DETAILED SOIL SURVEY
of the
LANGDON AREA

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TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

As an aid to urban planning, a detailed soil survey was carried out in 1976 on approximately 1,040 hectares (10.4 square kilometers or 4 square miles) in the vicinity of Langdon, Alberta. A soil survey report of the area indicates the geographic location of the soils, describes pertinent landscape features and gives soil interpretations for selected uses. The area is found within the jurisdiction of the Calgary Regional Planning Commission.

Six soil units were mapped on two different parent materials. The soils belong to three soil orders: Chernozemic, Solonetzic and Gleysolic.

Chernozemic soils have slight limitations for most urban uses. For agriculture, these soils have been rated as Class 1.

Solonetzic soils in the Langdon area have severe limitations for most urban uses due to low permeability and potential concrete corrosion hazard. For agriculture these soils have been rated as Class 3.

Gleysolic soils have severe limitations for all urban uses due to a shallow depth to a seasonal water table. For agriculture these soils have been rated as Class 5.

SECTION 1

INTRODUCTION

Soils are one of our most important natural resources. Man bases his activities on soils and depends on their productivity. They are the natural medium for the growth of plants; their properties and life serve to stabilize waste and purify water; and they serve as foundations for buildings, roads and all other man-made; land based structures. Mounting pressures upon land are constantly making soils more and more valuable.

Soils have been subject to grave abuse and misuse through improper land use development. Serious health, safety and pollution problems have been created by failure to consider the capabilities and limitations of soils during the planning and design stages of rural or urban development projects (Bauer, K.W. 1973). Such problems include malfunctioning septic tank sewage disposal systems, surface and groundwater pollution, flood damage, soil erosion, soil slumping, and footing and foundation failures. Knowledge of the soils and their ability to sustain development not only helps to avoid such problems but can also contribute to reducing development costs.

A need exists, therefore, in any planning program for a detailed soil survey which delineates the geographical location of various kinds of soils; identifies their chemical and engineering properties; and interprets their properties for the uses which are planned for the area.

USE OF THE REPORT

This report consists of a written text and a map. The written part includes introductory and background information on soils, soil mapping, and soil interpretations in the first section and descriptions of the soils, analytical results, and interpretations for various uses in the second section.

The soils map is presented on an aerial photo-mosaic base. The photo base aids in identification and location of areas, however the linear and spatial

distortion inherent in a photo mosaic must be appreciated. The soil-landscape units delineated on the map are described briefly in the map legend and in greater detail in the written report. The map and the report should be used together.

THE SOILS

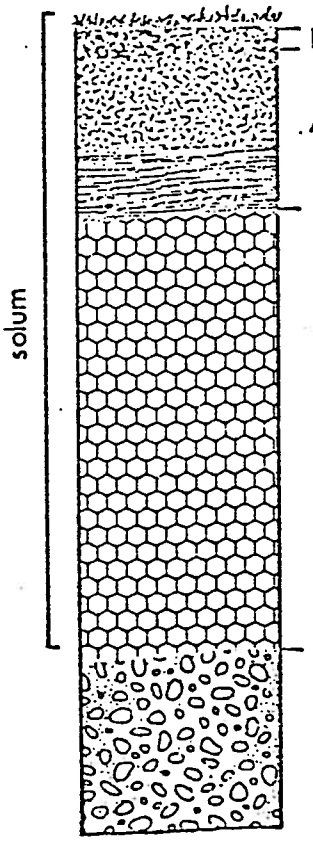
Soil Formation

Soil is a three dimensional natural body of unconsolidated matter on the immediate surface of the earth that has been subjected to, and influenced by, genetic and environmental factors of parent material, climate, biotic influences and topography all acting over a period of time to produce a product that differs in physical, chemical, biological and morphological properties and characteristics from the material from which it was derived and is capable of supporting the growth of land plants (Lavkulich, L.M. 1969).

Soil formation is defined in terms of degree of expression of a given set of properties; it is considered to be composed of two overlapping steps, (1) the accumulation of parent materials, and (2) the differentiation of horizons within the profile. The latter is attributed to additions, removals, transfers and transformations within the soil system.

These horizons differ from one another in such properties as color, texture, structure, consistence and chemical and biological activity. The major horizons are designated O for organic layers developed mainly from mosses, rushes and woody materials; L, F and H for organic layers developed mainly from leaves, twigs, woody materials and a minor component of mosses; and A, B and C for mineral horizons. Subdivisions of the master horizons are denoted by suffix letters appended to the master horizon symbol (see Figure 1, Table 3 and glossary).

FIGURE 1. DIAGRAM OF A SOIL PROFILE



--Organic layer which may be subdivided into L, F, H or Of, Om, and Oh.

--A mineral horizon at or near the surface. It may be a dark colored horizon in which there is an accumulation of humus (Ah), or a light colored horizon from which clay, iron, and humus have been leached (Ae).

--Mineral horizon that (1) may be altered to give a change in color or structure (Bm) or (2) may have an enrichment of clay (Bt) or (3) may have significant amounts of exchangeable Na and exhibit a columnar structure with pronounced stainings (Bn).

--Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying (Cg) or the accumulation of carbonates and soluble salts (Cca, Csa, Ck, Cs, Csk).

Soil Classification

Through observation of differences in soil characteristics in soil horizons it is possible to classify soils into taxonomic units. In this report the Canadian System of Soil Classification (Canada Soil Survey Committee. 1976) is used (see the Soil Key, Table 2 and the Soil Unit Descriptions).

This system classifies the soils in their natural state and thus indicates relationships between soils and their environment. These relationships are often important for assessing limitations of soils for various uses. However, the soil classification system does not use soil interpretations for uses as a basis for soil classification.

Soil classification systems are not truths that can be discovered but contrivances to organize information and ideas in ways that seem logical and useful (Soil Survey Manual. 1960). The general purpose of soil classification in Canada may be stated as follows: To organize the knowledge of soils so that it can be recalled systematically and communicated, and so that relationships may be seen; among kinds of soils; among soil properties and environmental factors; among soil properties and suitabilities of soils for various uses.

A taxonomic unit in the classification has specified limits of variation and should be thought of as consisting of (1) a single modal profile representing the most usual condition of each property (2) many other closely related profiles that vary from the modal profile within precisely defined limits.

Soil Mapping

Since soil is a continuum, and adjacent soils seldom have sharp boundaries, soil units are often defined in terms of two or more taxonomic units that are geographically associated on a landscape. These taxonomic units must be included in soil units because of the limitations imposed by the scale of mapping and the number of points that can be examined.

The notations on the soil map consist of numbers and letters: for example

$$\frac{1-3}{b-c}$$

The first digit in the number represents a geological parent material and landform; the second digit denotes the taxonomic unit or units (and sometimes textural

differences); and the letters denote the range in topography classes. The topographical classes are as follows:

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

The soils were mapped in the field by making observations at selected sites using a shovel or auger. These point observations were extrapolated to an area basis through the use of aerial photograph interpretation and field checking. The principal soils were sampled to depths of 1 metre for chemical and engineering properties.

Soil Texture

Throughout the report reference is made to soil texture and to soil drainage classes. Soil texture is according to the United States Department of Agriculture (USDA) textural classification which is described below. The soil drainage classes, according to the Canada Soil Survey Committee (1976) are outlined following the textural classification.

Soil Separates (Particles Size) on Which Textural Classes Are Based:

Separates	Diameter in Millimeters
Very Coarse Sand (VCS)	2.0 to 1.0
Coarse Sand (CS)	1.0 to 0.5
Medium Sand (MS) Sand (S)	0.5 to 0.25
Fine Sand (FS)	0.25 to 0.10
Very Fine Sand (VFS)	0.10 to 0.05
Silt (Si)	0.05 to 0.002
Clay (C)	less than 0.002

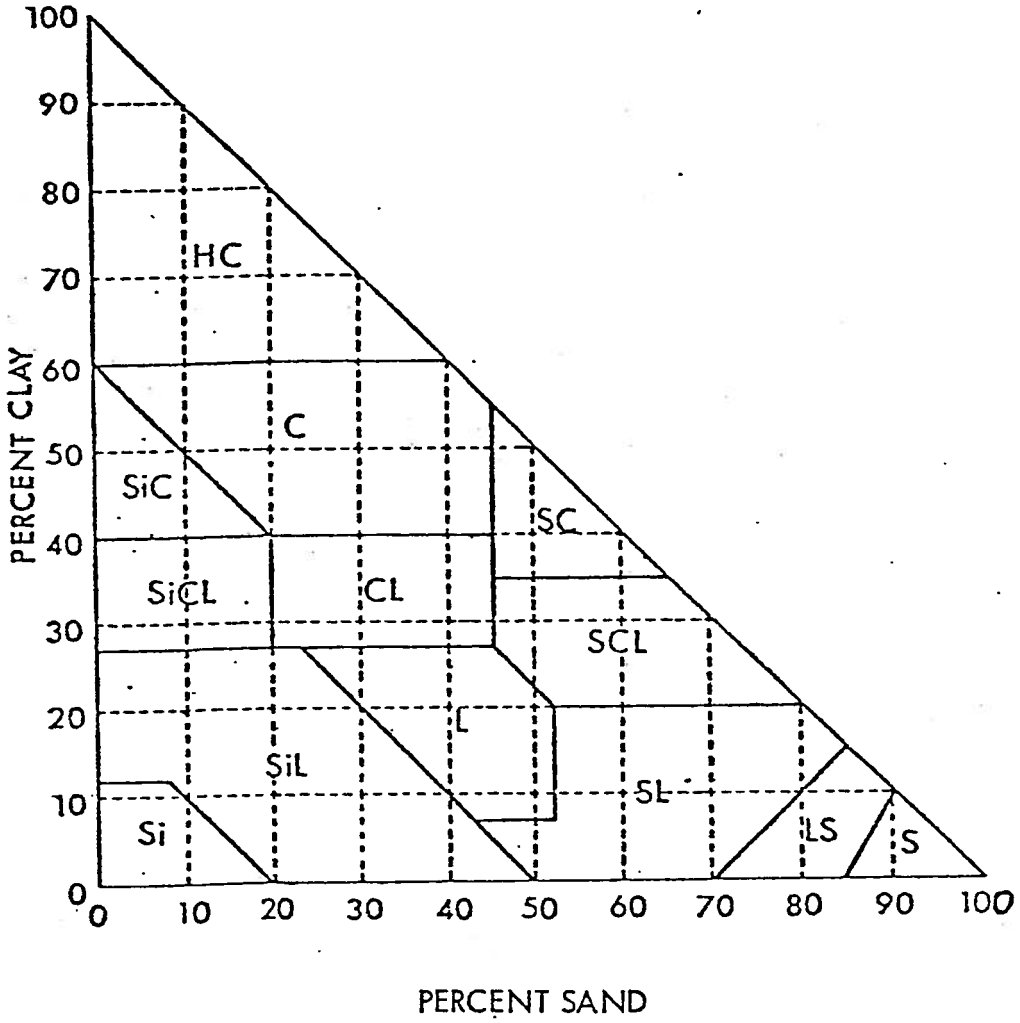


Figure 2. Soil textural classes. Percentages of clay and sand in the main textural classes of soils; the remainder of each class is silt.

The soil textural classes are grouped according to the Canada Soil Survey Committee as follows:

Very coarse textured: sands, loamy sands
Moderately coarse textured: sandy loam, fine sandy loam
Medium textured: very fine sandy loam, loam, silt loam, silt
Moderately fine textured: sandy clay loam, clay loam, silty clay loam
Fine textured: sandy clay, silty clay, clay (40 - 60% clay)
Very fine textured: heavy clay (more than 60% clay).

The gravelly class names are added to the textural class names according to the following rule:

% gravel by volume	
less than 20	- use textural class only
20 to 50	- gravelly and texture
50 - 90	- very gravelly and texture
more than 90 in surface 20 cm	- cobble land type.

Soil Drainage Classes

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

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

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

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

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

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

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

Specific reference to surface drainage may be designated in terms of run-off and described as high, medium, low or ponded. Similarly, specific reference to the characteristics of horizons within the profile may be designated in terms of permeability or percolation and described as rapid, moderate, slow, very slow, and none.

SOIL AND LAND USE

The soils of the area have been interpreted for limitations to roads, buildings with basements, sewage lagoons, septic tank absorption fields, trench-type sanitary landfills, shallow excavations, camp areas, picnic areas and playing fields and for suitability as a source of gravel, roadfill and topsoil. The soils have also been assigned capability ratings for agriculture in order to evaluate the area in terms of potential agricultural production.

These interpretations not only consider such soil properties as texture, depth to water table and depth to consolidated bedrock which affect many of the designated uses but also topography and flooding hazard.

Soil interpretations are included so that soils information may be more easily understood. These interpretations should be treated as evaluations of performance of soils <u>not</u> as recommendations for the use of soils. Many other factors are involved in the recommended use of soils. They are, however, valuable tools that can be used to assist the planner. Through their use, the planner can predict the type and degree of problem likely to be encountered, and plan the kind and amount of on-site investigations needed to determine corrective measures. Also, because soil boundaries are not precise, soil interpretations do not eliminate on-site investigations. They are, however, intended as an aid in planning these investigations, to reduce the amount of investigations and minimize the cost. For each use, the soils are rated in terms of degree of - slight, moderate or severe, or in terms of suitability as a source of material - good, fair or poor.

A slight soil limitation is the rating given soils that have properties favourable for the use. Good performance and low maintenance can be expected.

A moderate soil limitation is the rating given soils that have properties moderately favourable for the use. This limitation can be overcome or modified by - planning, design, or maintenance.

A severe soil limitation is the rating given soils that have one or more properties that are seriously unfavourable for the use. This limitation generally requires major soil reclamation, special design or intensive maintenance. In most situations, it is difficult and costly to alter the soil or to design a structure so as to compensate for the severe degree of limitation but using these soils without employing corrective measures could result in failure.

The decision as to whether or not a soil will be utilized for a specific use, regardless of the soil limitation is beyond the scope of this report.

SECTION II

LANGDON

Location and Extent of Study Area

The area described in this report covers approximately 1,040 hectares (10.4 square kilometers or 4 square miles) in the vicinity of Langdon, Alberta. Langdon is located in Section 22, Township 23, Range 27, west of the 4th meridian. It is approximately 12 miles east of Calgary by way of Glenmore Drive and secondary highway 560.

Physiography of Area

The terrain in the area is composed of nearly level to gently undulating morainal uplands interspersed with depressions and nearly level glaciofluvial veneer areas.

The surface bedrock in the area is the Paskapoo Formation which consists chiefly of soft, gray clayey sandstones that are strongly to very strongly calcareous (R. Green 1972).

The Keewatin ice sheet passed over this area and mixed material from the Paskapoo Formation with minor amounts of debris carried from as far away as the Canadian Shield and deposited the till in the form of gently undulating ground moraine.

Glaciofluvial materials were deposited by moving water in glacial times as a thin mantle over till in some portions of the area.

The Soils

Soil development in the area reflects the influence of parent materials, climate, biotic agents, drainage and vegetation.

Chernozemic soils are rapidly to imperfectly drained soils that are characterized by surface horizons that are darker in color than the subsurface horizons due to an accumulation of organic matter from the decomposition of xerophytic or mesophytic grasses and forbs representative of grassland vegetation. The soils of Alberta are divided into broad soil zones (Alberta Institute of Pedology; Soil Group Map of Alberta) based on color differences of the soil surface that have

Table 1. Key to the Soils of the Langdon Area

Parent Material	Soil Unit	Surface Soil Texture (1)	Topographic Classes (2)	Drainage Classes (3)	Dominant Soil Subgroup	Significant Soil Subgroup
Medium to moderately fine textured till	1-1	L	bc	well to imperfectly	thin Orthic Black	thin Rego Black thin Gleyed Rego Black
	1-2	L	bc	well to poorly	thin Orthic Black	thin Gleyed Rego Black Rego Humic Gleysol-saline
	1-3	L	A	poorly	Rego Humic Gleysol - saline	
	1-4	L	a	moderately well to poorly	Black Solodized Solonetz	thin Gleyed Rego Black-saline, Rego Humic Gleysol - saline
	1-5	L	a	moderately well to imperfectly	thin Rego Black-saline	thin Gleyed Rego Black - saline
Moderately coarse textured glaciofluvial over till	2-1	SL	ab	well to imperfectly	thin Orthic Black	thin Gleyed Rego Black

(1) Refer to pages 5, 6 and 7 of report
(2) Refer to page 4 of report
(3) Refer to page 7 of report

L - loam
SL - sandy loam

developed as a result of soil moisture and vegetation conditions over time. The Langdon area has slightly more precipitation and has a darker surface horizon than soils in the Dark Brown soil zone to the east. The area also has a thinner surface horizon than soils in the Black soil zone to the north. Thus, these Chernozemic soils have been classified as thin Black Chernozems.

Solonetzic soils are moderately well to imperfectly drained soils that are characterized by solonetzic B horizons and saline C horizons. A solonetzic B horizon has dark coated peds, columnar or prismatic structure and hard to extremely hard consistence when dry; the B horizon is impermeable and has a ratio of exchangeable calcium to sodium of 10 or less. In the Langdon area, Solodized Solonetz soils are common. They are typified by an Ae horizon and an intact B horizon.

Gleysolic soils are poorly drained soils associated with a high groundwater table at some period of the year. They are characterized by very dull colors and prominent mottles indicative of localized oxidation of ferrous iron. The native vegetation usually consists of rushes, reeds and sedge grasses. The Gleysolic soils in the Langdon area have been classified as Rego Humic Gleysols - saline. Such soils are characterized by 10 cm or more of Ah horizon, with little or no B horizon and a saline C horizon.

Six soil units were mapped - five on till and one on sandy glaciofluvial materials overlying till. In the following soil unit descriptions, soil colors are indicated as "d" and "m" for dry and moist conditions. Where the dominant soil subgroup resembles an established soil series the name is indicated in brackets. The profile descriptions are those of the dominant soil subgroup unless otherwise indicated. The letters L, M and H used for low, medium and high under lime content and salinity have the following limits:

Lime content: L - low (0-1%); M - medium (1-15%); H - high (>15%)

Salinity: L - low (electrical conductivity 0 to 1 mmhos/cm);
M - medium (1 to 4 mmhos/cm);
H - high (greater than 4 mmhos/cm).

TABLE 2. CANADIAN SOIL CLASSIFICATION SYSTEM

	ORDER	GREAT GROUP	DISTINGUISHING CHARACTERISTICS
1.	Chernozemic (Developed under grassland and transitional grassland-forest communities)	Brown	Light Brown Ah horizon
		Dark Brown	Light Brown Ah horizon
		Black	Black Ah horizon
		Dark Gray	Have L-H surface horizons typical of forest vegetation
2.	Solonetzic (Columnar or prismatic B horizon and a saline C horizon; Ca/Na ratio of B horizon is less than 10)	Solonetz	Ah horizon ----- Bnt horizon
		Solodized Solonetz	Ah ----- Ae ----- Bnt
		Solod	Ah ----- Ae ----- Bnt
3.	Luvisolic (Developed in forest areas; accumulation of clay in the B horizon)	Gray Brown Luvisol	(L-H) ----- Ah ----- Ae ----- Bt; Mull-like Ah horizon
		Gray Luvisol	L-H ----- (Ah) ----- Ae ----- Bt
4.	Podzolic (Accumulation of Fe+Al and/or organic matter in the B horizon)	Humic Podzol	Bh > 10 cm which contains > 1% O.C. < 0.3%Fe
		Ferro-Humic Podzol	Bhf > 10 cm which contains > 5%O.C. > 0.6%Fe+Al
		Humo-Ferric Podzol	Bhf ≥ 5 cm which contains < 5%O.C. > 0.6% Fe+Al
5.	Brunisolic (Generally weakly developed B horizons)	Melanic Brunisol	Ah > 5 cm, Bm > 5 cm; pH > 5.5
		Eutric Brunisol	Ah < 5 cm, Bm > 5 cm; pH > 5.5
		Sombric Brunisol	Ah > 5 cm, Bm > 5 cm; pH < 5.5
		Dystric Brunisol	Ah < 5 cm, Bm > 5 cm; pH < 5.5
6.	Regosolic (Weakly developed or young soils; no B horizon)	Regosol	(L-H) ----- Ah ----- C; no B horizon
7.	Gleysolic (Poorly drained and show mottling and gleying)	Humic Gleysol	Ah > 8 cm
		Gleysol	Ah < 8 cm
		Luvic Gleysol	Have Aeg and Btg horizons
8.	Organic (Contains > 17% organic carbon are > 60 cm in depth if dominantly fibric or > 40 cm if dominantly mesic or humic)	Fibrisol	Large amount of well preserved fiber
		Mesisol	Partially decomposed fiber
		Humisol	Well decomposed fiber (Black)
		Folisol	

TABLE 3. DEFINITION OF SOIL HORIZON SYMBOLS
(after Canada Soil Survey Committee, 1976)

Organic Layers

Organic layers are found at the surface of some mineral soils, and may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon by weight. Two groups of these layers are recognized.

O - This is an organic layer developed mainly from mosses, rushes, and woody materials.

Of - The fibric layer is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fibre that are readily identifiable as to botanical origin.

Om - The mesic layer is the intermediate stage of decomposition with intermediate amounts of fibre, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic layer is one that fails to meet the requirements of fibric or of humic.

Oh - The humic layer is the most highly decomposed of the organic soil materials. It has the least amount of fibre, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained.

L-F-H - These organic layers develop primarily from leaves, twigs, woody materials, and a minor component of mosses.

L - This is an organic layer characterized by an accumulation of organic matter in which the original structures are easily discernible.

F - This is an organic layer characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The layer may be partly comminuted by soil fauna as in moder[1], or it may be partly decomposed mat permeated by fungal hyphae, as in mor[1].

H - This is an organic layer characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This material differs from the F layer by its greater humification chiefly through the action of organisms. This layer is a zoogenous humus form consisting mainly of spherical or cylindrical droppings of microarthropods. It is frequently intermixed with mineral grains, especially near the junction with a mineral layer.

Master Mineral Horizons and Layers

Mineral horizons are those that contain less organic matter than that specified for organic layers.

[1]Bernier, B. 1968. Soils under forest. Proceedings of the Seventh Meeting of the National Soil Survey Committee of Canada. p. 145 and 147.

(TABLE 3 - cont'd)

A -This is a mineral horizon or horizons formed at or near the surface in the zone of removal of materials in solution and suspension, or of maximum in situ accumulation of organic matter or both. Included are:

(1) horizons in which organic matter has accumulated as a result of biological activity (Ah);

(2) horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of these (Ae).

B -This is a mineral horizon or horizons characterized by one or more of the following:

(1) an enrichment in silicate clay (Bt).
(2) an alteration of hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below (Bm and Bg).
(3) a prismatic or columnar structure that exhibits pronounced coatings or stainings or significant amounts of Na (Bn).

C -This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting the process of gleying or the accumulation of carbonates and soluble salts.

R -This is consolidated bedrock that is too hard to break with the hands or dig with a spade when moist, and that does not meet the requirements of a C horizon. The boundary between the R layer and any overlying unconsolidated material is called a lithic contact.

Lowercase Suffixes

b -A buried soil horizon.

e -A horizon characterized by the removal of clay, iron, aluminum, or organic matter alone, or in combination. When dry, it is higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae, Ahe).

g -A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less.

h -A horizon enriched with organic matter. When used with A it must show one Munsell unit of value darker than the horizon below, or have 0.5% more organic matter than the IC. It contains less than 17% organic carbon by weight.

(TABLE 3 - cont'd)

k -Denotes the presence of carbonate as indicated by visible effervescence when dilute HCl is added.

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

n -A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. When used with B it must also have the following properties; prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry.

s -A horizon with salts which may be detected as crystals or veins, as surface crusts, by distressed crop growth or by presence of salt-tolerant plants. It is most commonly used with C and k.

t -A horizon enriched with silicate clay. It is used with B (Bt, Btg).

SOIL UNIT DESCRIPTIONS

1. Soils Developed on Medium Textured Till.

Soil Unit: 1-1

Soil Classification: thin Orthic Black with significant thin Rego Black and thin Gleyed Rego Black

Parent Material: medium to moderately fine textured till

Topography: gently undulating and undulating

Drainage: well to imperfectly drained

Profile description of dominant soil subgroup: thin Orthic Black (Airdrie series)

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Ah	very dark gray (d)	15	6.0-7.0	soft	L	L	L
Bm	brown (d)	15	6.0-7.0	soft	CL	L	L
Ck	light brownish gray (d)	30+	7.5-8.5	-	CL	H	L

Soil Unit: 1-2

Soil Classification: thin Orthic Black with significant thin Rego Black and Rego Humic Gleysol - saline

Parent Material: medium to moderately fine textured till

Topography: gently undulating and undulating

Drainage: well to poorly drained

Profile description of a significant soil subgroup: thin Rego Black

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Ahk	very dark gray (d)	15	7.0-7.5	soft	L	M	L
Ck	light brownish gray (d)	15+	7.5-8.5	-	CL	H	L

Comments: In the western portion of the area the Orthic Humic Gleysols may be non-saline.

Soil Unit: 1-3

Soil Classification: Rego Humic Gleysol - saline

Parent Material: medium to moderately fine textured till

Topography: depressional

Drainage: poorly drained

Profile description of dominant soil subgroup: Rego Humic Gleysol - saline

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Om	dark brown (m)	8	7.0-7.5	-	-	-	-
Ahsag	black (m)	8	7.0-8.5	hard	L	M	H
Cskg	light gray (m)	8+	7.5-8.5	-	CL	H	H

Comments: A and C horizons are strongly gleyed and mottled.

Soil Unit: 1-4

Soil Classification: Black Solodized Solonetz with significant Rego Humic Gleysol-saline and thin Gleyed Rego Black - saline

Parent Material: medium to moderately fine textured till

Topography: nearly level

Drainage: moderately well to poorly drained

Profile description of dominant soil subgroup: Black Solodized Solonetz (Killam series)

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Ah	black (d)	15	6.0-6.5	slightly hard	L	L	L
Ae	light gray (d)	5	6.0-6.5	soft	SiL	L	L
Bnt	very dark gray brown (d)	10	7.0-7.5	very hard	CL	L	L
Csk	Gray brown (d)	40+	8.0-8.5	-	CL	H	H

Comments: The top of each column in the Bnt horizon is intact.

Soil Unit: 1-5

Soil Classification: thin Rego Black - saline with significant thin Gleyed Rego Black - saline

Parent Material: medium to moderately fine textured till

Topography: nearly level to gently undulating

Drainage: moderately well to imperfectly drained

Profile description of dominant soil subgroup: thin Rego Black - saline

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Ah	very dark gray brown (d)	25	7.0-7.5	soft	L	L	L
Ahsk	dark gray brown (d)	10	7.0-7.5	-	L	M	H
Csk	light gray brown (d)	25+	7.5-8.5	-	CL	H	H

Comments: A very thin Bnt horizon may be present.

2. Soils Developed on Medium to Coarse Textured Glaciofluvial materials overlying Till.

Soil Unit: 2-1

Soil Classification: thin Orthic Black with significant thin Gleyed Rego Black

Parent Material: moderately coarse textured glaciofluvial over till

Topography: nearly level to gently undulating

Drainage: well to imperfectly drained

Profile description of dominant soil subgroup: Orthic Black

Horizon	Color	Thickness (cm)	pH	Consistence when dry	USDA texture	Lime content	Salinity
Ah	very dark gray (d)	15	6.5-7.0	soft	SL	L	L
Bm	brown (d)	15	7.0-7.5	soft	SL	L	L
Ck	yellowish brown (d)	30	7.5-8.5	-	LS	H	H
IICsk	light gray brown (d)	60+	7.5-8.5	-	L	H	H

Comments: The lower portion of the Ck horizon is often gleyed and mottled.

Engineering Properties of the Soils

Engineering test data determined on representative soil samples are presented in Table 4. The samples analyzed were taken from subsoils of the soil units at representative sites. Depth of sampling generally ranged between 0.75 and 1.25 metres below the surface. A brief description of the significance of each engineering parameter follows:

1. Atterberg Limits

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

Tests have been devised to determine the moisture content of a soil at which it changes from one major physical condition to another (PCA Soil Primer, 1962). These tests conducted on the material passing the no. 40 sieve (0.42 mm) have been used as key factors in classifying soils for structural purposes.

The tests used for estimating plasticity are plastic limit, liquid limit, and plasticity index. The plastic limit is the moisture content at which the soil passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid and plastic limits. These three are known as Atterberg limits.

The plasticity index gives the range in moisture content at which a soil is in a plastic condition. A small plasticity index, such as 5, indicates that a small change in moisture content will change the soil from a semisolid to a liquid condition. A large plasticity index, such as 20, shows that a considerable amount of water can be added before a soil changes to a liquid condition.

2. Textural Classification

(a) AASHO Classification System (PCA Soil Primer, 1962).

The American Association of State Highway Officials system is an engineering property classification based on field performance of highways. In the AASHO system, the sieve analyses and the Atterberg limits are used to separate the soil material into seven basic groups A-1 to A-7. The best soils for road subgrades are classified as

A-1, the poorest as A-7.

In recent years these seven basic groups have been divided into subgroups with a group index that was devised to approximate within group evaluations. Group indices range from 0 for the best subgrade material to 20 for the poorest.

(b) Unified Soil Classification System (PCA Soil Primer, 1962).

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

Coarse grained soils are those that have 50% or less of material passing the number 200 sieve; fine grained soils have more than 50% of material passing the number 200 sieve. The letters G, S, C, M, W, P, L and H stand for gravel, sand, clay, silt, well graded, poorly graded, low liquid limit and high liquid limit, respectively.

The designation CL for example, indicates inorganic clays of low liquid limit; SW indicates well graded sand; and SC indicates clayey sands.

(c) United States Department of Agriculture Classification System

The system is defined on page 7 in section 1 of this report. A comparison of the different systems is given in the PCA Soil Primer.

Table 4. Engineering and Chemical Soil Data of Representative Soil Samples from the Langdon Area.

Soil Unit	Horizon	Depth from surface (cm)	pH	Elect. cond. (mmhos /cm)	% sulfate	% $CaCO_3$	Grain Size Analysis						Atterberg Limits		Textural Classification		
							% Passing Sieve				% Smaller than						
							#4	#10	#40	#200	.05mm	.002mm	Liquid Limit	Plasticity Index	AASHO	Unified	USDA
1-1	Ah	0-15	6.6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Bm	15-30	5.9	n.d.	n.d.	n.d.	100	98	94	63	60	35	39	14	A6(7)	ML	CL
	Ck	30+	8.2	1.4	0.02	14.5	100	99	95	71	65	38	36	16	A6(7)	CL	CL
1-4	Ah	0-15	6.0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Bnt	15-25	7.2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
	Csk1	25-50	8.2	12.0	0.47	16.7	100	100	98	75	67	36	34	16	A6(7)	CL	CL
	Csk2	50+	8.0	8.4	0.38	12.5	99	97	94	63	57	32	33	14	A6(7)	CL	CL

n.d. - not determined

SOIL INTERPRETATIONS

The guides for assessing soil limitations and the limitations for selected uses of the mapping units are presented in Tables 5 to 30. If a severe limitation occurs, lesser limitations are not specified.

Well to imperfectly drained Chernozemic soils developed on till and glaciofluvial materials overlying till have slight to moderate limitations for urban uses and have no limitations for crops. Gleysolic soils have severe limitations for most uses due to a seasonally high water table. In mapping units 1-2/bc and 1-4/ab Gleysolic soils occur as the significant subgroup, consequently on-site investigations are required. Solonetzic soils have severe limitations for most urban uses due either to slow permeability or a high sulfate content. They have moderately severe limitations for crops due to the depth of the rooting zone being restricted by an impermeable B horizon.

TABLE 5. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR ROAD LOCATION

Properties that affect design and construction of roads are (1) those that affect the load supporting capacity and stability of the subgrade; and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified Classification, and the shrink-swell potential give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth of bedrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade.

Soil limitation ratings do not substitute for basic soil data or for onsite investigations.

Item Affecting Use	Degree of Soil Limitation		
	NONE TO SLIGHT	MODERATE	SEVERE
Soil drainage class[1]	Rapidly[1], well and moderately well drained	Imperfectly drained	Poorly and very poorly drained
Flooding	None	Once in 5 years	More than once in 5 years
Slope	0 to 9% (AD)	9 to 15% (E)	More than 15% (>E)
Depth to Bedrock	More than 100 cm	50 to 100 cm	Less than 50 cm
Subgrade[2]			
a. AASHO Group Index[3]	0 to 4	5 to 8	more than 8
b. Unified soil classes	GW, GP, SW, GM, SM, and GC[4] and SC[4]	CL(with PI[5] less than 15), ML, SP	CL(with PI[5] 15 or more), CH, MH, OH, OL, Pt
Shrink-swell[6] potential	Low (PI[5] less than 15)	Moderate (PI[5] 10 to 15)	High (PI[5] greater than 20)
Susceptibility to frost heave[7]	Low (F1, F2)	Moderate (F3)	High (F4) (silty & peaty soils)
Stoniness	Stones greater than 1.5 m apart	Stones 0.5 to 1.5 m apart	Stones less than 0.5 m apart
Consolidated Bedrock exposures	Rock exposures greater than 90 m apart and cover less than 2% of the surface	Rock exposures 30 to 90 m apart and cover 2 to 10% of the surface	Rock exposures less than 30 m apart and cover greater than 10% su.face

1. For an explanation of soil drainage classes see page
2. This item estimates the strength of a soil as it applies to roadbeds. When available, AASHO Group Index values from laboratory tests were used; otherwise the estimated Unified classes were used. On unsurfaced roads, rapidly drained, very sandy poorly graded soils may cause washboard or rough roads.
3. Group Index values were estimated from information published by the Portland Cement Assn. 1962. pp 23 - 25.
4. Downgrade to moderate if content of fines (less than 200 mesh) is greater than about 30%.
5. PI means plasticity index.
6. Inherent swelling capacity is estimated as low when the plasticity index is less than 15, medium when the plasticity index is 10 to 15 and high when the plasticity index is greater than 20 (Terzaghi and Peck. 1967) Gravelly and stony soils may not exhibit shrink-swell as estimated by the plasticity index because of dilution of the fines with coarse fragments. In these situations decrease a severe limitation to moderate and a moderate limitation to slight.
7. Frost heave is important where frost penetrates below the hardened surface layer and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing front. The susceptibility classes are taken from the United States Army Corps of Engineers (1962), pp. 5 - 8. (See table 6)

Table 6. Frost Design Soil Classification.

Frost Group	Kind of Soil	% by weight finer than 0.02 mm	Unified Soil Classification System Soil Texture Type
F1	(a) Gravelly soils	3 - 10	GW, GP, GW-GM, GP-GM
F2	(a) Gravelly soils	10 - 20	GM, GW-GM, GP-GM
	(b) Sands	3 - 15	SW, SP, SM, SW-SM, SP-SM
F3	(a) Gravelly soils	more than 20	GM, GC
	(b) Sands (except very fine silty sands)	more than 15	SM, SC
	(c) Clays PI >12		CL, CH
F4	(a) All silts		ML, MH
	(b) Very fine silty sands	more than 15	SM
	(c) Clays PI <12		CL, CL-ML
	(d) Varved clays and other fine grained banded sediments		CL and ML; CL, ML and SM; CL, CH and ML; CL, CH, CL and SM

Potential frost action refers to the probable effects on structures, resulting from the freezing of soil material and its subsequent thawing. The action not only pertains to the heaving of soil as freezing progresses, but also to the excessive wetting and loss of soil strength during thaw. Damage to structures from frost action results not from the freezing of the soil itself but from the formation of ice lenses in the soil. In turn, the formation of ice lenses depends on the capacity of the soil to deliver water to a stationary or slowly moving freezing front. Thus poorly drained soils with a high water content are more subject to frost action than well drained soils.

Table 7: Limitations of Soils for Road Location.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 5.
1-1/bc	moderate	Moderate Texture and Stoniness Limitations
1-2/bc	moderate to severe	Moderate Texture and Stoniness Limitations on Dominant Soils. Very shallow depth to Seasonal Water Table on Gleysols (1).
1-3/A	severe	Very Shallow Depth to Seasonal Water Table Potential Frost Action
1-4/ab	moderate to severe	Moderate Texture and Stoniness Limitations on Dominant Soils. Very Shallow Depth to Seasonal Water Table on Gleysols (1).
1-5/ab	moderate	Moderate Texture, Stoniness and Depth to Water Table Limitations.
2-1/ab	slight	

(1) Needs on-site investigations.

TABLE 8. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR PERMANENT BUILDINGS[1]

This guide provides ratings for undisturbed soils evaluated for single storey buildings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundations; but soil slope, and susceptibility to flooding and other hydrologic conditions, such as seasonal wetness, that have effects beyond those related exclusively to foundations are considered. Also considered are soil properties, particularly depth to bedrock, which influence excavation and construction costs, both for the building itself and for the installation of utility lines. Excluded are limitations for soil corrosivity, landscaping and spetic tank absorption fields. On site investigations are needed for specific placement of buildings and utility lines, and for detailed design of foundations. All ratings are for undisturbed soils based on information gained from observations to a depth of 4 to 6 feet.

Item Affecting Use	Degree of Soil Limitation		
	NONE TO SLIGHT	MODERATE	SEVERE
Wetness[3]	With basements: Rapidly drained and well drained. Without basements: Rapidly, well and moderately well drained.	With basements: Moderately well drained Without basements: Imperfectly drained.	With basements: Imperfectly, poorly & very poorly drained. Without basements: Poorly & very poorly drained.
Depth to seasonal water table (seasonal means 1 month or more)	With basements: Below 150 cm Without basements: Below 75 cm	With basements: Below 75 cm Without basements: Below 75 cm	With basements: Above 75 cm Without basements: Above 60 cm
Flooding	None	None	Subject to flooding
Slope	0 to 9% (AD).	9 to 15% (E).	More than 15% (>E).
Shrink-swell Potential	Low	Moderate	High
Unified soil group[5]	GW, GP, SW, SP, GM, GC, SM, SC	ML, CL	CH, MH, OL, OH, Pt.
Potential frost action[6]	Low (F1, F2).	Moderate (F3).	High (F4).
Stoniness	Stones greater than 8 m apart	Stones 1.5 to 8 apart	Stones less than 1.5 m apart
Potential Concrete Corrosion	0.00 to 0.10% sulphate	0.10 - 0.50% sulphate	greater than 0.50% sulphate
Depth to Bedrock	With basements: More than 150 cm Without basements: More than 100 cm	With basements: 100 to 150 cm Without basements: 50 to 100 cm	With basements: Less than - 100 cm Without basements: Less than 50 cm

1. By reducing the slope limits by ½, this table can be used for evaluating soil limitations for buildings with large floor areas but with foundation requirements not exceeding those of ordinary 3-storey dwellings.
2. Some soils rated as having moderate or severe limitations may be good sites for an aesthetic or use standpoint but require more preparation or maintenance.
3. For an explanation of soil drainage classes see page
4. Reduce slope limits by ½ for those soils subject to hillside slippage.
5. This item estimates the strength of the soil, that is its ability to withstand applied loads.
6. The potential frost action classes are taken from the United States Army Corps of Engineers (1962), pp. 5 - 8. - See Table 6.

Table 9: Limitations of Soils for Permanent Buildings.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table
1-1/bc	Moderate	Moderate texture and stoniness limitations
1-2/bc	Moderate to Severe	Moderate texture and stoniness limitations on Chernozem; Very shallow depth to seasonal water table on Gleysol (1).
1-3/A	Severe	Very shallow depth to seasonal water table.
1-4/ab	Severe	High sulfate content (2)
1-5/ab	Severe	High sulfate content (2)
2-1/ab	Moderate	Moderate texture limitation below 60 cm

(1) Needs on-site investigations.

(2) A high soluble sulfate content results in potential concrete corrosion. The action of soluble sulfate is well documented by Swenson (1971). The concrete manual of the United States Bureau of Reclamation (1966) recognizes the following concrete corrosion categories: Negligible attack - less than 0.10%; Mild but positive attack - 0.10 to 0.20%; Considerable attack - 0.20 to 0.50%; Severe attack - greater than 0.50%.

TABLE 10. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR SEWAGE LAGOONS

A sewage lagoon (aerobic) is a shallow lake used to hold sewage for the time required for bacterial decomposition. Soils have two functions, (1) as an impounding vessel and (2) as material for the impounding embankment. When the lagoon is properly constructed it must be capable of holding water with minimum seepage.

Item Affecting Use	Degree of Soil Limitation		
	SLIGHT	MODERATE	SEVERE
Depth to water table[1] (seasonal or year round)	more than 150 cm	100-150 cm	less than 100 cm
Flooding[2]	None	None	Soils subject to flooding
Depth to Consolidated Bedrock	more than 150 cm	100-150 cm	less than 100 cm
Slope	less than 2%	2 - 9%	more than 9%
Organic Matter[4]	less than 2%	2 - 15%	more than 15%
Unified Soil Group[3]	GC, SC, CL, CH	GM, ML, SM, MH	GP, GW, SW, SP,[5] OL, OH, Pt

1. If the floor of the lagoon is nearly impermeable material at least 60 cm thick, disregard depth to watertable.

2. Disregard flooding if it is not likely to enter to damage the lagoon (low velocity and depth less than five feet).

3. Rated mainly for the floor of the lagoon.

4. Organic matter promotes growth of aquatic plants which are detrimental to the proper functioning of the lagoon.

5. Coarse textures constitute a possibility of groundwater contamination if floor of lagoon is not lined with impermeable material.

Table 11. Limitations of Soils for Sewage Lagoons.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 10.
1-1/bc	Moderate	Moderate texture limitation
1-2/bc	Moderate to Severe	Moderate texture limitation on Chernozems. Very shallow depth to seasonal water table on Gleysols (1)
1-3/A	Severe	Very shallow depth to seasonal water table
1-4/ab	Moderate to Severe	Moderate texture limitation on dominant soils. Very shallow depth to seasonal water table on Gleysols (1)
1-5/ab	Moderate	Moderate texture limitation
2-1/ab	Moderate	Moderate texture limitation

(1) Needs on-site investigations.

The guides on page 33 apply to soils to be used as absorption fields for septic tank effluent. A rating of severe need not mean that a septic tank system should not be installed but rather it indicates the difficulty and cost to be expected in installation and maintenance.

Permeability ratings are for soil layers at and below the depth of the tile line. Soils having a permeability rate greater than about 12 cm/hr or percolation rate less than about 8 min/cm are likely to present a pollution hazard to adjacent waters (Alberta Department of Manpower and Labour. 1972). The degree of hazard must however, be assessed by examining the proximity of the proposed installation to water bodies or the water table.

A seasonal water table, i.e. one persisting for more than one month, should be at least 120 cm below the bottom of the trench for soils having a slight to moderate limitation (United States Department of Health, Education and Welfare. 1969). It may, with caution, be possible to make some adjustment for the severity of a water table limitation in those cases where seasonal use of the facility does not coincide with the period of high water table.

The typical homeowner regards a soil absorption system as satisfactory as long as it can receive all the wastewater being generated without overflowing in the house itself (hydraulic failure). Soil absorption systems which are adequate hydraulically may fail by: (a) delivering excessive numbers of potentially pathogenic bacteria and viruses to private or public water supplies; (b) causing increased nitrogen and phosphorus inputs in ground or surface water supplies, which may in turn enhance eutrophication of surface water or cause potentially toxic nitrate levels in drinking water supplies (Beatty, M.T. and J. Bouma. 1973).

Failures due to inadequate removal of pathogens, nitrogen and phosphorus occur when there is inadequate soil (due to lack of thickness or to coarse texture) between a soil absorption system and highly porous material such as creviced bedrock or gravel (Bouma et al. 1972). Failure due to excessive build up of nitrogen or phosphorus in ground and surface waters may occur when there are too many homesites per unit area, even though the individual systems may each be functioning adequately to remove pathogens and absorb the liquid waste (Walker et al. 1973a, 1973b).

Table 12. Guides for Assessing Soil Limitations for Septic Tank Absorption Fields.

Item Affecting Use	Degree of Soil Limitation		
	Slight	Moderate	Severe
Permeability Class	Moderately rapid (approx. .4-12 cm/hr)	Moderate (approx. .2-4 cm/hr)	Slow (less than 2 cm/hr)
Percolation Rate[1]	Approx. 8-18 min/cm	18 to 24 min/cm	Slower than 24 min/cm
Depth to seasonal water table	More than 180 cm	120 to 180 cm	Less than 120 cm
Flooding Hazard	Not subject to flooding	Not subject to flooding	Subject to flooding
Slope	0 to 9 percent	9 to 15 percent	15 to 30 percent
Depth to Bedrock or Other Impervious Materials	More than 180 cm	120 to 180 cm	Less than 120 cm

[1] Field percolation test results are reliable only if the moisture is at or near field capacity when the test is run. In fact, nearly impermeable soils on which absorption fields have failed can give high percolation test results after periods of drought.

Table 13: Limitations of Soils for Septic Tank Absorption Fields.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 10.
1-1/bc	slight	
1-2/bc	slight to severe	Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-3/A	severe	Very Shallow Depth to Seasonal Water Table
1-4/ab	slight to severe	Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-5/ab	slight	
2-1/ab	slight	

(1) Needs on-site investigations.

Table 14. Guides for Assessing Soil Limitations for Trench-type Sanitary Landfills.

The trench-type sanitary landfill is a dug trench in which refuse is placed and covered daily with a layer of soil material. The daily depths of cover should be at least 15 cm and the final depth of top layer at least 60 cm. Because trenches are five meters or more deep, geological investigation is needed to determine the potential for pollution of groundwater as well as to ascertain the design. The presence of hard, non-rippable bedrock or gravelly strata in or immediately underlying the trench bottom is undesirable from the standpoints of excavation and potential pollution of groundwater.

Item Affecting Use	Degree of Soil Limitation		
	Slight	Moderate	Severe
Depth to Seasonal Water Table	(not class determining if more than 180 cm)		Less than 180 cm
Soil Drainage Class	Rapidly, well and moderately well drained	Imperfectly drained	Poorly and very poorly drained
Flooding	None	Rare	Occasional
Permeability	Less than 5 cm/hr	Less than 5 cm/hr	More than 5 cm/hr
Slope	0 to 15 percent	15 to 25 percent	More than 25 percent
Soil Texture[1] (dominant to a depth of 150 cm)	Sandy loam, loam, silt loam, sandy clay loam	Silty clay loam, clay loam, sandy clay, loamy sand	Silty clay, clay, muck, peat, gravel, sand
Depth to Hard Non-rippable Bedrock	More than 180 cm	More than 180 cm	Less than 180 cm
Stoniness Class	Slightly stony	Moderately stony	Very to excessively stony
Rockiness class	None	None	Slightly to extremely rocky

[1] Soil texture reflects ease of digging and moving and trafficability in the area.

Table 15: Limitations of Soils for Trench-Type Sanitary Landfills

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 14.
1-1/bc	moderate	Moderate Texture Limitation
1-2/bc	moderate to severe	Moderate Texture Limitation on Chernozems Very Shallow Depth to Seasonal Water Table on Gleysols (1) .
1-3/A	severe	Very Shallow Depth to Water Table
1-4/ab	moderate to severe	Moderate Texture Limitation on Solodized Solonetz Very shallow Depth to Seasonal Water Table on Gleysols (1)
1-5/ab	moderate	Moderate Texture Limitation
2-1/ab	moderate	Moderate Texture Limitation

(1) Needs on-site investigations.

TABLE 16. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR SHALLOW EXCAVATIONS

Shallow excavations are those that require digging or trenching to a depth of less than 2 metres for pipelines, sewer lines, utility lines and basements. Desirable soil properties are good drainage, good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or large stones and freedom from flooding. Additional interpretations concerning shrink-swell potential and corrosivity are needed for ultimate uses of the excavation. Texture is used as an index to workability and sidewall stability. If the bedrock is soft enough so that it can be dug out with ordinary handtools or light equipment, reduce ratings from severe to moderate.

Item Affecting Use	Degree of Limitation		
	SLIGHT	MODERATE	SEVERE
Soil drainage class	Rapidly and well drained	Moderately well drained	Imperfectly to very poorly drained
Depth to seasonal water table	Below 150 cm	From 75 - 150 cm	Above 75 cm
Flooding	None	Rare	Occasional
Slope	0 - 8 percent	8 - 15 percent	More than 15 percent
Texture of soil to depth of excavation	Fine sandy loam, sandy loam, silt loam, silty clay loam, sandy clay loam	Silt, clay loam, sandy clay, all gravelly types	Clay, silty clay, loamy sand, organic soils, all very gravelly types
Depth to bedrock	More than 150 cm	100 to 150 cm	Less than 100 cm
Stoniness class	Slightly stony	Moderately stony	Very stony
Rockiness class	None	Slightly rocky	Moderately to very rocky

Table 17: Limitations of Soils for Shallow Excavations.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 16.
1-1/bc	slight to moderate	Slight to Moderate Texture Limitation
1-2/bc	slight to severe	Slight to Moderate Texture Limitation on Chernozems Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-3/A	severe	Very Shallow Depth to Seasonal Water Table
1-4/ab	slight to severe	Slight to Moderate Texture Limitation on Solodized Solonetz Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-5/ab	slight to moderate	Slight to Moderate Texture Limitation
2-1/ab	slight to moderate	Slight to Moderate Texture Limitation

(1) Need on-site investigations.

TABLE 18. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR CAMP AREAS (Montgomery and Edminster. 1966)

This guide applies to soils to be used intensively for trailers and tents and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for campsites and parking areas. The soil should be suitable for heavy foot traffic and for limited vehicular traffic.[1] Soil suitability for growing and maintaining vegetation is not part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Item Affecting Use	Degree of Limitation		
	NONE TO SLIGHT	MODERATE	SEVERE
Wetness	Rapidly, well and moderately well drained soils. Water table below 75 cm during season of use	Moderately well and imperfectly drained soils. Water table below 50 cm during season of use	Imperfectly, poorly, and very poorly drained soils. Water table above 50 cm during season of use
Flooding	None	None during season of use	Floods during season of use
Permeability	Very rapid to moderate	Moderately slow and slow	Very slow
Slope	0 to 9 percent (AD)	9 to 15 percent (E)	Greater than 15 percent (greater than E)
Surface soil texture	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS and sand other than loose sand	SC, SiC, C, loose sand subject to severe blowing, organic soils
Coarse fragments[3] on surface	0 to 20 percent[4]	20 to 50 percent	Greater than 50 percent
Stoniness (stony)	Stones greater than 8 metres apart	Stones 8 to 1.5 metres apart	Stones less than 1.5 metres apart
Rockiness (rock)	No rock exposures	Rock exposures greater than 9 metres apart and cover less than 25 percent of the area	Rock exposures less than[5] 9 metres apart and cover greater than 25 percent of the surface

[1] For information specific to roads and parking lots see Table 5.

[2] Surface soil texture influences soil ratings as it affects foot trafficability, dust, soil permeability and erosion hazard.

[3] Coarse fragments include both gravels and cobbles. Gravels 2 - 80 mm, Cobbles 80 - 250 mm, Stones >250 mm.

[4] Some gravelly soils may be rated as slight if content of gravel exceeds 20 percent by only a small margin providing: (a) the gravel is imbedded in the soil matrix or (b) the fragments are less than 20 mm in size.

[5] Very shallow soils are rated as having a severe soil limitation for rockiness or stoniness. See also definitions of rockiness and stoniness in the Canadian System of Soil Classification (Canada Soil Survey Committee. 1976) pp. 139 - 140.

Table 19: Limitations of Soils for Camp Areas.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 18.
1-1/bc	Moderate	Moderate stoniness limitation
1-2/bc	Moderate to Severe	Moderate stoniness limitation on Chernozems Very shallow depth to seasonal water table on Gleysols (1)
1-3/A	Severe	Very shallow depth to seasonal water table.
1-4/ab	Severe	Very slow permeability on Solodized Solonetz. Very shallow depth to seasonal water table on Gleysols (1)
1-5/ab	Moderate	Moderate stoniness limitation
2-1/ab	Slight	

(1) Needs on-site investigations.

TABLE 20. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR PICNIC AREAS (Montgomery and Edminster. 1966)

This guide applies to soils considered for intensive use as park-type picnic areas. It is assumed that most vehicular traffic will be confined to access roads.[1] Soil suitability for growing and maintaining vegetation is not part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Items Affecting Use	Degree of Soil Limitation		
	NONE TO SLIGHT	MODERATE	SEVERE
Wetness	Rapidly, well and moderately well drained soils. Water table below 50 cm during season of use	Moderately well and imperfectly drained soils. Water table during season of use may be less than 50 cm for short periods	Poorly and very poorly drained soils. Water table above 50 cm and often near the surface for a month or more during season of use
Flooding	None during season of use	May flood once a year for short period during season of use	Floods more than once a year during season of use
Slope	0 to 9 percent (AD)	9 to 15 percent (E)	Greater than 15 percent (greater than E)
Surface soil texture[2]	SL,FSL,VFSL,L	SiL,CL,SCL, SiCL,LS, and sand other than loose sand	SC,SiC,C, loose and subject to severe blowing, organic soils
Coarse fragments[3] on surface	0 to 20 percent [4]	20 to 50 percent	More than 50 percent
Stoniness [3]	Stones greater than 1.5 metres apart	Stones 0.5 to 1.5 metres apart	Stones less than 0.5 metres apart
Rockiness	Rock exposures roughly 30 to 90 or more metres apart and cover less than 10% of the surface	Rock exposures 10 to 30 metres apart and cover about 10 to 25 percent of the surface	Rock exposures less than 10 metres apart and cover greater than 25 percent of the surface

[1] For information specific to roads or parking lots see Table 5.

[2] Surface soil texture influences soil ratings as it affects foot trafficability, dust, soil permeability and erosion hazard.

[3] See also definitions for gravel, rockiness and stoniness in the Canadian System of Soil Classification (Canada Soil Survey Committee. 1976) pp 139 - 140. Coarse fragments include both gravel and cobbles. Gravels 2 - 80 mm, Cobbles 80 - 250 mm, Stones more than 250 mm.

[4] Some gravelly soils may be rated as slight if the content of gravel exceeds 20 percent by only a small margin providing (a) the gravel is embedded in the soil matrix or (b) the fragments are less than 20 mm in size.

Table 21: Limitation of Soils for Picnic Areas

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 20.
1-1/bc	Slight	
1-2/bc	Slight to Severe	Very shallow depth to seasonal water table on Gleysols (1)
1-3/A	Severe	Very shallow depth to seasonal water table
1-4/ab	Slight to Severe	Very shallow depth to seasonal water table on Gleysols (1)
1-5/ab	Slight	
2-1/ab	Slight	

(1) Needs on-site investigations.

TABLE 22. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR PLAYING FIELDS. (Montgomery and Edminster. 1966)

This guide applies to soils considered for intensive use as playing fields for organized games such as baseball or football. Soil suitability for growing and maintaining vegetation is not a direct consideration in this guide, but is an important item to consider.

Item Affecting Use	Degree of Soil Limitation		
	SLIGHT	MODERATE	SEVERE
Flooding	none during season of use	subject to occasional flooding. Not more once in 3 years	subject to more than occasional flooding
Wetness	rapidly to moderately well drained	imperfectly drained soils subject to occasional ponding	poorly and very poorly drained
Depth to water table	more than 75 cm during season of use	50 to 75 cm during season of use	less than 50 cm during season of use
Permeability	very rapid to moderate 50 cm/hr to 15 mm/hr	moderately slow 15 - 5 mm	slow and very slow (less than 5 mm/hr)
Slope	0 - 2 percent	2 - 5 percent	more than 5 percent
Surface Texture	SL,FSL,VFSL,L	CL,SCL,SiCL,SiL LS and S other than loose sand	SC,SiC,C, loose sand, organic
Depth to Bedrock	more than 100 cm	60 to 100 cm	less than 50 cm
Surface stoniness	slightly stony	moderately stony	very to excessively stony

Table 23: Limitation of Soils for Playing Fields.

Mapping Unit	Degree of Limitation	Limiting Soil or Landscape Property from Table 22.
1-1/bc	moderate	Moderate Stoniness and Slope Limitations
1-2/bc	moderate to severe	Moderate Stoniness and Slope Limitations on Chernozems Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-3/A	severe	Very Shallow Depth to Seasonal Water Table
1-4/ab	severe	Very Slow Permeability on Solodized Solonetz Soils Very Shallow Depth to Seasonal Water Table on Gleysols (1)
1-5/ab	moderate	Moderate Stoniness Limitation
2-1/ab	slight	

(1) On-site investigations needed.

Table 24. Suitability Ratings of Soils as Sources of Gravel.

The main purpose of these ratings is to indicate local sources of gravel. The ratings are based on the probability that soils contain sizable quantities of gravel.

Item Affecting Use	Degree of Soil Suitability		
	Good	Fair	Poor
Unified Soil Group	GW, GP	GP-GM, GW-GM	GM, GP-GC, GW-GC (all other groups unsuited)
Flooding	none or occasional		frequent or constant
Wetness	better than poorly drained[1]		
Depth of Overburden	less than 60 cm	60 to 150 cm	more than 150 cm

[1] See page 7 for an explanation of drainage classes.

Table 25: Suitability of Soils As a Source of Gravel

Mapping Unit	Degree of Suitability	Limiting Soil or Landscape Property from Table 24.
1-1/bc	unsuited	Unified Soil Group Texture Unsuited - This Refers to All Mapping Units
1-2/bc	unsuited	
1-3/A	unsuited	
1-4/ab	unsuited	
1-5/ab	unsuited	
2-1/ab	unsuited	

TABLE 26. SUITABILITY RATINGS OF SOILS AS SOURCES OF ROADFILL

The ratings in this table indicate the performance of a soil after it is placed in a road embankment and also the degree of difficulty in excavating the fill material. Ratings of the material are the same as for road location (Table 3) however ratings of factors governing excavation differ.

Item Affecting Use	Degree of Suitability[1] GOOD	FAIR	POOR
	Rapidly to moderately well drained[2]	Imperfectly drained	Poorly and very poorly drained
Engineering Groups			
Unified Group	GW, GP, GC, SW, SP, SM, SC	ML, CL with P.I.[3] less than 15	CH, MH, OL, OH, Pt, and CL with P.I. more than 15
AASHO Group Index	0 - 4	5 - 8	greater than 8
Stoniness	none to moderately stony	very stony	exceedingly stony
Depth to consolidated bedrock	more than 2 m	1 to 2 m	less than 1 m
Slope	0 - 15%	15 - 30%	more than 30%

[1] A rating of unsuited (u) is applied to land units, such as bedrock (R), where no conventional fill material is present.

[2] See page 7 for an explanation of drainage classes.

[3] P.I. means plasticity index.

Table 27: Suitability of Soils as a Source of Roadfill.

Mapping Unit	Degree of Suitability	Limiting Soil or Landscape Property from Table 26.
1-1/bc	fair	Moderate Texture Limitation
1-2/bc	fair to poor	Moderate Texture Limitation on Chernozems Poorly Drained Gleysols (1)
1-3/A	poor	Poorly Drained
1-4/ab	fair to poor	Moderate Texture Limitation on Solodized Solonetz Soils Poorly Drained Gleysols (1)
1-5/ab	fair	Moderate Texture Limitation
2-1/ab	good	

(1) On-site investigations needed.

TABLE 28. SUITABILITY RATINGS OF SOILS AS SOURCES OF TOPSOIL

Topsoil, for these ratings, refers essentially to Ah horizon material. In some cases the B, and even C horizon materials could be used for dressing disturbed land. These ratings are intended for use by engineers, landscapers, planners and others who make decisions about selecting, stockpiling and using topsoil. These ratings are based on quality of topsoil and ease of excavation. In addition to the Good, Fair, and Poor ratings described below, an Unsuited (U) rating is used.

Item Affecting Use	Degree of Suitability[1]		
	GOOD	FAIR	POOR
Texture	SL, FSL, VFSL, L, SiL	CL, SCL, SiCL	LS, S, SC, SiC, C, Organic
Depth of topsoil	more than 15 cm	8 - 15 cm	less than 8 cm
Flooding	none	may flood occasionally	frequently or constantly flooded
Wetness	Drainage class not determining if better than poorly drained		poorly and very poorly drained
Coarse fragments % by volume	less than 3%	3 - 15%	more than 15%
Slope	less than 9%	9 - 15%	more than 15%
Stoniness	none to slightly stony	moderately stony	very to excessively stony
Salinity of topsoil	E.C.[2] 0 - 1[3]	E.C. 1 - 3	E.C. more than 3
Permeability of upper subsoil	moderate	slow	very slow

[1] A rating of unsuited (U) is used for soil and land units that do not have topsoil present.

[2] E.C. - electrical conductivity of a saturation extract in mmhos/cm.

[3] These are the limits suggested by the Alberta Soil and Feed Testing Laboratory when considering lawn growth.

Table 29: Suitability of Soils as a Source of Topsoil

Mapping Unit	Degree of Suitability	Limiting Soil or Landscape Property from Table 28.
1-1/bc	fair	Moderate Stoniness Limitation
1-2/bc	fair to poor	Moderate Stoniness Limitation on Chernozems Poorly Drained Gleysols (1)
1-3/A	poor	Poorly Drained
1-4/ab	fair to poor	Moderate Stoniness and Depth Limitations on Solodized Solonetz soils Poorly Drained Gleysols (1)
1-5/ab	poor	Very Saline (1)
2-1/ab	good	

(1) On-site investigations needed.

Agricultural Capability

These ratings are made using the Soil Capability for Agriculture (Canada Land Inventory, 1965). The CLI capability for agriculture is described using classes and subclasses. The classes indicate the relative degree of limitation, whereas the subclasses indicate the type of limitation. Seven classes are recognized in the system and are described as follows:

Class 1 - Soils in this class have no significant limitation in use for crops.

Class 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.

Class 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices.

Class 4 - Soils in this class have severe limitations that restrict the range of crops.

Class 5 - Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible.

Class 6 - Soils in this class are capable of only producing perennial forage crops and improvement practices are not feasible.

Class 7 - Soils in this class have no capability for arable culture or permanent pasture.

The following subclasses are recognized in the system and are described as follows:

A - the length of the frost-free period is usually adequate but the amount of precipitation is a limiting factor to crop growth.

D - the depth of the rooting zone is restricted by soil conditions other than wetness or consolidated bedrock.

F - low fertility.

H - the amount of precipitation is usually adequate but the length of frost-free period is limiting to the growth of cereal crops.

I - inundation by streams or lakes.

M - low moisture-holding capacity.

N - presence of enough soluble salts to adversely affect crop growth or restrict the range of crops than can be grown.

P - stoniness.

S - used in a collective sense for one or more subclasses.

T - adverse topography

W - excess water other than from flooding.

Table 30: Soil Capability for Agriculture

Mapping Unit	Class and Subclass	Limiting Soil or Landscape Property from page 51.
1-1/bc	1	
1-2/bc	1^{7} $5W^{3}$	Excess Water on 30% of the Area
1-3/A	5W	Excess Water
1-4/ab	$3D^{7}$ $5W^{3}$	Restricted Depth of Rooting Zone On 70% and Excess Water on 30% of Area
1-5/ab	2N	Presence of Enough Soluble Salts to Affect Crop Growth
2-1/ab	2M	Low Moisture Holding Capacity

(1) Small numerals placed after a class numeral give the approximate proportion of the class out of a total of 10.

According to the Agro-Climatic Map of Alberta (Bowser 1967) the Langdon area is in climatic subregion 1 where the amount of precipitation has usually been adequate and the frost-free period long enough to permit the growing of all the dryland crops that are typical to the Prairie Region of Western Canada. The best soils therefore, are placed in Class 1 and any soil or landscape property that restricts the range of crops that can be grown, or causes the use of moderate or special conservation practices, or renders the area suitable only for forage crops requires that an area should be placed in Classes 2, 3 or 5 as indicated in Table 30.

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GLOSSARY

This is included to define terms commonly used in the report; it is not a comprehensive soil glossary.

aeolian (eolian) deposit - material deposited by wind, includes both loess and dune sand.

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

alluvial deposit - material deposited by moving water.

aspect - orientation of the land surface with respect to compass direction.

Atterberg limits - see plastic limit, liquid limit.

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

bearing capacity - the average load per unit area that is required to rupture a supporting soil mass.

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

cation - exchange capacity (C.E.C.) - a measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents/100 grams of soil.

coarse fragments - rock or mineral particles greater than 2 mm in diameter.

colluvium - a heterogeneous mixture of material that has been deposited mainly by gravitational action.

creep - slow mass movement of soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and alternate freezing or thawing.

edaphic - (i) of or pertaining to the soil, (ii) resulting from, or influenced by, factors inherent in the soil or other substrate rather than by climatic factors.

eluviation - the removal of soil material in suspension or in solution from a layer or layers of the soil.

erosion - the wearing away of the land surface by running water, wind, or other erosive agents. It includes both normal and accelerated soil erosion. The latter is brought about by changes in the natural cover or ground conditions and includes those due to human activity.

field capacity - the percentage of water remaining in a soil after having been saturated and after free drainage has practically ceased.

fluvial deposit - accumulations of sediment (sand, gravel, silt, etc.) produced by the action of a stream or river.

glacio-fluvial deposits - material moved by glaciers and subsequently deposited by streams flowing from the melting ice.

gley - gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction is characterized by a gray, commonly mottled appearance, which on drying shows numerous rusty brown iron stains or streaks. Those horizons in which gleying is intense are designated with the subscript "g".

grain-size analysis - the determination of the various amounts of sand, silt, clay, gravel and cobbles in a soil sample.

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

horizon - a layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes. Soil horizons may be organic or mineral.

illuviation - the process of deposition of soil material removed from one horizon to another in the soil, usually from an upper to a lower horizon in the soil profile. Illuviated compounds include silicate clay, iron and aluminum hydrous oxides and organic matter.

infiltration - the downward entry of water into the soil.

lacustrine deposit - material deposited in lake water and later exposed either by a lowering of the water or by uplift of the land.

landforms - the various shapes of the land surface resulting from a variety of actions, such as deposition, erosion, etc.

liquid limit (upper plastic limit) - the water content at which a pat of soil, cut by a groove of standard dimensions, will flow together for a distance of 12 mm under the impact of 25 blows in a standard liquid limit apparatus.

lithic - a soil subgroup modifier that indicates a bedrock contact within 50 cm (20 in.) of the soil surface.

loamy - intermediate in texture between fine-textured and coarse textured.

loess - material transported and deposited by wind and consisting of predominately silt-sized particles.

morphology, soil - the makeup of the soil, including the texture, structure, consistence, colour, and other physical, mineralogical and biological properties of the various horizons of the soil profile.

miscellaneous land type - a mapping unit for areas of land that have little or no natural soil - e.g. rough mountainous land.

morainal - accumulations of unsorted, unstratified till deposited by direct action of glacier ice in a variety of topographic landforms.

mottles - spots or blotches of different colour or shades of colour interspersed with the dominant colour. Mottling in soils usually indicates poor aeration and drainage.

organic matter - the decomposition residues of plant material derived from: (i) plant materials deposited on the surface of the soil, and (ii) roots that decay beneath the surface of the soil.

parent material - unconsolidated mineral material or peat from which the soil profile develops.

peat - unconsolidated soil material consisting largely of undecomposed to partially decomposed organic matter accumulated under conditions of excessive moisture.

ped - a unit of soil structure such as a prism, block or granule formed by natural processes (in contrast to a clod which is formed artifically).

pedology - those aspects of soil science involving the constitution, distribution, genesis and classification of soils.

percolation, soil water - the downward movement of water through soil. Especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

permeability - the ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. Since different horizons of soil vary in permeability, the particular horizon under question should be designated.

pH - a notation used to designate the relative acidity or alkalinity of soils and other materials. A pH of 7.0 indicates neutrality, higher values indicate alkalinity, and lower values acidity.

phase, soil - a subdivision of a taxonomic class based on soil characteristics or combinations thereof which are considered to be potentially significant to man's use or management of the land.

plastic limit - water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm in diameter.

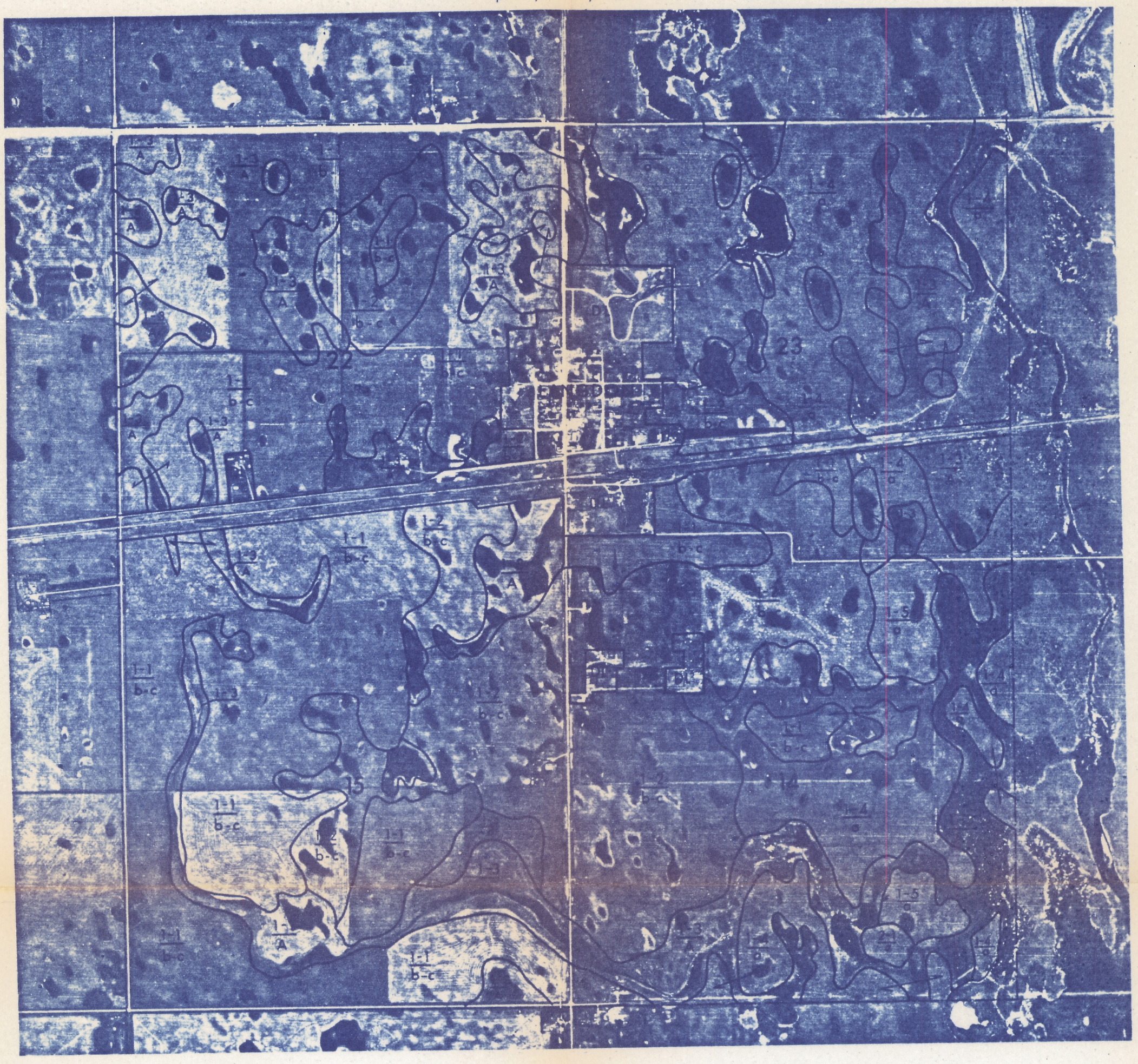
plasticity index - the numerical difference between the liquid and the plastic limit.

profile - a vertical section of the soil throughout all in horizons and extending into the parent material.

relief - the elevations or inequalities of the land surface when considered collectively. Minor configurations are referred to as "microrelief".

SOILS MAP OF THE LANGDON AREA

Tp. 23; R. 27; W. 4



SOILS LEGEND:

PARENT MATERIAL	SOIL UNIT	SURFACE TEXTURE (1)	TOPOGRAPHIC CLASSES	DRAINAGE CLASSES (2)	DOMINANT SOIL SUBGROUP	SIGNIFICANT SOIL SUBGROUPS
medium to moderately fine textured till	1-1	L	b,c	well to imperfectly	thin Orthic Black	thin Rego Black thin Gleyed Rego Black
	1-2	L	b,c	well to poorly	thin Orthic Black	thin Gleyed Rego Black Rego Humic Gleysol - saline
	1-3	L	A	poorly	Rego Humic Gleysol - saline	
	1-4	L	a	moderately well to poorly	Black Solodized Solonetz	thin Gleyed Rego Black - saline Rego Humic Gleysol - saline
	1-5	L	a	moderately well to imperfectly	thin Rego Black - saline	thin Gleyed Rego Black - saline
moderately coarse textured glaciofluvial over till	2-1	SL	a,b	well to imperfectly	thin Orthic Black	thin Gleyed Rego Black

(1) Refer to pages 5, 6 and 7 of report

(2) Refer to page 7 of report

soil line

boundary of mapped area

SYMBOLS:

L - Loam

SL - Sandy Loam

DL - Disturbed Land

W - Water

SLOPE CLASSES:

A - depressional to level	0	to 0.5% slope
a - nearly level	0	to 0.5% slope
b - gently undulating	0.5+	to 2 % slope
c - undulating	2+	to 5 % slope

APPROXIMATE SCALE: 1:15,000

1250 0 1250 2500 3750 Feet

Compiled on Uncontrolled Mosaic

Mapped and Compiled by: M. D. Scheelar

Soils Division

1978

Alberta RESEARCH COUNCIL