Alberta Research Council
Open File Report 1973-4

SOIL INTERPRETATIONS

for

SELECTED COMPONENTS OF COMMUNITY DEVELOPMENT

Within The Town of

Ponoka, Alberta

Prepared for: *Battle River Regional Planning Commission*

Prepared by: *Soils Division, Alberta Research Council*

Coordinated by: *Alberta Institute of Pedology*

M.D. Scheelar

ALBERTA RESEARCH COUNCIL

March, 1973

CONTENTS

INTRODUCTION

For more than three decades, planners and engineers have used reconnaissance soil survey maps for information about the soils of their particular area of concern. These reconnaissance soil survey maps were designed primarily for inventory purposes and as guides for determining land capability for agriculture. The soil properties affecting agricultural uses of soil are similar to those affecting urban uses. Detailed soil surveys (2) (4) give users more detailed information and thus are useful guides in developing comprehensive land use plans for urban development.

This report describes a detailed soil survey and soil interpretations of approximately 1,100 acres in selected areas within the town of Ponoka, Alberta. Ponoka is located in Townships 42 and 43, Range 25, west of the 4th meridian. It is approximately 60 miles south of the city of Edmonton and is accessible by highways 2 or 2A.

The soil map, printed at a scale of 440 feet to the inch, shows the location and extent of the soil areas. The soil legend included with the map indicates the classification of the soils.

The report describes the cultural and physical features of the area, classification of the soils, and some of the physical properties of the soils. A list of limiting soil properties and a table of soil interpretations are included. The soil interpretations indicate the degree of limitation (slight, moderate or severe) that each of the soils have for designated uses.

A glossary defining some of the more frequently used soil terminology is included in the appendix.

CULTURAL AND PHYSICAL FEATURES OF THE AREA

At present the land in the map area is developed for a number of diversified uses including agricultural cropland and feedlots, homesites and recreational facilities.

The terrain is composed of depressional to undulating river floodplains, level to gently undulating terraces, and gently undulating to rolling uplands. Low ridges are common in the southern portion of the area.

The soils in the Battle River valley are developed primarily from alluvial material deposited in recent times. These soils range in texture from fine sand to silty clay loam; some of the terraces, however, are gravelly.

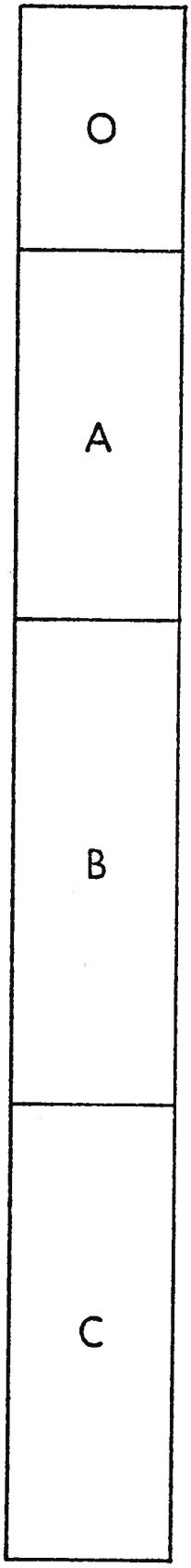
In the upland areas the soils range from fine sand to clay loam in texture. The sandy soils are of variable depth and overlie glacial till. Comparatively shallow deposits of sandy soils are characteristic of the northwestern portion of the area.

THE SOILS

I SOIL DEVELOPMENT

Soil is an organic or mineral layer (other than consolidated bedrock) thicker than four inches occurring naturally on the earth's surface. This layer has been subjected to the factors of soil development - climate, vegetation, living organisms, topography, and the properties of its parent material over a sufficient period of time to cause changes in its chemical and physical composition. These changes are reflected in the development of a sequence of horizons as indicated in Figure 1. The recognition of differences in the properties of each horizon permits the classification of the soils.

Figure 1. A sketch of a soil profile showing major soil horizons and a brief outline of differences in properties.



O - an organic horizon at the surface. May be further subdivided with respect to degree of decomposition. Characteristic of peaty phase of Gleysols only. Absent in all other soils in this area.

A - a dark colored mineral horizon at or near the surface in which there is an accumulation of organic matter. Present in all soils in map area. May be lighter colored in lower portion in Eluviated Black soils. May be dull in color in Gleysolic soils and gleyed intergrades. May be saline or carbonated in Saline Humic Gleysols, Carbonated Humic Gleysols, and Carbonated Black soils.

B - a mineral horizon below the A horizon in which there is no appreciable amount of organic matter but which is affected by other soil processes. There may be a change in color or structure as in Orthic Black or an accumulation of clay as in Eluviated Black soils. May be dull in color in Gleysolic soils and gleyed intergrades. May be carbonated or saline in Saline Humic Gleysols, Carbonated Humic Gleysols and Carbonated Black soils.

C - a mineral horizon below the B horizon which is comparatively unaffected by soil forming processes except for gleying and accumulation of salts and carbonates.

II. SOIL CLASSIFICATION AND MAPPING

The soil legend shown on the accompanying map indicates the classification of the soils in the map area. The soils were mapped and classified according to the System of Soil Classification for Canada (1).

Seven soil associations were mapped: two on recent alluvium, two on alluvial and aeolian sand, two on gravelly alluvial material, and one on till. Because of soil variability, the soil association, which often contains two or more soil subgroups, was employed in mapping the area. The soil association is further subdivided into dominant and significant soil subgroup members. The dominant soil represents more than 60 per cent of the association and the significant soil less than 40 per cent. Each mapping unit of a soil association contains unique parent material, terrain, and soil characteristics.

In a few instances two soil associations have been mapped as a complex e.g. Galahad 1 and Meniak 1. Such areas are mapped in this manner because it was impractical to separate the associations at the scale of mapping employed. These areas probably require considerable on-site investigations.

The use of soil associations is not regarded as a shortcoming of the mapping procedure because most of the inseparable units, although of significance taxonomically, are not sufficiently different in regard to soil properties to affect their use for urban development.

In the following section a generalized description of the soil associations used in the Ponoka area is presented. A detailed listing of the mapping units within each soil association is shown in the legend of the soil map.

Soil Associations

Beaumont Soil Association

Soils of the Beaumont association are moderately well drained Black

Chernozemic soils developed from weakly calcareous glacial till. They occur in the northwestern portion of the area on gently undulating landscapes where the slopes are usually less than two per cent. The surface soil (A horizon) is well granulated and slightly acidic, ranges from fine sandy loam to loam in texture, and vary in thickness from 8 to 16 inches. The subsoil (B and C horizons) ranges from loam to clay loam in texture, is moderately stony and is mildly alkaline in reaction.

Bigstone Soil Association

The Bigstone association consists of rapidly to well drained Black Chernozemic soils developed from moderately coarse to medium textured alluvial and aeolian material. They are distributed throughout the upland portion of the map area. The topography is quite variable, ranging from gently undulating to steeply rolling.

The surface soil (A horizon) is moderately coarse to medium textured, slightly acidic to neutral in reaction, and ranges from 6 to 18 inches thick. The subsoil (B and C horizons) is similar in texture and mildly alkaline in reaction. In some locations a secondary enrichment of carbonates occurs in the A and B horizons. Such soils have been designated as Carbonated Black.

Millet Soil Association

The Millet soil association consists of poorly to very poorly drained Gleysolic soils which often have a surface accumulation of peat (up to 16 inches). Millet soils are moderately coarse to medium textured and are developed from alluvial materials. The associated topography is level to depressional.

The surface soil (A horizon) is loose, neutral to moderately alkaline in reaction and ranges in texture from loamy fine sand to fine sandy loam. It varies in thickness from 8 to 12 inches. The subsoil is of similar texture, highly gleyed and mottled, and is moderately alkaline in reaction.

An enrichment of carbonates and soluble salts in the A and B horizons occurs in soils designated as Carbonated Humic Gleysols and Saline Humic Gleysols.

Sedgewick Soil Association

Soils of the Sedgewick association are rapidly to well drained Black Chernozemic soils developed from alluvial gravels. They occur on gently undulating topography with slopes of less than two per cent.

The surface soil (A horizon) is loose, slightly acidic to neutral in reaction and moderately coarse to medium textured. The A horizon varies from 6 to 12 inches in thickness. The subsoil (B and C horizons) is neutral to mildly alkaline and consists of stones and gravel ranging from 2 to 100 mm in diameter.

Carbonated Black soils have a secondary enrichment of carbonates in the A and B horizons.

Forestburg Soil Association

Soils of the Forestburg association are poorly to very poorly drained Humic Gleysols developed from alluvial gravels. Gleying is prominent in all horizons indicating a seasonal or permanent high water table. These soils often have up to 16 inches of peaty surface layers. They occur in depressional positions in the western portion of the map area.

The surface soil (A horizon) is neutral to moderately alkaline, fine sandy loam in texture, and is from 8 to 12 inches thick. The subsoil is similar to that of the Sedgewick soil association except for the occurrence of gleying.

Galahad Soil Association

Soils of the Galahad association consist of imperfectly drained Regosolic soils developed from recent alluvial deposits. They range in texture from fine sandy loam to silt loam. Distinct brownish-yellow mottles occur throughout the soil profile indicating seasonal high water table. The presence of buried organic horizons suggest that occasional flooding may occur.

The neutral to moderately alkaline surface soil (A horizon) varies in thickness from 12 to 24 inches. The subsoil (B and C horizons) is mildly to moderately alkaline in reaction. The texture ranges from coarse to moderately coarse in mapping unit 1 to moderately fine in mapping unit 2.

Menaik Soil Association

Menaik soils consist of poorly to very poorly drained Humic Gleysols developed from recent alluvial material. They occur in depressional positions on the Battle River floodplain. Prominent mottles and gleying occur throughout the soil profile and a peaty surface layer of from 6 to 16 inches in thickness often occurs. Surface soils and subsoils are similar to those of the Galahad association except for stronger gleying.

Miscellaneous Land Types

Areas of low development potential due to steep slopes and areas that have been disturbed by man's activities to an extent that soil classification is impractical have been delineated as Rough Broken Land and Disturbed Land on the soil map. Such areas have been excluded from detailed inspection in the survey and require on-site investigations.

ENGINEERING PROPERTIES OF THE SOILS

Samples were taken from representative soils horizons in the area. Engineering tests were carried out on the samples and the results are shown in Table 1. A brief description of the significance of each analytical parameter is given as follows:

1. Mechanical Analysis

The mechanical analysis was made by combined sieve and hydrometer analysis. The data shows the particle size distribution within the soils; the amounts of the gravel and sand fractions are determined by sieving while the silt and clay are determined by sedimentation techniques. The amount of each soil separate contained in a soil determines its texture. Where texture is known, approximations and estimations can be made of many soil properties, such as bearing value, water-holding capacity, frost-heave liability, soil-cement construction adaptability, etc.

2. Plasticity

In soil mechanics plasticity is defined as that property of a material which allows it to be deformed rapidly, without rupture, without elastic rebound, and without volume change (3).

Tests have been devised to determine the moisture content of a soil when it changes from one major physical condition to another. These tests conducted on the minus No. 40 sieve-size material, 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 limit

ABLE Eng ing ta of sont soil S , from Ponoka

Mapping Associations	Mapping Unit	Depth from Surface (inches)	Grain Size Analysis: Per cent Passing Sieve: 1 in	3/4 in	5/8 in	No. 4	No. 10	No. 40	No. 200	Per cent Smaller Than: .05 mm	.005 mm	.002 mm	.001 mm	Atterberg Limits: Liquid Limit	Plastic Limit	Plasticity Index	Activity No. Pl/C	Textural Classification: AASHO	Unified	USDA
Beaumont	Bmt 1	0-16	100	100	100	100	99	92	53	52	22	16	13	37	30	7	0.4	A-4 (4)	ML	L
		16-34	100	100	100	99	98	91	59	58	32	27	22	27	18	9	0.3	A-4 (4)	CL	L
		34-70	100	100	100	96	94	83	72	70	47	37	30	32	22	10	0.3	A-4 (6)	CL	CL
		70-100	100	100	100	99	97	90	61	59	36	29	22	26	18	8	0.3	A-4 (4)	CL	CL
Bigstone	Bgt 4	0-10	100	100	100	100	100	99	22	-	-	-	-	NP	NP	NP	-	A-2-4	SMd	-
		10-25	100	100	100	100	100	100	19	18	12	11	11	NP	NP	NP	-	A-2-4	SMd	LS
		25-36	100	100	100	100	100	100	18	16	13	12	12	NP	NP	NP	-	A-2-4	SMd	LS
		36-48	100	100	100	100	100	100	18	16	12	10	10	NP	NP	NP	-	A-2-4	SMd	LS
		48-60	100	100	100	100	100	99	15	13	12	11	10	NP	NP	NP		A-2-4	SMd	S
Bigstone	Bgt 6	0-11	100	100	100	100	100	96	19	17	9	8	8	NP	NP	NP	-	A-2-4	SMd	LS
		11-29	100	100	100	100	100	95	18	14	11	10	9	NP	NP	NP	-	A-2-4	SMd	LS
		29-39	100	100	100	100	100	93	14	12	10	9	9	NP	NP	NP	-	A-2-4	SMd	LS
		39-53	100	100	100	100	100	92	17	13	9	8	7	NP	NP	NP	-	A-2-4	SMd	LS
		53-61	100	100	100	100	100	95	15	13	11	10	10	NP	NP	NP	-	A-2-4	SMd	LS
Bigstone	Bgt 1/t	0-10	100	100	100	100	99	94	27	-	-	-	-	30	26	4	-	A-2-4	SMu	-
		10-30	100	100	100	100	98	90	29	28	18	16	16	20	-	-	-	-	-	SL
		30-46	100	100	100	100	100	97	92	90	50	33	25	34	23	11	0.3	A-6 (8)	CL	SiCL
		46-70	100	100	100	100	99	93	48	43	22	20	18	24	17	7	0.4	A-4 (2)	SM-SC	L
Bigstone	Bgt 1/t	0-12	100	100	100	100	99	92	44	42	20	17	15	36	28	8	0.5	A-4 (2)	SMu	SL
		12-28	100	100	100	99	98	90	44	40	23	20	18	24	18	6	0.3	A-4 (2)	SM-SC	SL-SCL
		28-34	100	100	100	98	98	94	48	47	27	24	21	23	18	5	0.2	A-4 (3)	SM-SC	SCL
Galahad	Gld 1	0-44	100	100	100	100	100	99	34	32	18	16	13	32	24	8	0.5	A-2-4	SMu	SL
		44-69	100	100	100	100	100	96	12	10	9	8	7	NP	NP	NP	-	A-2-4	SM-SM	S
		69-90	100	100	100	100	100	65	12	10	9	7	6	NP	NP	NP	-	A-2-4	SM-SM	S
Galahad	Gld 2	0-21	100	100	100	100	100	100	66	-	-	-	-	57	46	11	-	A-7-5(11)	MH	-
		21-48	100	100	100	100	100	100	68	67	38	28	20	44	34	10	0.4	A-5 (8)	ML	L-CL
		48-72	100	100	100	100	100	100	69	56	33	28	24	37	24	13	0.5	A-6 (8)	CL	L-CL
Menaik	Mnk 1	0-9	100	100	100	100	100	100	53	-	-	-	-	-	-	-	-	-	-	-
		9-34	100	100	100	100	100	100	78	76	37	30	22	35	24	11	0.4	A-6 (8)	CL-ML	CL
		34-64	100	100	100	100	100	100	33	32	20	16	13	27	23	4	0.3	A-2-4	SMd	SL
Sadgewick	Sgw 1	30-60	40	20	10	10	10	4	1	-	-	-	-	-	-	-	-	A-1-a	GW	G

and the plastic limit. This parameter gives the range in moisture contents 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 whereas a large plasticity index, such as 20, shows that considerable water can be added before a soil becomes liquid.

3. Activity Number

Activity is a term applied to plastic soils in reference to a change in volume that takes place in the presence of varying moisture conditions. The more active a soil, the greater, in general, will be its change in volume when passing, for example, from the liquid limit to the shrinkage limit. The activity number is defined as the plasticity index divided by the per cent by weight of clay size particles. Clays for which the activity number is less than .75 are considered relatively inactive; normal activity is associated with values between .75 and 1.5; while values greater than 1.5 indicate progressively more active clays (3).

4. Soil Classification

A. AASHO Classification System

The American Association of State Highway Officials system is an engineering property classification based on field performance of highways. In the AASHO system, soil material is classified into seven groups. Each group has about the same general load-carrying capacity. The groups are designated A-1 to A-7; the best soils for road subgrades are classified as A-1, the next best A-2, with the poorest soils classified 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 indexes range from 0 for the best subgrades to 20 for the poorest.

b. Unified Soil Classification System

In the Unified Soil Classification system the soils are identified according to their textures and plasticity and are grouped according to their performance as engineering construction materials. In this system, soil materials are divided into coarse grained soils, fine grained soils and highly organic soils. The coarse grained 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 having 50 per cent or less of material passing the No. 200 sieve; fine grained have more than 50 per cent material passing the No. 200 sieve. The letters G, S, C, M, and O stand for gravel, sand, clay, silt, and organic material respectively. The designation CL, for example, indicates silts mixed with clays whereas SC shows sands with an appreciable amount of fines. Also recognized in the Unified System are organic silts (OL), organic clays (OH), and peat or other highly organic soils (PT).

c. United States Department of Agriculture System

The system of textural classification used by Canadian soil scientists is known as the USDA system. There is some variation in the size limits of the particles between the USDA system and the two engineering systems but the differences are not great. A comparison of the different systems is given in the PCA Soil Primer (4).

SOIL SURVEY INTERPRETATIONS

During the course of a soil survey, pedologists make numerous soil observations and descriptions to assist with the compilation of the soil map and report. The soil map, as a result, may appear complex to people not familiar with pedology. Soil survey interpretations are therefore included

with this report in order that the soil information may be more easily understood.

Soil survey interpretations should be treated as evaluations of soil performance not as recommendations for the use of soils. They are useful in aiding site selection and assist the planner, engineer or developer to avoid costly mistakes. However, the interpretations are not intended to eliminate on-site investigations for specific structures but are intended to be an aid in planning these investigations to reduce their number and thus minimize cost.

For each use, the soils are rated in terms of degree of limitation - slight, moderate or severe. These categories are defined as follows: slight - soils with few known limitations for the use indicated; moderate - soils that have one or more properties limiting their use. Correcting these factors will increase construction costs but if not corrected, maintenance costs will increase, severe - soils that have one or more properties that seriously limit their use. The cost of development may be very high but using these soils without employing corrective measures could result in failure. The decision as to whether or not a soil will be used for a specific purpose, regardless of the soil limitation, is beyond the scope of this report.

The four main components of community development considered to be the most important to this study are: (1) lawns and landscaping, (2) sewage disposal, (3) homesite locations with basements and, (4) streets and roads.

Soil properties and landscape features that appear important in affecting the designated uses of the soils in the Ponoka area are presented in Table 2.

The suitability of the various mapping units for the selected uses is shown in Table 3. These ratings - slight, moderate and severe, are determined on the basis of the properties listed in Table 2. The principal limiting properties are shown by figures that correspond to the numbers in Table 2.

1. Seasonal or permanent high water table
2. Droughtiness
3. Poor trafficability
4. Steep slopes
5. Topsoil salinity
6. High soluble sulphate content
7. Frequency of flooding
8. Groundwater contamination hazard

Table 3. Soil Suitability for Selected Uses

Soil Association	Mapping Units	Soil Limitation For: Lawns and Landscaping	Sewage Disposal	Homesite Locations with Basements	Street, Road, and Parking Lot Location
Beaumont	Bmt 1	S	S	S	S
Bigstone	Bgt 1,2,3,1/t,1/1,2/t,3/t,4/t	M2	S	S	S
	Bgt 4,5,4/g,1/g	V2,3	V8	S	S
	Bgt 6,7	V2,3,4	V4,8	V4	V4
Millet	Mlt 1,3,1/g,1P,3P	V1	V1	V1	V1
	Mlt 2	V1,5	V1	V1,6	V1
Sedgewick	Sgw 1,2	M2	V8	S	S
	Sgw 1/5,3/t	M2	S	S	S
	Sgw 3	V2	V8	S	S
Forestburg	Fbg 1,2,1P,2P	V1	V1	V1	V1
Galahad	Gld 1,2,3	M7	M-V1,7	M-V1,7	M1,7
Menaik	Mnk 1,1P	V1,7	V1,7	V1,7	V1,7
	Mnk 2	V1,5,7	V1,7	V1,67	V1,7

S - Slight, M- Moderate, V - Severe

g - gleyed
P - peaty
/t - overlying till

1. Lawns and Landscaping

The soils are rated for this use assuming they will be used for growing turf, shrubs and/or trees. Suitable soils are those which are capable of supporting a turf that can withstand traffic and control erosion. Soil properties considered in rating the soil for this use are surface texture as it relates to droughtiness and trafficability, thickness of topsoil, depth to a seasonal high water table, slope, frequency of flooding, and topsoil salinity.

Soils with the highest potential, for this use in the Ponoka area, are those of the Beaumont association while some of the mapping units of the Bigstone and Galahad associations have moderate limitations due to a droughtiness factor. Those soils characterized by a seasonally high water table or a potential flooding hazard have a severe limitation for this use. These include some mapping units of the Millet and Menaik soil associations. Table 3 shows the limitations of each of the soil mapping units for lawns and landscaping in the area.

2. Sewage Disposal

The successful operation of a septic tank tile disposal field depends upon the soil's ability to absorb and filter the effluent that passes through the field. At the same time consideration must be given to the possible contamination of groundwater systems in areas characterized by extremely permeable soils. The soil properties considered in rating the mapping units for this use include the texture of the soil as it relates to absorption and possible groundwater contamination, depth to a seasonal high water table, and frequency of flooding.

Soils considered to have only a slight limitation for this use are those of the Beaumont association. The other soil associations have moderate to

severe limitations depending upon their properties and position in the landscape. The ratings of individual mapping units for this purpose are shown in Table 3.

3. Homesite Locations with Basements

The soil properties considered to have the greatest significance for this use are texture, depth to a seasonally high water table, steep slopes, potential flooding, and soluble sulphate content.

The soil mapping units having the highest potential for this use include the Beaumont association and most of the mapping units of the Bigstone and Sedgewick associations. A moderate limitation can be attached to soils of the Galahad association because of the imperfectly drained nature of these soil areas, while a severe limitation, due to a high water table and poor drainage, occurs in the Millet and Forestburg soil areas. Soluble salts (6,7) as they affect concrete corrosion, may present a moderate to severe limitation in some of the soils of the Millet association.

4. Streets, Roads and Parking Lot Locations

The soil properties considered in rating the soils for this use include texture, drainage and depth to water table, slope, and potential flooding hazard.

Generally the well to moderately well drained soils in the Ponoka area have good bearing strength and are suitable for the construction of streets, roads and parking lots. The soils with major limitations for this use are the poorly and very poorly drained soils and those that may be subject to periodic flooding. Such soils include the Millet, Forestburg, and Menaik soil associations. These are wet soils and special engineering practices may be required where construction is planned.

ACKNOWLEDGMENTS

Mr. Z. Widtman drafted the final soil map. Mr. J. Beres determined the physical properties and Mrs. K. Harker, Mr. W. McKean and Mr. A. Schwarzer determined the chemical properties of the soil. Mrs. C. Novasky edited and typed the report. Field assistance was given by Mr. E. Stolarchuk. Special acknowledgment is given to the many property owners whose cooperation allowed soil investigations to be conducted on their land.

REFERENCES

1. Canada Department of Agriculture. 1970. The System of Soil Classification for Canada. Available from the Queen's Printer, Ottawa.

2. Lindsay, J. D. and M. D. Scheelar. 1972. Soil Survey for Urban Development, Edmonton, Alberta. Research Council of Alberta Report 72-7.

3. Means, R. E. and J. V. Parcher. 1966. Physical Properties of Soils. C. E. Merrill Books Inc., Columbus, Ohio.

4. Portland Cement Association. 1962. P. C. A. Soil Primer. 33 West Grand Ave., Chicago, Illinois.

5. Scheelar, M. D. and J. D. Lindsay. 1972. Soil Interpretations for Selected Components of Community Development Adjacent to the City of Wetaskiwin, Alberta. Report prepared for the Battle River Regional Planning Commission, Wetaskiwin, Alberta.

6. Swenson, E. G. 1971. Concrete in Sulphate Environments. Canadian Building Digest. Division of Building Research, National Research Council of Canada, Ottawa.

7. United States Bureau of Reclamation. 1966. Concrete Manual, United States Dept. Interior, Bureau of Reclamation, 7th edition.

APPENDIX

Aeolian material - material deposited by wind.

Alluvial material - material deposited by water.

Association, Soil - a group of soils geographically associated in a characteristic repeating pattern in the landscape.

Calcareous material - material containing free carbonates which effervesces visibly when treated with dilute hydrochloric acid.

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

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

Field capacity - the amount of moisture held in a soil after the free water has been drained away into drier soil material below.

Gleying - a reduction process that takes place in soils that are saturated with water for long periods of time.

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.

Illuviation - the process of deposition of soil material from an upper to a lower horizon in the soil profile.

Intergrade - a soil that possesses moderately well-developed distinguishing characteristics of two or more soil Orders.

Lacustrine materials - material deposited in lake water and later exposed by a lowering of the water or uplift of the land.

Liquid 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.

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.

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

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

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 plastic limits.

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

Saline material - material whose saturated extract has an electrical conductivity greater than 4 mmhos/cm. The grades of salinity are: weakly saline - 4 to 8 mmhos/cm., moderately saline - 8 to 15 mmhos/cm., and strongly saline - over 15 mmhos/cm.

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

(1) Rapidly drained - soil moisture content seldom exceeds field capacity except immediately after water additions.

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

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

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

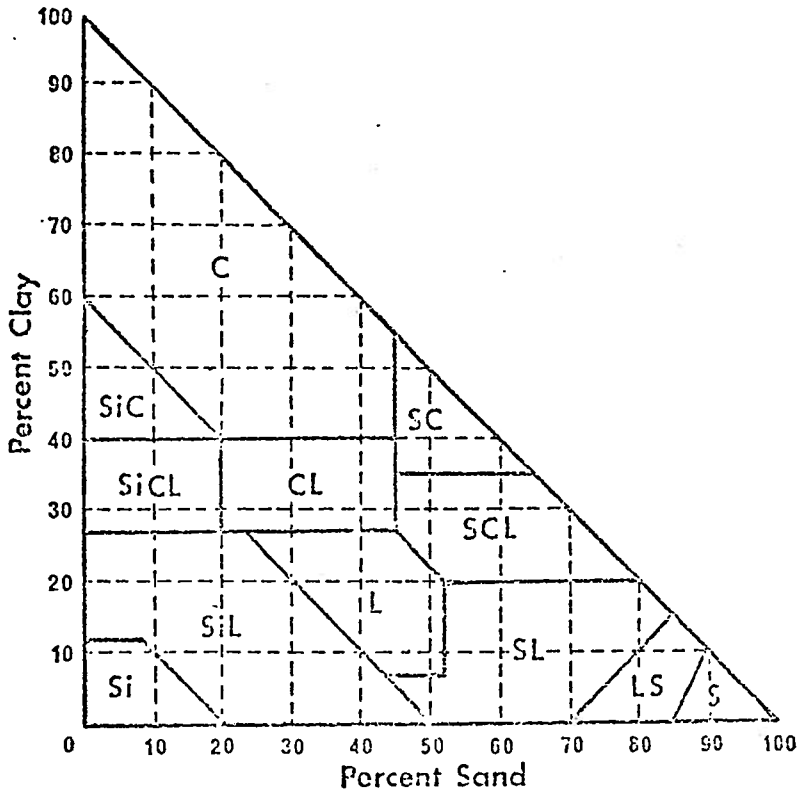
(5) Poorly drained - soil moisture in excess of field capacity remains in all horizons for a large part of the year.

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

Texture - the composition of the soil on the basis of the per cent of the different soil separates. The soil separates or particle sizes on which textural classes are based are:

Separates	Diam. in mm.*
Gravel (G)	more than 2.0
Very coarse sand (VCS)	2.0 - 1.0
Coarse sand (CS)	1.0 - 0.5
Medium sand (MS)	0.5 - 0.25
Fine sand (FS)	0.25 - 0.10
Very fine sand (VFS)	0.10 - 0.05
Silt (Si)	0.05 - 0.002
Clay (C)	less than 0.002
Fine clay (FC)	less than 0.0002

* USDA Classification



The various textures are grouped as follows: coarse textured - sands (S) and loamy sands (LS); moderately coarse textured - sandy loams (SL) and fine sandy loams (FSL); medium textured - loams (L), very fine sandy loams (VFSL), silt loams (SiL), and silts (Si); moderately fine textured - sandy clay loam (SCL), clay loam (CL), and silty clay loams (SiCL); fine textured - sandy clays (SC), clays (C), and silty clays (SiC); very fine textured - heavy clays (HC).

Topographic classes and symbols -

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

Water holding capacity - the ability of a soil to hold water.

Water table - the upper limit of that part of the soil that is wholly saturated with water.