus spp), Dogwood (Cornus stolonifera), low-bush cranberry (Viburnum edule), beaked hazelnut (Corylus cornuta), saskatoon-berry (Amelanchier alnifolia), Canadian buffalo-berry (Shepherdia canadensis), wild rose (Rosa spp), wild red raspberry (Rubus strigosus), snowberry (Symphoricarpos albus, var pauciflorus), wild gooseberry (Ribes spp), wild currant (Ribes spp), bracted honeysuckle (Lonicera involucrata), wild strawberry (Fragaria virginiana var glauca), tall larkspur (Delphinium glaucum), tall buttercup (Ranunculus spp), wild vetch (Vicia americana), wild sweet pea (Lathyrus ochroleucus), fireweed (Epilobium angurstifolium), meadow rue (Thalictrum spp), northern bedstraw (Galium boreale), baneberry (Actaea rubra), common yarrow (Achillea millefolium), bunchberry (Cornus canadensis), twin-flower (Linnaea borealis var americana), goldenrod (Solidago spp), aster (Aster spp), Canada hawkweed (Hieracium canadense), white clover (Trifolium repens), red clover (Trifolium pratense), common dandelion (Taraxacum officinale), native grass (various species), timothy (Phleum pratense), fescue (Festuca spp), western dock (Rumex occidentalis var fenestratus), horsetail (Equisetum spp), cow parsnip (Haracleum lanatum), arrow-leaved coltsfoot (Petasites sagittatus), marsh marigold (Caltha palustris), Labrador tea (Ledum groenlandicum), cloudberry (Rubus chamaemorus), cotton grass (Eriophorum angustifolium), and sphagnum moss (Sphagnum spp).

SOILS

Seven map units were recognized in the study area. The soils of three were classified in the Luvisolic order, two in the Organic order, and one in each of the Gleysolic and Brunisolic orders in the Canadian soil classification system (Canada Soil Survey Committee, 1978). The system is outlined in Greenlee (1981). Pertinent features of the map units are outlined in Table 1.

Soils of the Luvisolic Order are well to imperfectly drained mineral soils characterized by an Ae horizon near the surface, and it generally varies from 7.5 to 30 cm in thickness. It is a leached gray coloured horizon, very low in organic matter (humus) content and in plant nutrients. Luvisolic soils in their natural state commonly have surface L-H and Ah horizons as well. The L-H horizon ranges from 2.5 to 12.5 cm or more in thickness; however, the Ah horizon below is usually less than 5 cm thick,

TABLE 1. Key to the Soils

MAP UNIT	CLASSIFICATION	PARENT MATERIAL	SURFACE TEXTURE	SLOPE (class & gradient)	SURFACE STONINESS	DRAINGE	COMMENTS AND LIMITATIONS
1	Gleyed Gray Luvisol	Very coarse textured glaciolacustrine sediments (sand) overlying moderately fine to very fine textured till - 70% moderately fine to fine textured till - 30%	sandy loam - 70% loam to sandy clay loam - 30%	b (> 0.5 to 2%)	0 to 3	imperfect	(1) Sandy surface glaciolacustrine sediments range from 0 to 75 cm thick, and are stony and gravelly in some areas. (2) Some discontinuous pockets of Ah or Ahe occur in the sandy glaciolacustrine overlays. (3) Occasional sand pockets occur in the till. Slight to severe limitations, poor source of roadfill and sand, unsuitable source of gravel - surface stoniness, seasonally high groundwater table, sandy surface texture, thin Ah horizon, high shrink-swell potential, susceptibility to frost heave, rapid permeability (of sandy overlay), groundwater contamination hazard, high clay content (of subsoil).
2	Orthic Humic Gleysol and Orthic Gleysol, peaty and non-peaty phases.	very coarse (sand) to fine textured fluvial sediments	clay	b (> 0.5 to 2%)	0	poor	(1) Ah occurs as discontinuous pockets in Bg1 horizon. (2) Bg2 has sand, clay loam, and clay pockets. (3) Till is sometimes within 60 cm of surface. Severe to very severe limitations, poor source of sand, very poor source of roadfill, unsuitable source of gravel - seasonally high groundwater table or surface ponding, organic surface layer > 15 cm thick, high clay content (of Ah horizon), slippery or sticky when wet, rapid permeability (of subsoil), groundwater contamination hazard, erosion hazard (of subsoil).
3	Gleyed Eutric Brunisol	fine textured lacustrine sediments	silty clay loam	b (> 0.5 to 2%)	0	imperfect	(1) Ah varies from 5 to 9 cm thick. (2) Only one small patch of this soil found. Moderate to very severe limitations, poor source of roadfill, unsuitable source of sand or gravel - high clay content, slow permeability, seasonally high groundwater table, slippery or sticky when wet, thin Ah horizon, high shrink - swell potential, susceptibility to frost heave, groundwater contamination hazard.
4	Orthic Gray Luvisol - 90%, Terric Humisol - 10%	moderately fine textured till - 90% predominantly humic peat, overlying moderately fine textured	silt loam	c, D, d, e, f. (> 2 to 30%)	1	Luvisols - well drained, Terric Humisols - very poor	(1) Terric Humisols occur in a few small depressions (2) Discontinuous Ahe and Ah horizons occur in the Orthic Gray Luvisols. Slight to severe limitations (Luvisols), poor source of roadfill, unsuitable source of sand or gravel - high clay content, slow

TABLE 1. Key to the Soils

MAP UNIT	CLASSIFICATION	PARENT MATERIAL	SURFACE TEXTURE	SLOPE (class & gradient)	SURFACE STONINESS	DRAINGE	COMMENTS AND LIMITATIONS
4 contd		till - 10%					permeability, slippery or sticky when wet, erosion hazard, excessive slopes, thin Ah horizon , moderate to high shrink - swell potential, susceptibility to frost heave.
5	Gleyed Dark Gray Luvisol - 60% Orthic Gray Luvisol-20% Terric Humisol - 20%	moderately fine textured till - 80% predominantly humic peat, overlying moderately fine textured till - 20%	silty clay loam to silt loam	c (> 2 to 5%)	1	Gleyed Dark Grey Luvisol - moderately well drained, Orthic Gray Luvisol - well drained, Terric Humisol - very poor.	Orthic Gray Luvisols occur on knolls, Terric Humisols in small depressions. Slight to severe limitations (Luvisols), poor source of roadfill, unsuitable source of sand or gravel - high clay content, slippery or sticky when wet, slow permeability, moderate to high shrink- swell potential, susceptibility to frost heave, seasonally high groundwater table.
TH	Terric Humisol	predominantly humic peat, overlying moderately fine textured till.	humic peat	a (0 to 0.5%)	0	very poor	Very severe limitations, very poor source of roadfill, unsuitable source of sand or gravel - Organic soil, extreme wetness, flooding hazard (overflow), lack of Ah horizon, high shrink - swell potential, groundwater contamination hazard, susceptibility to frost heave.
TM	Terric Mesisol	predominantly mesic peat, overlying moderately fine textured till.	fibric peat	a (0 to 0.5%)	0	very poor	Very severe limitations, very poor source of roadfill, unsuitable source of sand or gravel - Organic soil, extreme wetness, lack of Ah horizon, high shrink - swell potential, groundwater contamination hazard, susceptibility to frost heave.

and often absent altogether. When Luvisolic soils are cultivated, the L-H and Ah horizons quickly become mixed with the Ae, resulting in gray coloured fields. Also, the L-H and Ah horizons rapidly become broken down under conditions of heavy foot traffic in recreation areas, and often disappear completely from a combination of physical destruction and soil erosion. When thoroughly dried out, the Ae horizon is often baked and hard, so that plant seedlings may be unable to push up through the crust. Also, entry of moisture from rainfall may be hampered and runoff increased, thereby enhancing soil erosion. This problem is especially serious on steep slopes.

Well drained Luvisolic soils developed on moderately fine textured till occur over the majority of the study area. In the northwest quarter of section 19, township 46, range 5, the soils are only moderately well drained. Also, a narrow band of imperfectly drained Luvisolic soils developed on a thin veneer of very coarse textured glaciolacustrine sediments (sand), overlying the till, borders most of the lakeshore.

Soils of the Organic order include all soils that have developed largely from organic deposits, contain more than 30% organic matter by weight, and meet specifications of depth and horizon thickness within a defined control section. The majority of Organic soils are either water saturated or nearly so for much of the year unless artificially drained. The organic deposits are derived primarily from the decomposition of hydrophytic or mesohydrophytic vegetation. The further classification and naming of the great groups into Fibrisols, Mesisols and Humisols depends on the occurrence and identification of three major diagnostic layers: Fibric, Mesic and Humic. Fibric layers are the least decomposed of all the organic soil materials and have large amounts of well preserved fibres, which are readily identifiable as to botanic origin. The organic matter of humic layers is in a highly decomposed state, and often has a smooth greasy feel when moist. It has the least amount of recognizable plant fibre, and is usually darker in colour than fibric or mesic materials. It is relatively stable and changes little in physical or chemical composition with time. The organic matter of mesic layers is in an intermediate stage of decomposition between that of fibric and humic layers, and is partially altered both chemically and physically. Management problems in areas of cultivated Organic soils involve the maintenance of controlled drainage, adequate fertilization, and tillage practices necessary to maintain a firm bed for seed germination and root development. Over-drainage and dessication of peat are detrimental to crop production and to the maintenance of the organic layers in a desirable physical condition. Under cultivation, many Organic soils show deficiences in macro and micro mineral nutrients, and most require the application of phosphorus and potassium to obtain maximum productivity. Special problems also exist in using Organic soils for construction purposes. These are their low bearing strength, high shrink-swell potential and susceptibility to frost heaving.

Patches of Organic soils are common in depressional locations throughout the study area.

Soils of the Gleysolic order are poorly drained mineral soils whose profiles reflect the influence of waterlogging for significant periods. Water saturation causes reducing conditions due to a lack of aeration.

These conditions result in gleyed horizons having dull gray to olive, greenish or bluish-gray moist colours, frequently accompanied by prominent usually rust-coloured mottles resulting from localized oxidation and reduction of hydrated iron oxides.

Only one area of Gleysolic soils developed on medium to very coarse textured fluvial sediments (sand) was mapped, paralleling the creek that runs into Buck Lake, in the northeastern corner of the study area.

Soils of the Brunisolic order are rapidly to imperfectly drained mineral soils with sufficient profile development to exclude them from the Regosolic order, but that lack the degrees or kinds of horizon development specified for soils of other orders. Their common characteristic of identification is the development in situ of the prominent brownish Bm horizon with sufficient alteration by hydrolysis, oxidation or solution to produce significant changes in color, structure and composition different from those of an A or C horizon. Because the processes of leaching and weathering are relatively weakly developed in Brunisolic soils, they tend to reflect the chemical characteristics, particularly the base status and acidity, of parent materials from which they have been derived.

Only one small patch of imperfectly drained Brunisolic soils developed on fine textured lacustrine sediments occurs near the northwestern corner of the northwest quarter of secion 19, township 46, range 5. An explanation as to why Luvisolic soils have not developed at this location is not readily apparent.

Very minor differences exist among some map units. However, the differences are usually significant with regard to a particular recreational or engineering use, and thus justify separation of different map units. They are described in chronological order, and horizon thicknesses represent averages. Thicknesses of comparative horizons in identical soil profiles often vary as much as 10 to 40 percent from the norm at different points in the landscape.

The dominant plant species are listed using common names. These are very general lists, and not intended to be complete.

Map Unit 1

Classification:	Gleyed Gray Luvisol.
Parent material:	very coarse textured glaciolacustrine sediments (sand), overlying moderately fine to very fine textured till - 70%, moderately fine to fine textured till - 30%.
Landform:	glaciolacustrine veneer overlying level morainal ($L^{G}v$/Ml), and level morainal (Ml).
Slope:	gently undulating (>0.5 to 2%).
Surface stoniness:	nonstony to very stony (0 to 3).
Drainage:	imperfect.

Vegetation: varying proportions of aspen and balsam poplar; some white birch and white spruce; abundant understory, including willow, wild rose, dogwood, saskatoon-berry, Canadian buffalo-berry, low-bush cranberry, wild red raspberry, wild gooseberry, wild currant, some alder; bracted honeysuckle, aster, Canada hawkweed, goldenrod, white clover, common yarrow, meadow rue, horsetail, fireweed, common dandelion, wild vetch, tall larkspur, wild sweet pea, bunchberry, wild strawberry, northern bedstraw; patches of cow parsnip; native grass, and timothy.

Profile description: Gleyed Gray Luvisol developed on glaciolacustrine sediments, overlying till.

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
L-H	7	abundant, fine to coarse, horizontal and oblique roots			4.9	42
Ahe	14	sandy loam	platy	very friable, moist	5.3	6.1
Aeg	18	sand	amorphous	loose, moist	5.2	0.58
ABg	40	fine sand	amorphous	loose, moist	5.7	0.21
IIBtg	16	heavy clay	subangular blocky	firm, moist	6.8	1.05
IIBCg	76	heavy clay	amorphous	very firm, moist	7.4	nd[2]
IICcag	at 150	clay loam	amorphous	very firm, moist	7.6	nd

[1]OM - organic matter, [2]nd - not determined

Gleyed Gray Luvisol developed on till

Horizon	Thickness (cm)	Field Texture	Structure	Consistence
L-H	7-13	leaf litter		
Aeg	7-12	loam to sandy clay loam	platy	very friable, moist
Btg	30-40	silty clay loam to silty clay	subangular blocky	firm to very firm, moist
BC	0-45	silty clay to silty clay loam	amorphous	very firm, moist
Cca	at 55-90	clay loam to sandy clay loam	amorphous	firm to very firm, moist

Comments: (1) Some unpredictable pockets occur where the sandy glaciolacustrine overlay is absent. These sediments vary from 0 to 75 cm in thickness; and are very stony and gravelly in some areas.

(2) Some discontinuous pockets of Ah or Ahe horizons occur in the sandy glaciolacustrine overlays. They range from 0 to 10 cm thick, and from loam to loamy sand in texture. Where the thickness is more than 5 cm, the soils are classified as Gleyed Dark Gray Luvisols.

(3) Occasional sand pockets occur in the till.

Limitations: slight to severe. Moderate due to surface stoniness for picnic areas, otherwise slight; severe due to surface stoniness for campgrounds, paths, lawns and landscaping, buildings without basements, otherwise moderate; severe for buildings with basements, septic tank absorption fields, trench type sanitary landfills, road location; poor source of roadfill; poor source of sand due to thin deposits; unsuitable as a source of gravel due to unsuitable textures. Other limitations include seasonally high groundwater table, sandy surface texture, thin Ah horizon, high shrink-swell potential, susceptibility to frost heave, rapid permeability (of sandy overlay), groundwater contamination hazard, high clay content (of subsoil).

Map Unit 2

Classification: Orthic Humic Gleysol and Orthic Gleysol, peaty and non-peaty phases (these great groups and phases are all intimately and unpredictably associated).

Parent material: very coarse (sand) to fine textured fluvial sediments.

Landform: level fluvial (F1).

Slope: gently undulating (>0.5 to 2%)

Surface stoniness: nonstony (0).

Drainage: poor.

Vegetation: Natural-slough grass, willow, arrow-leaved coltsfoot, cow parsnip, western dock; occasional small patch of white spruce and balsam poplar.

Tame hay-fescue, timothy, red clover, white clover, common dandelion, slough grass, common yarrow, other forbs.

Profile description: Orthic Gleysol and Orthic Humic Gleysol, peaty phase.

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
Oh (Ap)	0-24	plentiful, vertical and oblique roots			5.5	40
Ah	0-24	clay	granular	very friable, moist	5.6	27
Bg1	27	fine sand	amorphous	loose, moist	5.4	0.37
Bg2	33	sandy loam	amorphous	very friable, moist	5.8	0.78
Bg3	at 60	silt loam	amorphous	firm, moist	6.1	nd[2]

[1]OM - organic matter, [2]nd - not determined.

Comments: (1) The Ah horizon occurs as discontinuous pockets in the Bg1 horizon.

(2) The Bg2 horizon has pockets of sand-, clay loam-, and clay-textured sediments.

(3) Till sometimes occurs within 60 cm of the surface.

Limitations: Severe to very severe–very severe for septic tank absorption fields and trench type sanitary landfills; severe for all other uses; poor source of roadfill; very poor source of sand due to thin deposits of sand, and seasonally high groundwater table or surface ponding; unsuitable as a source of gravel due to unsuitable textures. Other limitations include organic surface layer more than 15 cm thick, high clay content (of Ah horizon), slippery or sticky when wet, rapid permeability (of subsoil), groundwater contamination hazard, erosion hazard (of subsoil).

Map Unit 3

Classification: Gleyed Eutric Brunisol.

Parent material: fine textured lacustrine sediments.

Landform: lacustrine blanket, overlying level morainal (Lb/Ml).

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

Surface stoniness: nonstony (0).

Drainage: imperfect.

Vegetation: white spruce; occasional balsam poplar and white birch; very sparse understory, consisting of willow, dogwood, Canadian buffalo–berry, wild rose, bracted honeysuckle, snowberry, bunchberry, common yarrow, fireweed, baneberry, horsetail, native grass.

Profile description: Gleyed Eutric Brunisol.

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
L–H	7	plentiful, fine to coarse, horizontal and oblique roots			6.7	50
Ah	9	silty clay loam	platy	very friable, moist	7.2	15.8
Bmg	23	silty clay loam to silty clay	subangular blocky	friable, moist	7.3	nd[2]
Ccag	at 32	clay	subangular blocky	firm, moist	7.5	nd

[1]OM – organic matter, [2]nd – not determined.

Comments: (1) The Ah horizon varies from 5 to 9 cm in thickness.

(2) Only one small patch of this soil was found.

Limitations: Moderate to very severe–very severe for trench type sanitary landfills; moderate for picnic areas, paths, lawns and landscaping, buildings without basements; severe for campgrounds, buildings with basements, septic tank absorption fields, road location; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include high clay content, slow permeability, seasonably high groundwater table, slippery or sticky when wet, thin Ah horizon, high shrink–swell potential, susceptibility to frost heave, groundwater contamination hazard.

Map Unit 4

Classification: Orthic Gray Luvisol – 90%.
Terric Humisol – 10%.

Parent material: moderately fine textured till – 90%.

predominantly humic peat, overlying moderately fine textured till – 10%.

Landform: hummocky morainal (Mh), inclined morainal (Mi), undulating morainal (Mu).

Slope: undulating to strongly rolling (>2 to 30%).

Surface stoniness: slightly stony (1).

Drainage: Luvisols – well drained.

Terric Humisols – very poor.

Vegetation (for the Luvisols): mainly aspen; scattered white birch, balsam poplar, white spruce; willow, low-bush cranberry, dogwood; some beaked hazelnut and saskatoon-berry; wild rose, wild red raspberry, bracted honeysuckle, fireweed, meadow rue, northern bedstraw, bunchberry, wild strawberry, common yarrow, aster, wild vetch, Canada hawkweed, twin-flower, native grass, fescue.

Profile description: Orthic Gray Luvisol

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
L-H	5	abundant, fine to coarse, horizontal and oblique roots			5.5	56
Ahe	4	silt loam	platy	friable, moist	4.8	5.5
Ae	12	silt loam	platy	slightly hard, dry	4.7	1.14
Bt	54	clay	subangular blocky	very firm, moist	4.4	nd[2]
BC	45	loam	amorphous	firm, moist	6.2	nd
Cca	at 115	clay loam	amorphous	very firm, moist	7.3	nd

[1]OM - organic matter, [2]nd - not determined.

Terric Humisol

Horizon	Thickness (cm)	Field Description		
Oh	45-65	predominantly humic peat		
		Field Texture	Structure	Consistence
Cg	at 45-65	clay loam	amorphous	firm to very firm, moist

Comments: (1) The Terric Humisol soils are found in only a few small depressions.

(2) Discontinuous pockets of Ahe and Ah horizons, as much as 5 cm thick occur in the Orthic Gray Luvisol soils.

Limitations (for the Luvisols-the Terric Humisols are rated under the Th map unit): Slight to severe-slight on suitable topography for buildings without basements; severe for septic tank absorption fields and road location; moderate on suitable topography for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include high clay content, slow permeability, slippery or sticky when wet, erosion hazard, excessive slopes, thin Ah horizon, moderate to high shrink-swell potential, susceptibiity to frost heave.

Map Unit 5

Classification: Gleyed Dark Gray Luvisol - 60%.
Orthic Gray Luvisol - 20%.
Terric Humisol - 20%.

Parent material: moderately fine textured till - 80%.
predominantly humic peat, overlying moderately fine textured till - 20%.

Landform: undulating morainal (Mu).

Slope: undulating (>2 to 5%).

Surface stoniness: slightly stony (1).

Drainage: Gleyed Dark Gray Luvisol - moderately well drained.
Orthic Gray Luvisol - well drained.
Terric Humisol - very poor.

Vegetation (for the Luvisols): aspen; some balsam poplar, white spruce, white birch; willow, low-bush cranberry, dogwood; some alder; wild rose, bracted honeysuckle, wild gooseberry, wild currant, fireweed, wild vetch, goldenrod, bunchberry, common yarrow, tall buttercup, wild sweet pea, northern bedstraw, common dandelion, aster, horsetail, cow parsnip, native grass.

Profile description: Gleyed Dark Gray Luvisol

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
L-H	8	abundant very fine to coarse, horizontal and oblique roots.			5.7	61
Ah	9	silty clay loam	granular	very friable, moist	5.2	11.8
Aeg	6	silt loam	subangular blocky	slightly hard to hard, dry	5.0	0.87
Btg	45	clay	subangular blocky	very firm, moist	5.8	nd[2]
BC	40	clay loam	amorphous	firm, moist	7.6	nd
Cca	at 100	clay loam	amorphous	firm, moist	7.6	nd

[1]OM - organic matter, [2]nd - not determined

Orthic Gray Luvisol

Horizon	Thickness (cm)	Lab Texture	Structure	Consistence	pH $CaCl_2$	OM[1] %
L-H	5	abundant, fine to coarse, horizontal and oblique roots			5.5	56
Ahe	4	silt loam	platy	friable, moist	4.8	5.5
Ae	12	silt loam	platy	slightly hard, dry	4.7	1.14
Bt	54	clay	subangular blocky	very firm, moist	4.4	nd[2]
BC	45	loam	amorphous	firm, moist	6.2	nd
Cca	at 115	clay loam	amorphous	very firm, moist	7.3	nd

[1]OM - organic matter, [2]nd - not determined.

Terric Humisol

Horizon	Thickness (cm)	Field description		
Oh	45-65	predominantly humic peat		
		Field Texture	Structure	Consistence
Cg	at 45-65	clay loam	amorphous	firm to very firm, moist

Comment: The Orthic Gray Luvisols occur on knolls, and the Terric Humisols occur in small depressions.

Limitations (for the Luvisols - the Terric Humisols are rated under the TH map unit): slight to severe-slight for buildings without basements; severe for septic tank absorption fields and road location; moderate for all other uses; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include high clay content, slippery or sticky when wet, slow permeability, moderate to high shrink-swell potential, susceptibility to frost heave, seasonally high groundwater table.

TH (Organic soil)

Classification: Terric Humisol

Parent material: predominantly humic peat, overlying moderately fine textured till.

Landform: horizontal fen (Nh).

Slope: nearly level (0 to 0.5%).

Surface stoniness: nonstony (0).

Drainage: very poor.

Vegetation: slough grass, willow; varying proportions and patches of white birch, balsam poplar, alder, white spruce, black spruce; patches of arrow-leaved coltsfoot, cow parsnip, marsh marigold, horsetail.

Profile description: Terric Humisol

Horizon	Thickness (cm)	Field description		
Oh	45-65	predominantly humic peat		
		Field Texture	Structure	Consistence
Cg	at 45-65	clay loam	amorphous	firm to very firm, moist

Comments: (1) Where the thickness of the Oh horizon is less than 40 cm near the edges of these soil areas, the soils are classified as peaty phases of Gleysols.

(2) A layer of loam- to sand-textured sediments, ranging from 5 to 35 cm thick, is sometimes found at the surface of the Cg horizon.

Limitations: Very severe for all uses; very poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include Organic soil, extreme wetness, flooding hazard (overflow), lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, susceptibility to frost heave.

TM (Organic soil)

Classification: Terric Mesisol

Parent material: predominantly mesic peat, overlying moderately fine textured till.

Landform: horizontal bog (Bh).

Slope: nearly level (0 to 0.5%).

Surface stoniness: nonstony (0).

Drainage: very poor.

Vegetation: black spruce, sphagnum moss, Labrador tea, cloudberry; some patches of cotton grass.

Profile description: Terric Mesisol

Horizon	Thickness (cm)	Field description		
Of	35-55	predominantly fibric peat		
Om	50-60	predominantly mesic peat		
Oh	30	predominantly humic peat		
		Field texture	Structure	Consistence
Cg	at 125-135	clay loam	amorphous	firm, moist

Limitations: Very severe for all uses; very poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include Organic soil, extreme wetness, lack of Ah horizon, high shrink-swell potential, groundwater contamination hazard, susceptibility to frost heave.

Special Features

The soils in Alberta have been classified into broad general zones (Figure 2) as established by Alberta Soil Survey during the normal course of soil surveys, and correlated with temperature and precipitation records. Annual precipitation amounts change gradually from one soil zone to another, and are not abrupt changes at the point where a zone boundary has been located. Thus a zone boundary is a broad transitional belt, which can be many kilometres across. Topsoil colours reflect this gradual change.

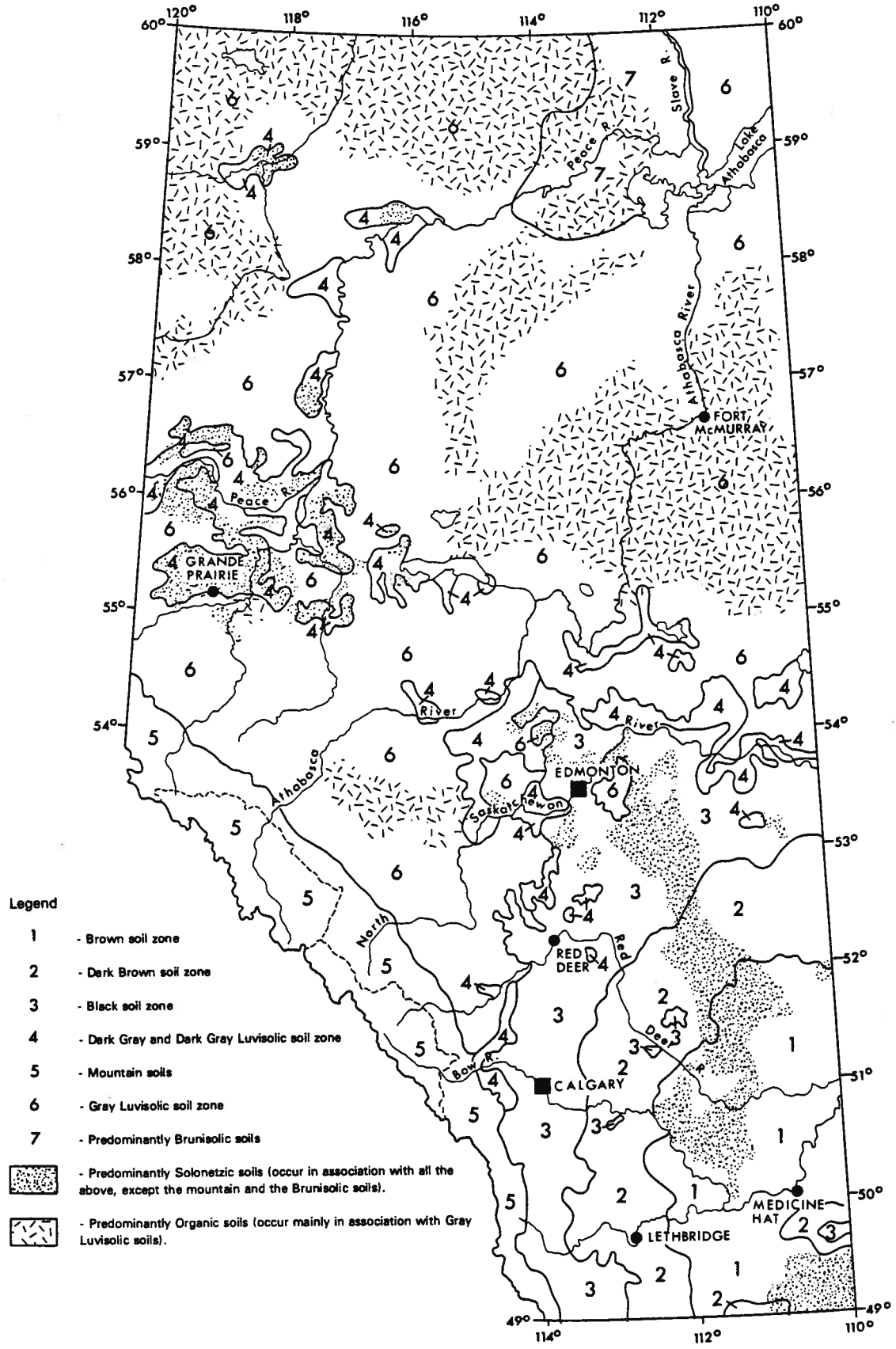

Figure 2. Map Showing soil zones of Alberta (From Soil Group Map of Alberta, Alberta Institute of Pedology, undated).

For example, in the centre of the Brown Soil Zone (annual precipitation about 30 to 33 cm), topsoil colours are brown. Similarly in the centre of the Dark Brown Soil Zone (annual precipitation about 38 cm), topsoil colours are dark brown. Between these two zones, topsoil colours are brown to dark brown, and annual precipitation is about 35 cm. The boundary between the two soil zones has been placed approximately at that midpoint.

Zonal soils are soils with well developed soil characteristics that reflect the zonal or normal influences of climate and living organisms, mainly vegetation, as active factors of soil genesis. Examples are Brown, Dark Brown, or Black soils of the Brown, Dark Brown, or Black Soil Zones, respectively. Intrazonal soils are soils with morphology that reflects the influence of some local factor of relief, parent material, or age; rather than of climate and vegetation. An example is Solonetzic soils, which develop as a result of salinization. This may originate internally from a saline parent material, or from saturation by external saline waters. Solonetzic soils are found across many soil zones (Figure 2). Azonal soils are soils without distinct genetic horizons, and are represented by Regosolic soils in Canada. These occur across all the soil zones in the province.

The study area is situated in the Gray Luvisolic soil zone and the soils throughout the majority of the area have been classified as Orthic Gray Luvisols, which are zonally normal. Some have been classified as Dark Gray Luvisols, which are also zonally normal, but are much more common in the Dark Gray and Dark Gray Luvisolic soil zone. Other soils have been classified as Organic, Gleysolic, and Brunisolic; which are all intrazonal. Gleysolic soils occur across all the soil zones; and Organic and Brunisolic soils occur in most. With the exception of the Brunisolic soils, soils of the study area can be considered typical, both locally and regionally (Lindsay et al., 1968; Peters et al., 1981). Brunsolic soils are uncommon in this region.

Special features of soils in the study area are the inherent properties of Luvisolic and Organic soils. The Luvisolic soils in their natural state display surface leaf litter (L-H) and leached light gray coloured Ae horizons, typical of soils developed under forest vegetation. The Ae horizons are underlain by much finer textured Bt horizons of clay accumulation. The Organic soil profiles do not display well developed distinctive horizons that depict mineral soils. Organic soils are soft and spongy to walk over, and readily absorb water which can easily be squeezed out in the hand. These soils act as reservoirs that store vast quantities of water. The humic peat, prevalent in the Terric Humisols of the study area, feel slippery and greasy when manipulated and squeezed in the hand.

SOIL INTERPRETATIONS

An explanation of soil interpretations and definitions of the soil limitation and suitability ratings are given in Greenlee (1981). The results of soil chemical and physical analyses are given in Tables 2 and 3.

Table 2. Chemical and Physical Analyses of Selected Map Units.

Map Unit	Horizon	Depth cm	pH $CaCl_2$	Exchangeable cations [1]meq/100 gm soil				[2]CEC meq/100 gm	[3]OC %	$CaCO_3$ equiv %	Mech Analysis % from frac<2mm diam			[4] % VFS	[5] % CF	Texture	
				Na+	K+	Ca++	Mg++				sand	silt	clay			Lab det	Field est
1	L - H	7 - 0	4.9	0.04	0.27	8.03	0.87	74.8	24.5	[6] nd	nd	nd	nd	nd	0	nd	nd
	Ahe	0 - 14	5.3	0.07	0.09	18.5	1.79	31.4	3.6	nd	73	18	9	8	0	SL	L
	Aeg	0 - 18	5.2	0.02	0.04	2.50	0.36	3.3	0.34	nd	93	6	1	13	0	S	S
	ABg	18 - 58	5.7	0.05	0.04	1.63	0.46	2.2	0.12	nd	96	3	1	17	0	FS	S
	II Btg	58 - 74	6.8	1.49	0.72	28.8	13.6	44.9	0.63	nd	2	20	78	nd	5	HC	SiC
	II BCg	74 -150	7.4	nd	nd	nd	nd	nd	nd	1.9	1	17	82	nd	0	HC	SiC
	II Ccag	at 150	7.6	nd	nd	nd	nd	nd	nd	3.1	24	39	37	5	10	CL	C
2	Oh(Ap)	24 - 0	5.5	0.33	0.13	64.5	7.56	96.1	23.3	nd	nd	nd	nd	nd	0	nd	nd
	Ah	0 - 24	5.6	0.71	0.16	65.4	9.22	96.4	15.1	nd	25	25	50	4	0	C	SiL

[1]meq - milliequivalents, [2]CEC - cation exchange capacity, [3]OC - organic carbon, [4]VFS - very fine sand, [5]CF - coarse fragments (> 2 mm diam) (field estimate), [6]nd - not determined.

Table 2. Chemical and Physical Analyses of Selected Map Units.

Map Unit	Horizon	Depth cm	pH $CaCl_2$	Exchangeable cations [1]meq/100 gm soil				[2]CEC meq/100 gm	[3]OC %	$CaCO_3$ equiv %	Mech Analysis % from frac<2mm diam			[4] % VFS	[5] % CF	Texture	
				Na+	K+	Ca++	Mg++				sand	silt	clay			Lab det	Field est
2 cont'd	Bg1	0 - 27	5.5	0.03	0.04	2.69	0.46	3.7	0.22	[6] nd	91	7	2	19	0	FS	S
	Bg2	27 - 60	5.8	0.09	0.17	10.4	1.90	13.8	0.46	nd	68	20	12	13	0	SL	L
	Bg3	at 60	6.1	0.35	0.41	15.5	2.72	20.8	nd	0.1	13	66	21	8	0	SiL	L
3	L - H	7 - 0	6.7	nd	nd	nd	nd	nd	29.6	nd	nd	nd	nd	nd	0	nd	nd
	Ah	0 - 9	7.2	nd	nd	nd	nd	nd	9.32	nd	6	59	35	nd	0	SiCL	L
	Bmg	9 - 32	7.3	nd	nd	nd	nd	nd	nd	1.9	11	49	40	nd	0	SiCl-SiC	SiC
	Ccag	at 32	7.5	nd	nd	nd	nd	nd	nd	2.4	19	28	53	nd	0	C	SiC
4	L - H	5 - 0	5.5	nd	nd	nd	nd	nd	33.2	nd	nd	nd	nd	nd	0	nd	nd
	Ahe	0 - 4	4.8	0.10	1.22	12.2	2.72	26.7	3.3	nd	10	65	25	nd	15	SiL	SiL

[1]meq - milliequivalents, [2]CEC - cation exchange capacity, [3]OC - organic carbon, [4]VFS - very fine sand, [5]CF - coarse fragments (> 2 mm diam) (field estimate), [6]nd - not determined.

Table 2. Chemical and Physical Analyses of Selected Map Units.

Map Unit	Horizon	Depth cm	pH $CaCl_2$	Exchangeable cations [1]meq/100 gm soil				[2]CEC meq/100 gm	[3]OC %	$CaCO_3$ equiv %	Mech Analysis % from frac<2mm diam			[4] % VFS	[5] % CF	Texture	
				Na+	K+	Ca++	Mg++				sand	silt	clay			Lab det	Field est
4 cont'd	Ae	4 - 16	4.7	0.32	0.62	5.78	1.79	13.8	0.67	[6] nd	13	67	20	3	15	SiL	SiL
	Bt	16 - 70	4.4	0.27	0.57	17.7	7.94	31.4	nd	nd	15	35	50	2	15	C	SiC
	BC	70 -115	6.2	0.35	0.25	16.5	6.15	22.7	nd	0.1	41	33	26	15	15	L	SiCL
	Cca	at 115	7.3	nd	nd	nd	nd	nd	nd	2.6	32	37	31	7	15	CL	CL
5	L - H	8 - 0	5.7	nd	nd	nd	nd	nd	36.0	nd	nd	nd	nd	nd	0	nd	nd
	Ah	0 - 9	5.2	0.22	2.04	20.4	5.84	53.4	7.1	nd	8	63	29	nd	15	SiCL	SiL
	Aeg	9 - 15	5.0	0.08	0.42	6.41	2.25	11.7	0.51	nd	17	58	25	5	15	SiL	SiL
	Btg	15 - 60	5.8	0.38	0.54	20.3	9.22	32.7	nd	nd	20	34	46	nd	15	C	SiC
	BC	60 -100	7.6	0.54	0.37	19.4	8.45	29.2	nd	0.1	27	41	32	nd	15	CL	CL
	Cca	at 100	7.6	nd	nd	nd	nd	nd	nd	4.0	24	40	36	nd	15	CL	CL

[1]meq - milliequivalents. [2]CEC - cation exchange capacity, [3]OC - organic carbon, [4]VFS - Very fine sand, [5]CF coarse fragments, (> 2 mm diam), (field estimate), [6]nd - not determined.

Table 3. Physical Analyses of Selected Map Units (1)

Map Unit	Depth cm	Field Moisture %	Mechanical Analysis											Liquid Limit	Plasticity Index	Optimum Moisture %(2)	Maximum Dry Density lb/ft.^{3} (2)	Classification		
			Percentage Passing Sieve							Percentage Smaller Than								AASHO	Unified	USDA
			1 inch	3/4 inch	5/8 inch	#4 (4.7 mm.)	#10 (2.0 mm.)	#40 0.42 mm.)	#200 (0.074 mm.)	0.05 mm.	0.005 mm.	0.002 mm.	0.001 mm.							
1	120-150	39	100	100	100	100	100	100	97	92	84	72	56	74	38	3 nd	nd	A-7-5 (20)	MH	HC
3	90-120	38	100	100	100	100	100	100	100	96	90	85	77	88	51	nd	nd	A-7-5 (20)	CH	HC
4	120-150	13	100	100	100	100	100	94	65	64	41	36	29	38	19	19	105.0	A-6 (10)	CL	CL
5	120-150	21	100	100	100	97	97	92	68	67	45	36	32	37	17	20	102.5	A-6 (10)	CL	CL

(1) Map Units developed on similar parent material: 4 and 5.

(2) These values are obtained from charts worked out by the Alberta Transportation Laboratory, Edmonton.

(3) nd - not determined.

Soil erodibility ratings (K values) and predicted water erosion hazards of selected map units are presented in Tables 4 and 5. As well as surface horizons, values have been worked out for soil parent materials, because they may be exposed during construction activities.

Soils of Map Units 1, 4, and 5 have moderate limitations for recreational development, and collectively they cover most of the study area. Soils of Map Unit 2 have severe limitations, and Map Unit 3 soils have moderate to severe limitations. The most common limitations are high clay content, slow permeability, slippery or sticky when wet, seasonally high groundwater table, and thin Ah horizons. Others are erosion hazard, surface stoniness, excessive slopes, Organic soil, and flooding hazard (overflow).

Soils of all map units, except those of Map Unit 2, have severe limitations for road construction due to high shrink-swell potentials and susceptibility to frost heave. Map Unit 2 soils have severe limitations due to seasonally high groundwater tables and erosion hazard. Map Units 1, 3, and 5 soils are influenced by seasonally high groundwater tables also.

The Organic soils have very severe limitations for all uses because of their inherent properties and extreme wetness.

A source of gravel was not found in the study area. Map Unit 1 soils constitute only a poor source of sand because of the thin deposits. Map Unit 2 soils constitute a very poor source because of thin deposits and a seasonally high groundwater table. All other soils are unsuitable due to unsuitable textures.

Specific limitations and suitabilities of the various soils for selected uses are shown in tables 6 to 16 inclusive. The ratings were determined on the basis of morphological, physical, and chemical properties of the soils, as well as steepness of slope. The principal limiting properties are indicated, and are generally listed in decreasing order of importance. Limitations due to slope are not further subdivided once the slope becomes steep enough to cause a very severe limitation for a specified use. It follows, however, that the steeper the slope, the more severe the limitation, and this fact should be kept in mind while using the soil interpretation tables. In tables 6 to 14 inclusive, the soil limitations for various uses have been designated as none to slight, moderate, severe, and very severe. In tables 15 and 16, the suitability of soils as sources of roadfill and as sources of sand and gravel respectively, have been designated as good, fair, poor, and very poor.

TABLE 4. Soil Erodibilty Ratings (K-values) of Selected Map Units

MAP UNIT	HORIZON	K-VALUE(1)	MAP UNIT	HORIZON	K-VALUE(1)
1	Ahe	0.15	5	Ah	0.25
	Aeg	0.18		BC	0.36
	II BCg	0.17			
	II Ccag	0.37			
2	Ah	0.15			
	Bg1	0.27			
	Bg2	0.32			
	Bg3	0.62			
3	Ah	0.29			
	Bmg	0.35			
	Ccag	0.24			
4	Ahe	0.32			
	Ae	0.52			
	Bt	0.29			
	Cca	0.40			

(1) The K-values were determined from data provided in this report using the soil erodibility nomograph presented in Figure 5 of Greenlee (1981).

(2) Where the percent organic matter was more than four, it was taken as four for the purposes of the nomograph; and where it was not determined, it was assumed to be zero.

Where the percent VFS was not determined, it was assumed to be zero.

TABLE 5. Predicted Water Erosion Hazards of Selected Map Units

MAP UNIT	HORIZON	EROSION RISK (1)
2		
1/b0 1/b3	Ahe	L
	Aeg	L
	IIBCg	L
	IICcag	L
2/b0	Ah	L
	Bg1	L
	Bg2	L
	Bg3	M
3/b0	Ah	L
	Bmg	L
	Ccag	L
4/c1	Ahe	L
	Ae	M
	Bt	L
	Cca	L-M
4/D1 4/d1	Ahe	L-M
	Ae	M-H
	Bt	L-M
	Cca	M
4/e1	Ahe	M
	Ae	H
	Bt	M
	Cca	M-H
4/f1	Ahe	M-H
	Ae	H
	Bt	M-H
	Cca	H
5/c1	Ah	L
	BC	L-M

(1) L = Low erosion risk, M = Moderate erosion risk, H = High erosion risk. These ratings were derived by applying the K-values from Table 4 to the graph presented in Figure 6 of Greenlee (1981).

(2) Coarse fragments are assumed to be > 20% where the surface stoniness is reported as 3 or more; and ≤ 20% where the surface stoniness is reported as 2 or less.

TABLE 6. Soil Limitations for Fully Serviced Campgrounds

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
3 1/b0	M - Wet	4/f1	S - Slope, Er, Sl Perm
1/b3	M - Wet S - Stony	4 5/c1	M - Slip, Clay, Sl Perm
2/b0	S - Wet, Org Surf, Slip	TH/a0	VS - Org, Wet, Flood
3/b0	S - Sl Perm, Wet, Slip	TM/a0	VS - Org, Wet
4 4/c1 4/D1 4/d1	M - Sl Perm, Slip, Er		
4/e1	M - Slope, Er, Sl Perm		

1. For explanation, see Soil Map
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe
3. These ratings are for the soils developed on sand overlying till. The soils developed on till have the additional moderate limitation of Sl Perm.
4. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Org - Organic soil
Org Surf - Organic surface layer > 15 cm thick
Sandy - Sandy surface texture
Slip - Slippery or sticky when wet
Slope - Excessive slope
Sl Perm - Slow permeability
Solz - Solonetzic soil
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 7. Soil Limitations for Picnic Areas

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
3 $\frac{1}{b0}$	SL	$\frac{4}{f1}$	S - Slope, Er, Sl Perm
$\frac{1}{b3}$	M - Stony, otherwise SL	4 $\frac{5}{c1}$	M - Slip, Clay, Sl Perm
$\frac{2}{b0}$	S - Wet, Org Surf, Slip	$\frac{TH}{a0}$	VS - Org, Wet
$\frac{3}{b0}$	M - Clay, Sl Perm, Slip	$\frac{TM}{a0}$	VS - Org, Wet
4 $\frac{4}{c1}$ $\frac{4}{D1}$ $\frac{4}{d1}$	M - Sl Perm, Slip, Er		
$\frac{4}{e1}$	M - Slope, Er, Sl Perm		

1. For explanation, see Soil Map
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe
3. These ratings are for the soils developed on sand overlying till. The soils developed on till have the additional moderate limitation of Sl Perm.
4. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Org - Organic soil
Org Surf - Organic surface layer > 15 cm thick
Sandy - Sandy surface texture
Slip - Slippery or sticky when wet
Slope - Excessive slope
Sl Perm - Slow permeability
Solz - Solonetzic soil
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 8. Soil Limitations for Paths

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
1/b0	M - Sandy	4/f1	S - Slope, Er, Slip
1/b3	M - Sandy S - Stony	[3] 5/c1	M - Slip, Clay
2/b0	S - Wet, Org Surf, Slip	TH/a0	VS - Org, Wet
3/b0	M - Clay, Slip	TM/a0	VS - Org, Wet
[3] 4/c1 4/D1 4/d1	M - Clay, Slip, Er		
4/e1	M - Slope, Er, Slip		

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe
3. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Org - Organic soil
Org Surf - Organic surface layer > 15 cm thick
Sandy - Sandy surface texture
Slip - Slippery or sticky when wet
Slope - Excessive slope
Solz - Solonetic soil
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 9. Soil Limitations for Lawns and Landscaping

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
[3] 1/b0	M - Thin Ah	4/f1	S - Slope, Er, Thin Ah
1/b3	M - Thin Ah S - Stony	[5] 5/c1	M - Clay, Sl Perm
2/b0	S - Wet, Org Surf, Clay	TH/a0	VS - Wet, Org, Thin Ah
3/b0	M - Clay, Sl Perm, Thin Ah	TM/a0	VS - Wet, Org, Thin Ah
[4] 4/c1 4/D1 4/d1	M - Thin Ah, Clay, Sl Perm		
4/e1	M - Slope, Er, Thin Ah		

1. For explanation, see Soil Map
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe
3. These ratings are for the soils developed on sand overlying till. The soils developed on till have the additional moderate limitation of Sl Perm.
4. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.
5. This rating is for the Gleyed Dark Gray Luvisols. The Orthic Gray Luvisols are rated under Map Unit 4, and the Terric Humisols under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Lime - High lime content (soil nutrient imbalance)
Org - Organic soil
Org Surf - Organic surface layer > 15 cm thick
R Perm - Rapid permeability (droughtiness)
Saline - Surface soil salinity
Sandy - Sandy surface texture
Slope - Excessive slope
Sl Perm - Slow permeability
Solz - Solonetzic soil
Stony - Surface stoniness
Thin Ah - Thin or no Ah horizon
Wet - Seasonally high groundwater table or surface ponding

TABLE 10. Soil Limitations for Buildings With Basements

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
1/b0 1/b3	S - Wet, Sh-Sw, Frost	[3] 5/c1	M - M Sh-Sw, Frost, Wet
2/b0	S - Wet	TH/a0	VS - Org, Wet, Sh-Sw
3/b0	S - Wet, Sh-Sw, Frost	TM/a0	VS - Org, Wet, Sh-Sw
[3] 4/c1 4/D1 4/d1	M - M Sh-Sw, Frost		
4/e1	M - Slope, M, Sh-Sw, Frost		
4/f1	S - Slope, M Sh-Sw, Frost		

1. For explanation, see Soil Map
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe
3. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Flood - Flooding hazard (overflow)
Frost - Susceptibility to frost heave
M Sh-Sw - Moderate shrink-swell potential
Org - Organic soil
Sh-Sw - High shrink-swell potential
Slope - Excessive slope
Stony - Surface stoniness
Sulfate - Possible concrete hazard (soluble sulfate)
Wet - Seasonally high groundwater table or surface ponding

TABLE 11. Soil Limitations for Buildings Without Basements

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
1/b0	M - Wet	3 5/c1	SL
1/b3	M - Wet S - Stony	TH/a0	VS - Wet, Org, Flood
2/b0	S - Wet	TM/a0	VS - Wet, Org
3/b0	M - Wet		
3 4/c1 4/D1 4/d1	SL		
4/e1	M - Slope		
4/f1	S - Slope		

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.
3. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Flood - Flooding hazard (overflow)
Org - Organic soil
Slope - Excessive slope
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 12. Soil Limitations for Septic Tank Absorption Fields

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
[3] 1/b0 1/b3	S - Wet, R Perm, GW	[4] 5/c1	S - Clay, Sl Perm, Wet
2/b0	VS - Wet, R Perm, GW	TH/a0	VS - Wet, GW, Org
3/b0	S - Wet, GW, Sl Perm	TM/a0	VS - Wet, GW, Org
[4] 4/c1 4/D1 4/d1	S - Clay, Sl Perm		
4/e1	S - Clay, Sl Perm, Slope		
4/f1	S - Slope, Clay, Sl Perm		

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.
3. This rating is for the soils developed on sand overlying till. The soils developed on till have a severe limitation due to Sl Perm, instead of R Perm.
4. These ratings are for the Luvisolic soils. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
Org - Organic soil
R Perm - Rapid permeability
Slope - Excessive slope
Sl Perm - Slow permeability
Wet - Seasonally high groundwater table or surface ponding

TABLE 13. Soil Limitations for Trench Type Sanitary Landfills

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
1/b0 1/b3	S - Wet, GW, Clay	TH/a0	VS - Wet, GW, Org
2/b0	VS - Wet, R Perm, GW	TM/a0	VS - Wet, GW, Org
3/b0	VS - Clay, Wet, GW		
3 4/c1 4/D1 4/d1 4/e1	M - Clay, Slip		
4/f1	M - Slope, Clay, Slip		
3 5/c1	M - Clay, Slip, Wet		

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.
3. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Flood - Flooding hazard (overflow)
GW - Groundwater contamination hazard
Org - Organic soil
R Perm - Rapid permeability
Slip - Slippery or sticky when wet
Slope - Excessive slope
Stony - Surface stoniness
Text - Unsuitable texture
Wet - Seasonally high groundwater table or surface ponding

TABLE 14. Soil Limitations for Road Location

MAP SYMBOL [1]	DEGREE OF LIMITATION [2]	MAP SYMBOL	DEGREE OF LIMITATION
1/b0 1/b3	S - Sh-Sw, Frost, Wet	[3] 5/c1	S - Sh-Sw, Frost
2/b0	S - Wet, Er	TH/a0	VS - Wet, Sh-Sw, Flood
3/b0	S - Sh-Sw, Wet, Frost	TM/a0	VS - Wet, Sh-Sw, Frost
[3] 4/c1 4/D1 4/d1	S - Sh-Sw, Frost		
4/e1	S - Sh-Sw, Slope, Frost		
4/f1	S - Slope, Sh-Sw, Frost		

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.
3. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Frost - Susceptibility to frost heave
M Sh-Sw - Moderate shrink-swell potential
Org - Organic soil
Sh-Sw - High shrink-swell potential
Slope - Excessive slope
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 15. Soil Suitability for Source of Roadfill

MAP SYMBOL [1]	DEGREE OF SUITABILITY [2]	MAP SYMBOL	DEGREE OF SUITABILITY
1/b0	P - Sh-Sw, Frost	3 5/c1	P - Sh-Sw, Frost
1/b3	P - Sh-Sw, Frost, Stony	TH/a0	VP - Wet, Sh-Sw, Frost
2/b0	P - Wet, Er	TM/a0	VP - Wet, Sh-Sw, Frost
3/b0	P - Sh-Sw, Frost		
3 4/c1 4/d1 4/D1 4/e1	P - Sh-Sw, Frost		
4/f1	P - Sh-Sw, Slope, Frost		

1. For explanation, see Soil Map.
2. G - Good, F - Fair, P - Poor, VP - Very poor.
3. The ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

BR - Shallow depth to bedrock
Clay - High clay content
Er - Erosion hazard
Flood - Flooding hazard (overflow)
Frost - Susceptibility to frost heave
M Sh-Sw - Moderate shrink-swell potential
Org - Organic soil
Sh-Sw - High shrink-swell potential
Slope - Excessive slope
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 16. Soil Suitability for Source of Sand or Gravel

MAP SYMBOL [1]	DEGREE OF SUITABILITY [2]	MAP SYMBOL	DEGREE OF SUITABILITY
[3] 1/b0 1/b3	P - Thin	TM/a0	VP - Text, Org, Wet
2/b0	VP - Thin, Wet		
3/b0	VP - Text		
[4] 4/c1 4/D1 4/d1 4/e1 4/f1	VP - Text		
[4] 5/c1	VP - Text		
TH/a0	VP - Text, Org, Wet		

1. For explanation, see Soil Map.
2. G - Good, F - Fair, P - Poor, VP - Very poor.
3. This rating is for the soils developed on sand overlying till. The soils developed on till are unsuitable due to unsuitable textures.
4. These ratings are for the Luvisols. The Terric Humisols are rated under the TH map unit.

ABBREVIATIONS

Flood - Flooding hazard (overflow)
OB - Excessive overburden
Org - Organic soil
Text - Unsuitable texture
Thin - Thin deposit of sand or gravel
Wet - Seasonally high groundwater table or surface ponding

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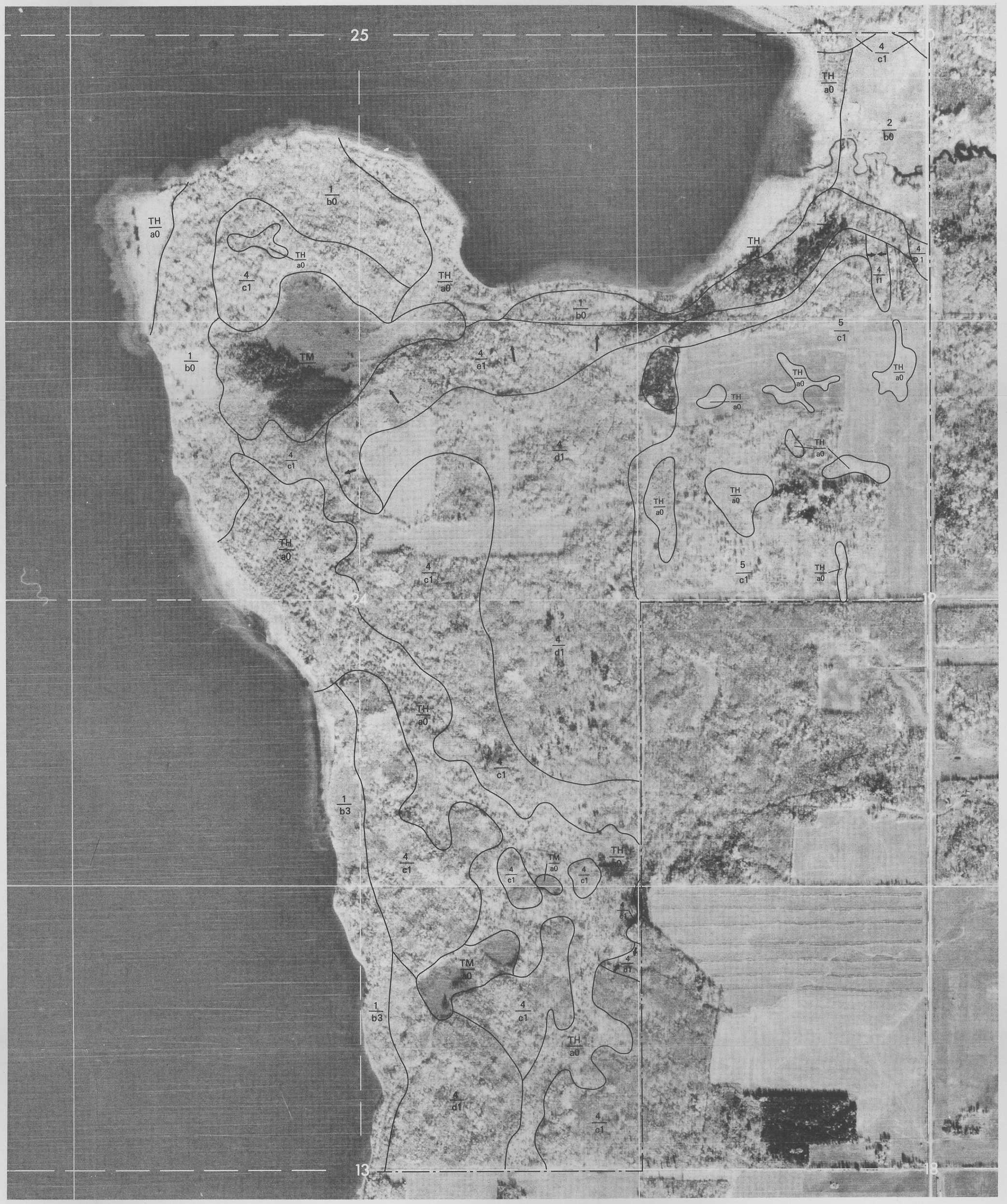
SOIL MAP OF BUCK LAKE STUDY AREA

Tp 46, R 5-6, W4M



SOIL CLASSIFICATION			
MAP UNIT	SOIL ORDER	SOIL SUBGROUP	SOIL PARENT MATERIAL
1	Luvisolic	Gleyed Gray Luvisol	very coarse textured glaciolacustrine sediments (sand), overlying moderately fine to very fine textured till - 70% moderately fine to fine textured till - 30%
2	Gleysolic	Orthic Humic Gleysol and Orthic Gleysol, (peaty and non-peaty phases)	very coarse (sand) to fine textured fluvial sediments
3	Brunisolic	Gleyed Eutric Brunisol	fine textured lacustrine sediments
4	Luvisolic - 90%	Orthic Gray Luvisol	moderately fine textured till
	Organic - 10%	Terric Humisol	predominantly humic peat, overlying moderately fine textured till
5	Luvisolic - 80%	Gleyed Dark Gray Luvisol - 60%	moderately fine textured till
		Orthic Grey Luvisol - 20%	
	Organic - 20%	Terric Humisol - 20%	predominantly humic peat, overlying moderately fine textured till
TH	Organic	Terric Humisol	predominantly humic peat, overlying moderately fine textured till
TM	Organic	Terric Mesisol	predominantly mesic peat, overlying moderately fine textured till

LEGEND:

Map Symbol:

4 / c 1 — map unit; surface stoniness rating; topographic class

- soil line
- boundary of mapped area
- direction of slope

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

Compiled on uncontrolled mosaic
Mapped and compiled by:
G.M. Greenlee, P.Ag.
Soils Department
1983

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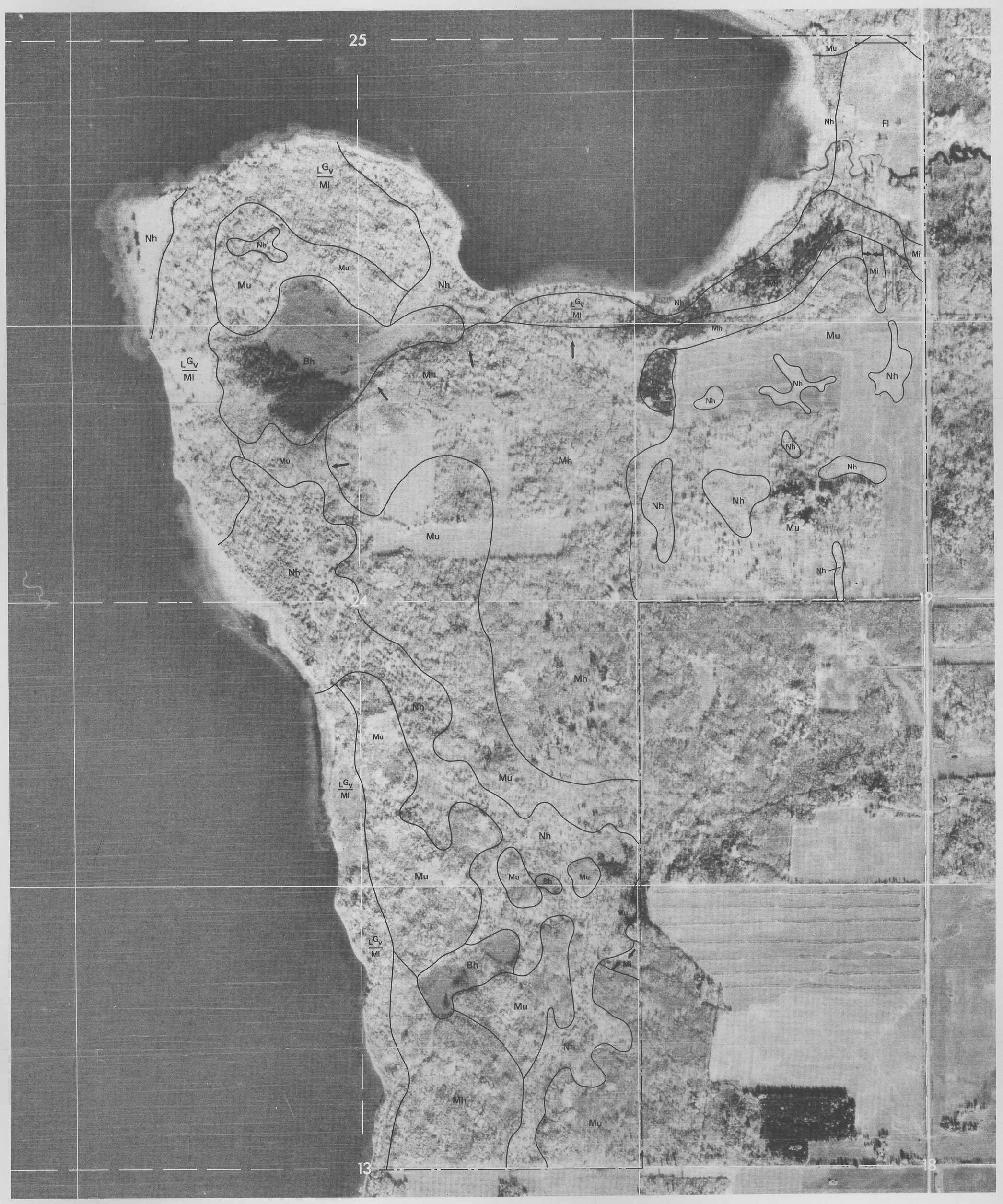
LANDFORM MAP OF BUCK LAKE STUDY AREA

Tp 46, R 5-6, W4M



LEGEND:

B - Bog
- Bh - horizontal bog

F - Fluvial
- Fl - level fluvial

L - Lacustrine
- $\frac{Lb}{Ml}$ - lacustrine blanket, overlying level morainal
- $\frac{L^{G_v}}{Ml}$ - glaciolacustrine veneer, overlying level morainal

M - Morainal
- Mh - hummocky morainal
- Mi - inclined morainal
- Ml - level morainal
- Mu - undulating morainal

N - Fen
- Nh - horizontal fen

- landform line
- boundary of mapped area
- direction of slope

Compiled on uncontrolled mosaic
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Soils Department
1983

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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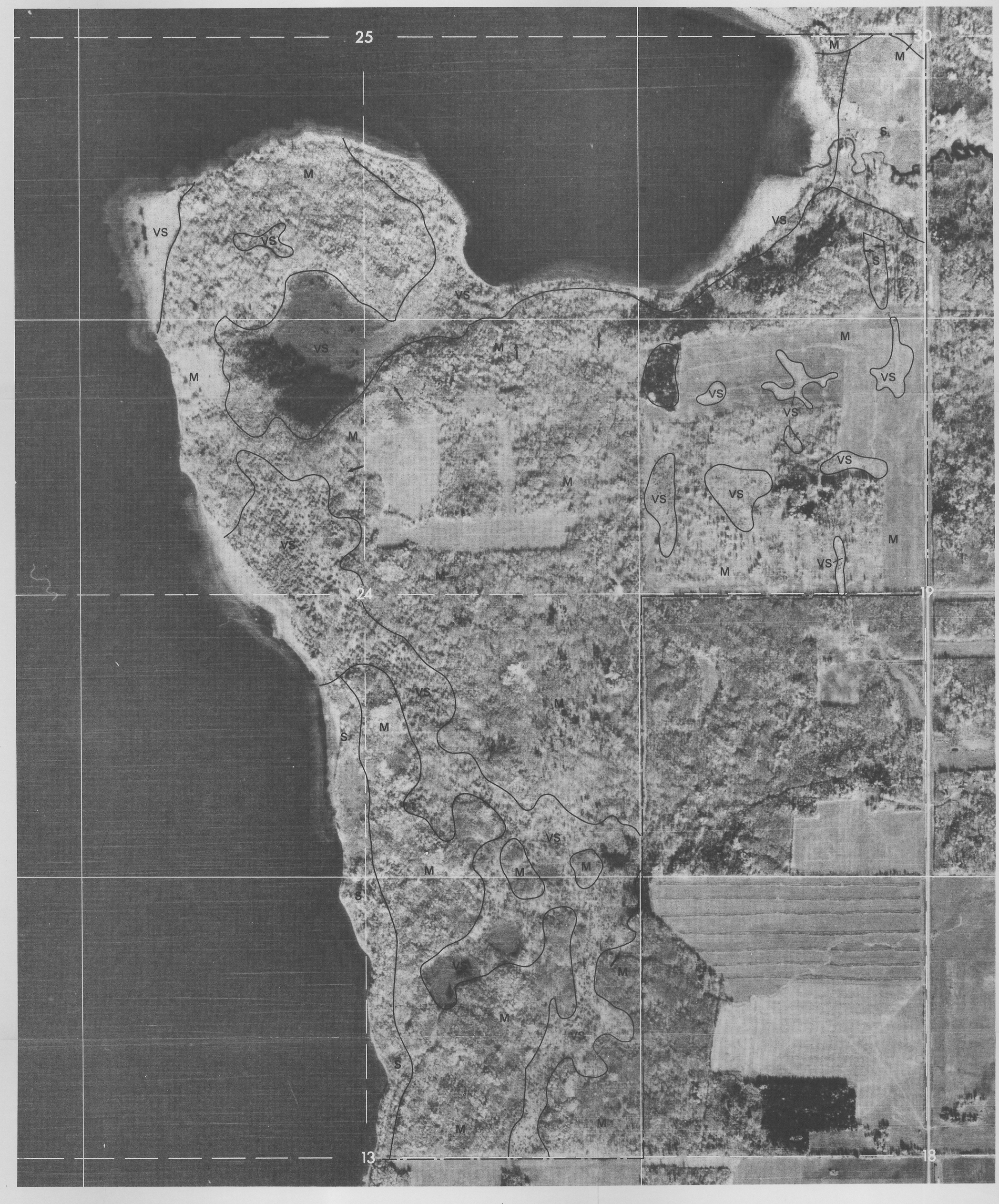
SOIL LIMITATIONS FOR RECREATION IN BUCK LAKE STUDY AREA

Tp 46, R 5-6, W 4 M



LEGEND:

SL - none to slight soil limitations

M - moderate soil limitations

S - severe soil limitations

VS - very severe soil limitations

- soil limitation line

- boundary of mapped area

- direction of slope

Compiled on uncontrolled mosaic
Mapped and compiled by:
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Soils Department
1983

APPROXIMATE SCALE 1:8000

666 0 666 1332 1998 Feet

160 0 160 320 480 Metres

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