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# SOIL SURVEY OF JARVIS BAY PROVINCIAL PARK AND INTERPRETATION FOR RECREATIONAL USE

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## PREFACE

This report is one of a series describing detailed and semi-detailed soil surveys, which were conducted in the following Alberta Provincial Parks during the summer of 1976: Cypress Hills, Writing-on-Stone, Dry Island Buffalo Jump, Jarvis Bay, Wabamun Lake, Thunder Lake, Moose Lake and Moonshine Lake. Also included were the Blue Lake Centre in William A. Switzer Provincial Park; as well as areas in the vicinities of Carseland and Hilliard's Bay (on the northwestern shore of Lesser Slave Lake). The total area mapped was approximately 30 000 ha.

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

The Alberta Research Council provided the staff, and the Outdoor Recreation Planning Branch of Alberta Recreation and Parks contributed the funds for the 1976-77 provincial parks soil survey program. Costs included field, office, laboratory, drafting, editing, and printing; as well as equipment and supplies. Office and laboratory space were provided by The University of Alberta. Mrs. Sharon DeFelice and Miss Ruby Wallis typed and assisted in compiling and proof reading the report. Mrs. J. Dlask drafted the soil, landform, and soil limitations for recreation maps, while Mr. J. Beres determined the soil physical properties. The soil chemical analyses were determined by the Alberta Soil and Feed Testing Laboratory. Able field assistance was given by Mr. M. Hennie.

Special acknowledgement is given to the Park Rangers and other park employees, who co-operated by allowing soil investigations to be conducted throughout the park, and who invariably offered assistance when needed.

## SUMMARY

The mapped area comprises about 80 ha; and is located about 18 km east and 8 km north of Red Deer, adjacent to the northeastern corner of Sylvan Lake. The study area is covered by moderately fine textured till. The region has a cold snow-forest climate with humid winters, characterized by frozen ground and a snow cover of several months duration. The average temperature of the coldest month is -14.5° C; and summers are cool and short, having less than four months with an average temperature above 10° C. The

study area is situated in the aspen grove section of the boreal forest region, where only trembling aspen is abundant in the natural stands.

Only two map units were recognized in the study area. The key profile types are Orthic Gray Luvisols, Dark Gray Luvisols, and Humic Luvic Gleysols. These are distributed over the landscape in relation to landform, parent material, and drainage. One map unit is a soil complex, and the other is a soil series; their distribution is shown on the soil map.

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

Map Unit 1 soils cover nearly the whole study area, and are well suited for recreational development when found on suitable topography. Map Unit 2 soils have severe limitations due to seasonally high groundwater tables or surface ponding. Soils of both map units have severe limitations for road construction, and a source of sand or gravel was not found in the study area. Careful study of the soil map and Tables 4 to 14 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 80 ha; and is located about 18 km east and 8 km north of Red Deer, adjacent to the northeastern corner of Sylvan Lake (Figure 1). It encompasses the northeast quarter and part of the northwest quarter of section 9, township 39, range 1, west of the fifth meridian.

### PHYSIOGRAPHY AND SURFICIAL DEPOSITS

The study area is situated in the Eastern 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 non-marine in origin (Green, 1972). The surface elevation of the study area is about 980 m, and it is drained into Sylvan Lake; which in turn is drained via Sylvan Creek into the Red Deer River to the southeast. The study area is covered by moderately fine textured till.

### 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

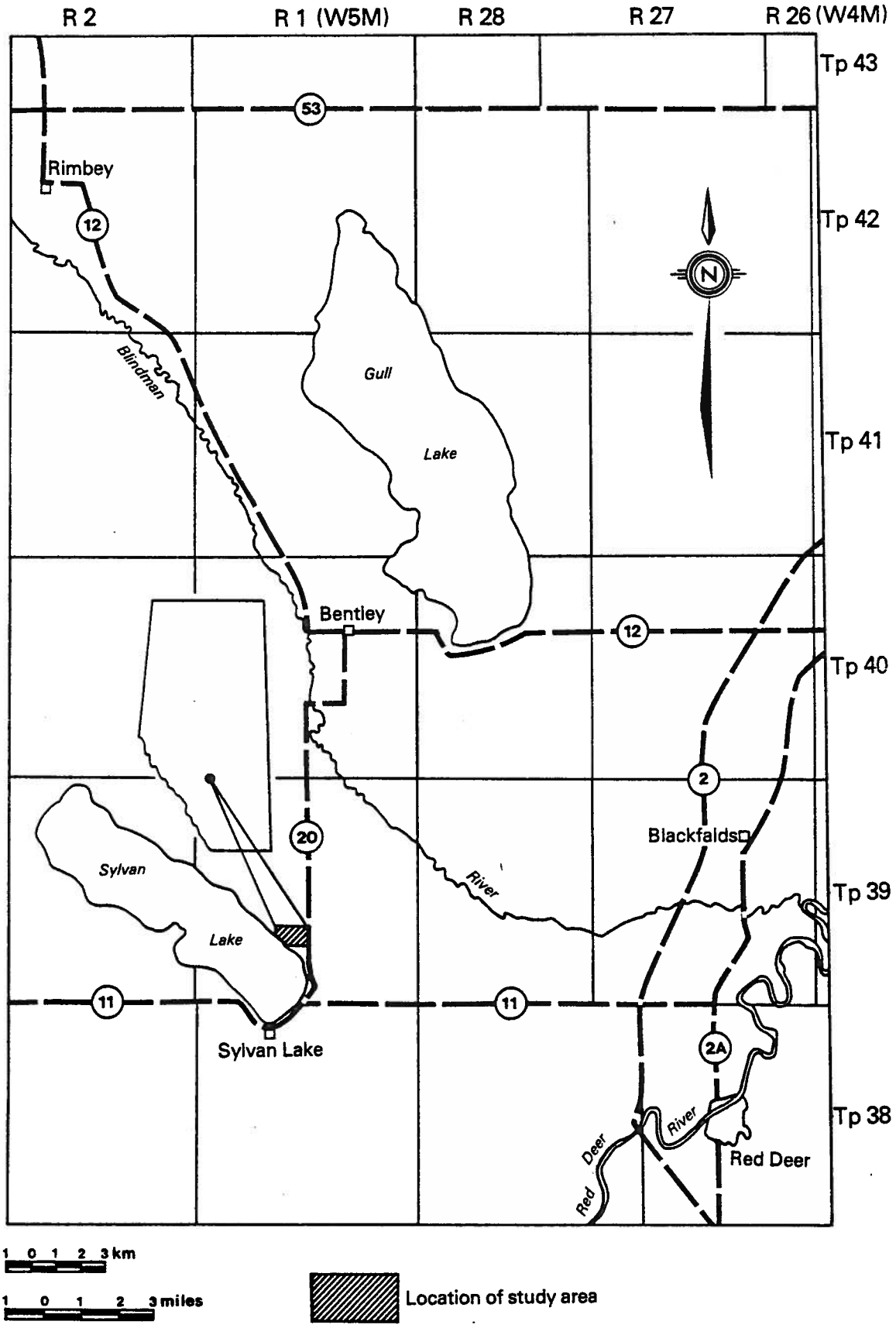


Figure 1. Map showing location of study area.

by frozen ground and a snow cover of several months duration. The average temperature of the coldest month is below -3° C; and summers are cool and short, having less than four months with an average temperature above 10°C.

Weather records for 1967 through 1980 from a station at Rimbey about 30 km north of the study area, and at an elevation of 914 m were used to compile the following information (Environment Canada, 1982): the mean annual temperature is 2.2°C. July is the warmest month of the year with a mean temperature of 15.6° C, and January is the coldest month with a mean temperature of -14.5° C. The mean annual precipitation is 482 mm, and 77% falls as rain. The average frost-free period is 107 days. Somewhat lower average temperatures may be expected in the study area, since elevations are significantly higher than at Rimbey. A frost-free period of only 75 to 90 days is indicated in the study area by the Agro-Climatic Map of Alberta (Bowser, 1967).

## VEGETATION

The mapped area is situated in the aspen grove section of the boreal forest region as classified by Rowe (1972). In the aspen grove section, only trembling aspen is abundant in the natural stands. Balsam poplar is frequently present on moist lowlands, and occasionally prominent on uplands after fire. White birch has a sporadic distribution, but is usually found only on rough broken land. Prairie and meadow patches were interspersed with the aspen bluffs in the original vegetation.

Aspen is the predominant vegetation throughout the study area. Since the Outdoor Recreation Planning Branch of Alberta Recreation and Parks conducts biological studies of provincial parks and recreation areas, the vegetation is not extensively discussed in this report. However, a few of the common plants observed during the field work are indicated as part of the map unit descriptions, and these are listed as follows (Moss, 1959; Cormack, 1967): apsen (Populus tremuloides), beaked hazelnut (Corylus cornuta), saskatoon-berry (Amelanchier alnifolia), wild rose (Rosa spp), dogwood (Cornus stolonifera), wild red raspberry (Rubus strigosus), low-bush cranberry (Viburnum edule), slough grass (Beckmannia syzigachne), and willow (Salix spp).

## SOILS

Only two map units were recognized in the study area; the soils of one were classified in the Luvisolic Order, and the other in the Gleysolic Order 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, and often

Table 1. Key to the Soils.

| Map Unit | Classification | Parent Material | Surface Texture | Slope (class & gradient) | Surface Stoniness | Drainage | Comments and Limitations |
|---|---|---|---|---|---|---|---|
| 1 | Orthic Gray Luvisol-70%<br>Dark Gray Luvisol - 30% | moderately fine textured till | loam | c,d,E,e,f<br>(> 2 to 30%) | 0 - 1 | well drained | (1) Pockets of Ah, 7 to 8 cm thick, occasionally found. (2) Under cultivation, Ap horizon 15 to 20 cm thick occurs on surface. Slight to severe limitations, poor source of roadfill, unsuitable as source of sand or gravel - excessive slopes, erosion hazard, thin or no Ah horizon, high clay content, slow permeability (of subsoil), moderate to high shrink-swell potential, susceptibility to frost heave. |
| 2 | Humic Luvic Gleysol | moderately fine textured till | loam | a<br>(0 to 0.5%) | 0 | poor | Severe to very severe limitations, poor source of roadfill, unsuitable as a source of sand or gravel - seasonally high groundwater table or surface ponding, groundwater contamination hazard, high clay content, slow permeability (of subsoil), moderate to high shrink-swell potential, susceptibility to frost heave. |

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.

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-colored mottles resulting from localized oxidation and reduction of hydrated iron oxides.

Only two small patches of Gleysolic soils, developed on moderately fine textured till, occur in the north-central portion of the study area. The remainder is covered by well drained Luvisolic soils developed on moderately fine textured till.

The map units 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 purported to be complete.

Map Unit 1

| | |
|---|---|
| Classification: | Orthic Gray Luvisol - 70%<br>Dark Gray Luvisol - 30% (these two subgroups are intimately and unpredictably associated). |
| Parent Material: | moderately fine textured till |
| Landform: | hummocky morainal (Mh), inclined morainal (Mi), undulating morainal (Mu) |
| Slope: | undulating to strongly rolling (>2 to 30%) |
| Surface stoniness: | nonstony to slightly stony (0 to 1) |
| Drainage: | well drained |
| Vegetation: | aspen, beaked hazelnut, saskatoon-berry, wild rose; some dogwood and wild red raspberry; small amount of low-bush cranberry |

Profile description: Orthic Gray Luvisol

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---|---|---|---|---|
| L-H | 4-8 | leaf litter | | |
| Ah | 0-3 | loam | granular | very friable, moist |
| Ae | 15-20 | loam | platy | very friable, moist |
| Bt | 25-40 | clay loam | subangular blocky | firm, moist |
| BC | 47-85 | clay loam | amorphous | very firm, moist; hard, dry |
| Cca | at 110-125 | clay loam | amorphous | hard, dry |

Comments: (1) The L-H horizons are occasionally only 3 to 5 cm thick, and occasionally 7 to 10 cm thick.

(2) Pockets of Ah, 7 to 8 cm thick are occasionally found. These soils are classified as Dark Gray Luvisols.

(3) The Ae horizons are occasionally only 5 to 8 cm thick.

(4) When these soils are cultivated, an Ap horizon, 15 to 20 thick, is found on the surface. The texture is loam, the structure is granular, and the moist consistence is very friable. The L-H and Ae horizons are absent.

Limitations: Slight to severe - slight on suitable topography for campgrounds, picnic areas, paths, and buildings without basements; moderate on suitable topography for lawns and landscaping, buildings with basements, and trench type sanitary landfills; severe for septic tank absorption fields, and road location; poor source of roadfill; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include excessive slopes, erosion hazard, thin or lack of Ah horizon, high clay content, slow permeability (of subsoil), moderate to high shrink-swell potential, and susceptibility to frost heave.

Map Unit 2

Classification: Humic Luvic Gleysol

Parent material: moderately fine textured till

Landform: level morainal (M1)

Slope: nearly level (0 to 0.5%)

Surface stoniness: nonstony (0)

Drainage: poor

Vegetation: slough grass; willows around fringes of depressions

Profile description: Humic Luvic Gleysol

| Horizon | Thickness (cm) | Field Texture | Structure | Consistence |
|---|---|---|---|---|
| Oh | 12 | dominantly humic peat | | |
| Ahg | 20 | loam | granular | very friable, moist |
| Aeg | 10 | loam | platy | very friable, moist |
| Btg | 20 | clay loam | amorphous | firm, moist |
| BCg | at 50 | clay loam | amorphous | very firm, moist |

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; unsuitable as a source of sand or gravel due to unsuitable textures. Other limitations include seasonally high groundwater table or surface ponding, groundwater contamination hazard, high clay content, slow permeability (of subsoil), moderate to high shrink-swell potential, and 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. 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

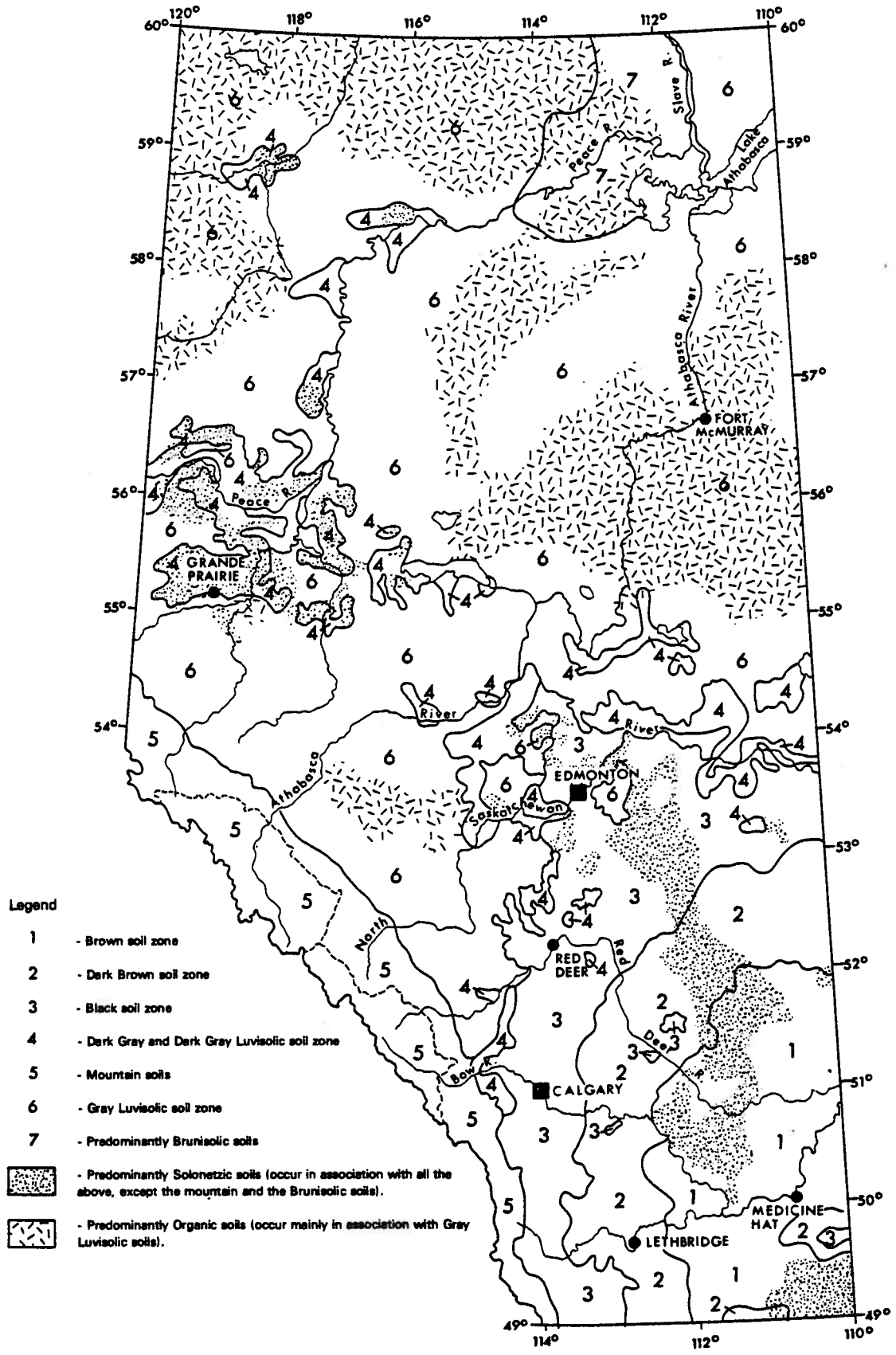


Figure 2. Map showing soil zones of Alberta (From Soil Group Map of Alberta, Alberta Institute of Pedology, undated).

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 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 most of the soils are classified as Orthic Gray Luvisols, which are zonally normal. A few pockets of Dark Gray Luvisols, which are also zonally normal, are found as well. Two small patches of Gleysolic soils also occur in the study area. These are intrazonal soils, and they occur across all the soil zones. Soils of the study area can be considered typical locally, as Luvisolic soils are prominent in the immediate vicinity of Sylvan Lake (Peters and Bowser, 1958). Chernozemic soils are much more prevalent on a regional basis however, especially to the south and east (Bowser et al, 1951). The Gray Luvisolic soil zone commences several km to the west and northwest, and a narrow band extends around Sylvan Lake from the northwest (Peters and Bowser, 1958; Peters et al, 1981).

Special features of soils in the study area are the inherent properties of Luvisolic soils. In their natural state they 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.

## MISCELLANEOUS SYMBOLS

This symbol indicates escarpments.

This symbol indicates the location of a small drainage channel or intermittent stream.

## 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.

Map Unit 1 soils cover nearly the whole study area, and are well suited for recreational development when found on suitable topography. They have moderate limitations for lawns and landscaping due to the thin or lack of Ah horizons. Map Unit 2 soils have severe limitations due to seasonally high groundwater tables or surface ponding.

Map Unit 1 soils have severe limitations for road construction because of high shrink-swell potentials, susceptibility to frost heave, and excessive slopes. Map Unit 2 soils also have severe limitations for most of the same reasons, as well as seasonally high groundwater tables or surface ponding.

TABLE 2. Chemical Analyses of Selected Map Units [1]

| MAP UNIT | DEPTH cm | pH H20 | [2] EC | [3] Na | [3] SO4 | [3] OM | [3] CaCO3 |
|---|---|---|---|---|---|---|---|
| 1 | 0 - 15 | 6.1 | 0.2 | L- | - | M- | - |
| | 15 - 30 | 6.1 | 0.1 | L- | - | - | - |

[1]Chemical Analyses done by Alberta Soil and Feed Testing Laboratory,

[2]EC - electrical conductivity, millimhos/cm, [3]These tests are rated into 4 categories: High (H), Medium (M), Low (L), and None (-). The degree within each category is indicated by a + or - sign. The tests for OM (organic matter) and CaCO3 (free lime) are visual estimates only.

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 | | | | | | | | | | |
| | | | 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. | | | | | AASHO | Unified | USDA |
| 1 | 90-120 | 3 nd | 100 | 100 | 100 | 100 | 100 | 98 | 77 | 70 | 38 | 27 | 18 | 38 | 16 | 22 | 97.5 | A - 6 (10) | CL | L-CL |
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(1) Map Units developed on similar parent material: 1 and 2.

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

(3) nd - not determined.

Excessive slope is not a factor however.

A source of sand or gravel was not found in the study area.

Specific limitations and suitabilities of the various soils for selected uses are shown in tables 4 to 14 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 4 to 12 inclusive, the soil limitations for various uses have been designated as none to slight, moderate, severe, and very severe. In tables 13 and 14, 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 Limitations for Fully Serviced Campgrounds

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| 1c0, 1d1 | SL | | |
| 1E1, 1e1 | M - Slope, Er | | |
| 1f1 | S - Slope, Er | | |
| 2a0 | S - Wet | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 5. Soil Limitations for Picnic Areas

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| 1/c0, 1/d1 | SL | | |
| 1/E1, 1/e1 | M - Slope, Er | | |
| 1/f1 | S - Slope, Er | | |
| 2/a0 | S - Wet | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 6. Soil Limitations for Lawns and Landscaping

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ | M - Thin Ah | | |
| $\frac{1}{E1}$ $\frac{1}{e1}$ | M - Slope, Thin Ah, Er | | |
| $\frac{1}{f1}$ | S - Slope, Er, Thin Ah | | |
| $\frac{2}{a0}$ | S - Wet | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 7. Soil Limitations for Paths

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| 1/c0 1/d1 | SL | | |
| 1/E1 1/e1 | M - Slope, Er | | |
| 1/f1 | S - Slope, Er | | |
| 2/a0 | S - Wet | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 - Solonetzic soil
Stony - Surface stoniness
Wet - Seasonally high groundwater table or surface ponding

TABLE 8. Soil Limitations for Buildings with Basements

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ | M - M Sh-Sw, Frost | | |
| $\frac{1}{E1}$ $\frac{1}{e1}$ | M - Slope, M Sh-Sw, Frost | | |
| $\frac{1}{f1}$ | S - Slope, M Sh-Sw, Frost | | |
| $\frac{2}{a0}$ | S - Wet, M Sh-Sw, Frost | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 corrosion hazard (soluble sulfate)
Wet - Seasonally high groundwater table or surface ponding

TABLE 9. Soil Limitations for Buildings Without Basements

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ | SL | | |
| $\frac{1}{E1}$ $\frac{1}{e1}$ | M - Slope | | |
| $\frac{1}{f1}$ | S - Slope | | |
| $\frac{2}{a0}$ | S - Wet | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 10. Soil Limitations for Septic Tank Absorption Fields

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| 1/c0, 1/d1 | S - Sl Perm | | |
| 1/E1, 1/e1 | S - Sl Perm, Slope | | |
| 1/f1 | S - Slope, Sl Perm | | |
| 2/a0 | VS - Wet, GW, Sl Perm | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 11. Soil Limitations for Trench Type Sanitary Landfills

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| 1/c0, 1/d1, 1/E1, 1/e1 | M - Clay | | |
| 1/f1 | M - Slope, Clay | | |
| 2/a0 | VS - Wet, GW, Clay | | |

1. For explanation, see Soil Map.
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 12. Soil Limitations for Road Location

| MAP SYMBOL [1] | DEGREE OF LIMITATION [2] | MAP SYMBOL | DEGREE OF LIMITATION |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ | S - Sh-Sw, Frost | | |
| $\frac{1}{E1}$ $\frac{1}{e1}$ | S - Sh-Sw, Frost, Slope | | |
| $\frac{1}{f1}$ | S - Slope, Sh-Sw, Frost | | |
| $\frac{2}{a0}$ | S - Wet, Sh-Sw, Frost | | |

1. For explantaion, see Soil Map
2. SL - None to slight, M - Moderate, S - Severe, VS - Very severe.

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 13. Soil Suitability for Source of Roadfill

| MAP SYMBOL [1] | DEGREE OF SUITABILITY [2] | MAP SYMBOL | DEGREE OF SUITABILITY |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ $\frac{1}{E1}$ $\frac{1}{e1}$ | P - Sh-sw, Frost | | |
| $\frac{1}{f1}$ | P - Sh-Sw, Frost, Slope | | |
| $\frac{2}{a0}$ | P - Sh-Sw, Wet, Frost | | |

1. For explanation, see Soil Map.
2. G - Good, F - Fair, P - Poor, VP - Very poor.

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 14. Soil Suitability for Source of Sand or Gravel

| MAP SYMBOL [1] | DEGREE OF SUITABILITY [2] | MAP SYMBOL | DEGREE OF SUITABILITY |
|---|---|---|---|
| $\frac{1}{c0}$ $\frac{1}{d1}$ $\frac{1}{E1}$ $\frac{1}{e1}$ $\frac{1}{f1}$ | VP - Text | | |
| $\frac{2}{a0}$ | VP - Text, Wet | | |

1. For explanation, see Soil Map.
2. G - Good, F - Fair, P - Poor, VP - Very poor.

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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