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RECONNAISSANCE

Soil Survey of the High Prairie and McLennan Sheets

BY

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ACKNOWLEDGMENT

The soil survey of the High Prairie and McLennan Sheets was conducted as a joint project of the Research Council of Alberta, the Canada Department of Agriculture and the University of Alberta. The work was done under the general supervision of the Alberta Soil Survey Committee.

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The township plans and the base maps for this area were supplied by the Surveys and Mapping Branch, Canada Department of Mines and Technical Surveys and by the Technical Division, Alberta Department of Lands and Forests.

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Much useful information, dealing with the subject matter of this report, was contributed by personnel of the Canada and Alberta Departments of Agriculture, by many farmers within the surveyed area, and by members of the staff of the University of Alberta.

*Dr. A. L. Brown was Senior Soil Surveyor for the Research Council of Alberta in 1946 and 1947.

INTRODUCTION

This is the second of a series of reconnaissance soil survey publications describing the agricultural areas of the Peace River Land District in Alberta. The report of the Rycroft and Watino sheets, published in 1950, and this report cover a portion of the area previously described in the Research Council of Alberta Report No. 31 titled "Preliminary Soil Survey of the Peace River-High Prairie-Sturgeon Lake Area." The latter was published in 1935 and was based on information obtained by exploratory soil surveys conducted in the years 1928 to 1931.

The Peace River Land District contains relatively large areas of land that are suitable for agricultural development. A more detailed inventory of the soil resources of this area was required to meet the needs of both present and prospective settlers and to delineate those portions of the area that should be withheld from settlement. Accordingly, the present soil survey program in this area was initiated in 1945 as a joint project of the Research Council of Alberta, the Canada Department of Agriculture and the University of Alberta.

The field and laboratory work required in the preparation of this publication was started in 1947 and completed in 1950. The report and the accompanying maps are supplementary to each other and both should be referred to in seeking information regarding the soils of the mapped area.

The report is divided into a number of sections and the topics dealt with in each are listed in the table of contents. Included in this report is a general description of the mapped area dealing with the topography, drainage, climate, vegetation and other factors that have a bearing on soil development, settlement and crop production. The greater part of the report deals with a description of the characteristics and agricultural adaptations of the various soil series shown on the soil map. The sections devoted to outlining the systems of soil classification and of soil rating should be carefully studied by those using the accompanying maps. A glossary is included giving the definitions of the more frequently used scientific terms.

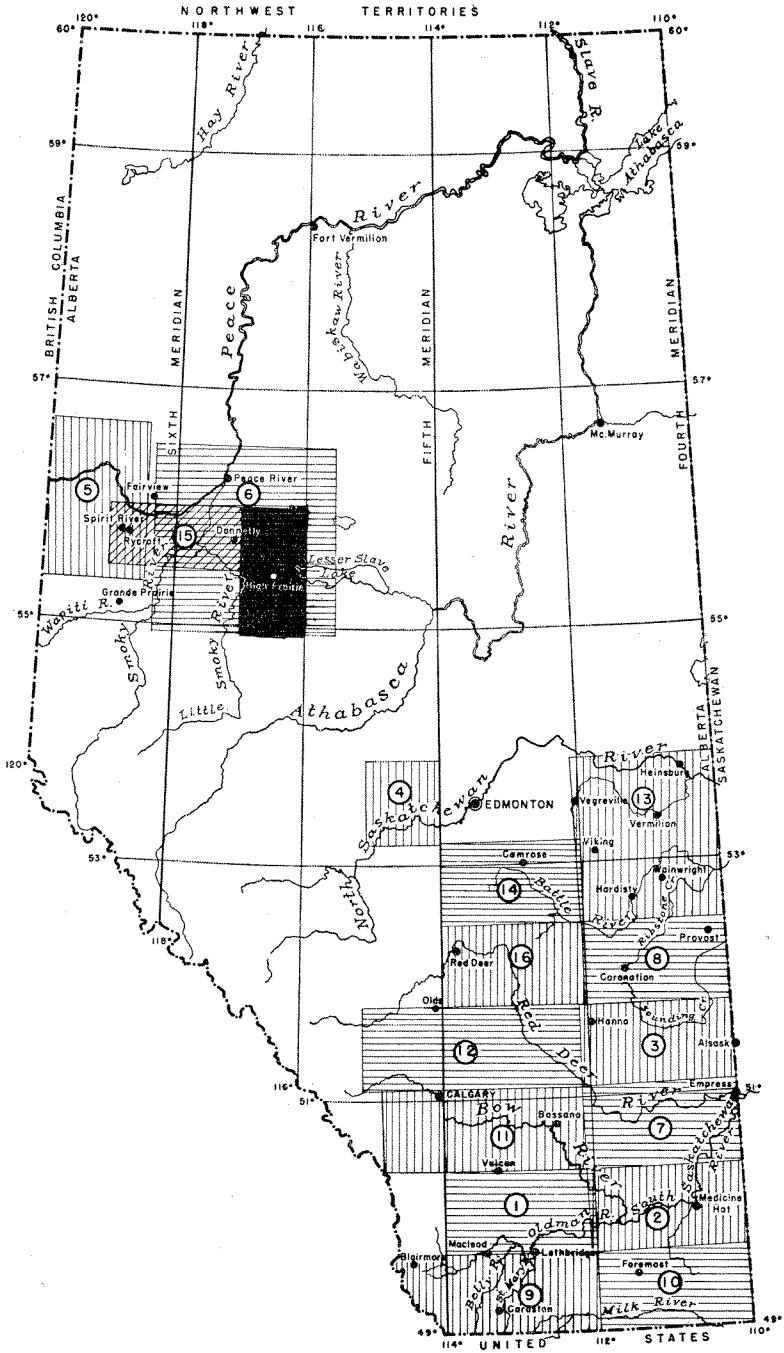
The soil map, printed on the scale of three miles to the inch, shows the cultural and natural features such as towns, railroads, post offices, schools, churches, lakes and rivers, and the location and extent of the different soil areas. The designated soil areas are separated by either solid or broken black boundary lines and identified by the use of colors, letter combinations and symbols. Topography is indicated on the map by means of hatchuring. The topographical separations are described in the report and the method used to indicate the separations is illustrated in the map legend. All map abbreviations, symbols, color schemes, and conventional signs are listed in the map legend. The township and range numbers

are shown at the margins of the map and a diagram of a township is included with the legend to assist those unfamiliar with the system used in numbering sections within a township.

Three other maps accompany this report; one shows the distribution of tree cover, one shows the distribution of the cultivated, abandoned, and virgin land in the area at the time of survey and the other shows a suggested productivity grouping based on a rating of the soils mapped in this area. They are small scale maps that are published in black and white and provide information supplementing that given on the soil map. The tree cover map distinguishes areas on the basis of the extent to which tree cover may be an impediment to land improvement, the cultivation map indicates the extent of agricultural development in the area while the soil rating map distinguishes the better land from the poorer land and suggests the possible utilization of the area.

The rating or classification indicated on the maps and in the report should be regarded as average for the areas rather than specific for individual land parcels. The information of the survey is not given in sufficient detail to show soil variations in individual parcels. However the maps and report can furnish information of valuable assistance in determining the characteristics of the soils encountered in the various portions of this area. It is pointed out, in the following pages, that a wide variety of soil conditions exist in this area. A recognition of these conditions will aid in planning land use practices that are essential to establishing a profitable and permanent agriculture.

Figure 1—LOCATION MAP



Sketch map of Alberta showing locations of surveyed areas for which reports have been published: (1) Macleod sheet, (2) Medicine Hat sheet, (3) Sounding Creek sheet, (4) St. Ann sheet, (5) Dunvegan area, (6) Peace River, High Prairie, Sturgeon Lake area, (7) Rainy Hills sheet, (8) Sullivan Lake sheet, (9) Lethbridge and Pincher Creek sheets, (10) Milk River sheet, (11) Blackfoot and Calgary sheets, (12) Rosebud and Banff sheets, (13) Vermilion and Wainwright sheets, (14) Peace Hills sheet, (15) Rycroft and Watino sheets, (16) Red Deer sheet. **(IN BLACK)** High Prairie and McLennan sheets.

NOTE: Reports for areas 1 to 7 inclusive are out of print, but may be obtained on loan from the University Extension Library, University of Alberta, Edmonton.

Soil Survey of the High Prairie and McLennan Sheets

GENERAL DESCRIPTION OF THE AREA

LOCATION AND EXTENT

The High Prairie and McLennan sheets are in the southeastern portion of the Peace River district. They include portions of the former Smoky River and Iosegun sheets and cover approximately 2,700 square miles or 1,730,000 acres.

The general location of the surveyed sheets is indicated on the sketch map in Figure 1. Their exact boundaries are as follows: on the east, west longitude 116°00′; on the west, west longitude 117°00′; on the south, north latitude 55°00′; and on the north, north latitude 56°00′. Included in these sheets are all or parts of townships 69 to 81 in ranges 13 to 20 west of the fifth meridian. In addition to the above, however, an area comprising approximately 100,000 acres in the remainder of township 69 in ranges 14 to 20 has also been included and will be dealt with as part of the mapped area.

SETTLEMENT AND AGRICULTURAL DEVELOPMENT

The discovery and initial development of the Peace River district were incidental to the fur trade of the Canadian West. The rival fur trading companies explored new regions and set up strategic fur trading posts. Subsequent to Alexander Mackenzie's ascent of the Peace river in 1792-93, the fur trading companies enlarged their sphere of operations from the vicinity of Great Slave lake by establishing posts along the Peace river and in various other portions of the Peace River area. Fort Fork, near the present site of Peace River, and forts at Shaftesbury and Dunvegan were among the first to be established. Later the Hudson's Bay Company established a fort just east of Buffalo bay to tap the heavy beaver market of this area.

For nearly a hundred years after its discovery the only approach to the Peace River district was by means of canoe and river boat from Lake Winnipeg via the Upper Churchill and Athabasca rivers. Subsequently more direct routes were established from the "ends of steel" and from improved roads. By 1890 the railroad reached Edmonton and in the ensuing westward thrust of population many settlers found their way into the Peace River area. They came by way of the Athabasca and Lesser Slave rivers and across Lesser Slave lake to Grouard. Later they also came by way of the Edson trail. From Grouard they trekked by wagon train, horseback or on foot to their various destinations in this area. Until 1914, Grouard

was a large and busy centre serving as a port of entry for much of this large and undeveloped area.

Fur traders, trappers, and adventurers lured by the Klondike gold rush, formed the nucleus of the early settlements adjacent to the trading posts and missions. The stories of these early settlers and missionaries must have been encouraging for by 1903 there was a fairly large and growing settlement to the northwest of Lesser Slave lake. Crops were grown adjacent to the Anglican and Catholic missions and adjacent to Bredin and Cornwall's and to the Hudson's Bay trading posts. In these early years, however, the growth of settlement was slow largely because of the difficulty of marketing. Steel was laid into McLennan in March, 1915, and the major portion of the agricultural development in this area has taken place since that time.

Figure 2.—The Grouard trail near Leicester. This trail served as one of the main transportation routes of the Peace River area until about 1914.

According to the Census of Canada the population of the High Prairie and McLennan area was 696 in 1916. By 1921 it had increased to 1,260, while in 1941 the total population of the mapped area was approximately 3,890. The census returns for 1946, however, showed a decrease in population to 2,970. This decrease may have been due largely to the normal shifts in population resulting from Canada's participation in the war effort. The 1946 census returns further show that the incorporated villages of High Prairie and McLennan had populations of 643 and 823 respectively. McLennan is a divisional point of the Northern Alberta Railway and much of the town's population consists of railway personnel.

Table 1 gives, in summary, the number of farms, the occupied and the improved acreage in the surveyed area for each of the census years from 1916 to 1946. The data, compiled from the Canada

Census returns, shows a very marked increase in the number of farms between the years 1926 and 1931. The progressive decrease in the number of farms since 1931 might suggest a period of consolidation. The farmers remaining in the area have gradually increased the size of their farm holdings and of their acreage of improved land. Similarly the percent of land improved increased from 20 in 1931 to 33 in 1946. The Soil Survey estimated that in 1949 about 40 percent of the occupied land was under cultivation. The tree cover has been relatively heavy in much of the mapped area and as a result the percent of land improved is comparatively low.

TABLE 1.—Number of Farms, Acres Occupied and Acres Improved in the High Prairie and McLennan Sheets, 1916-1946.

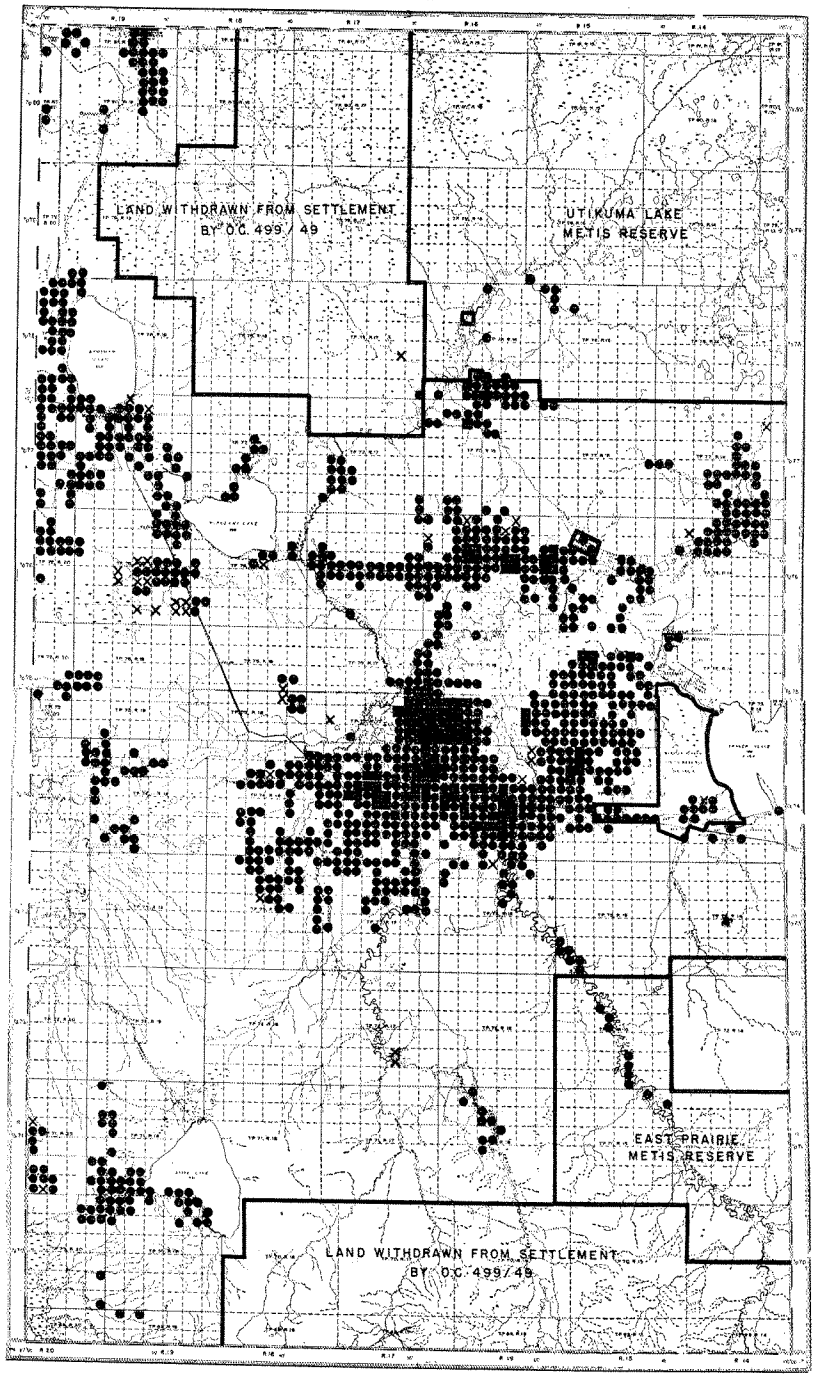
Year	Number of Farms	Acres Occupied	Acres per Farm	Acres Improved	Percent of Land Improved
1916	153	30,830	200	5,528	18
1921	278	63,669	229	11,735	18
1926	227	55,325	244	15,276	28
1931	736	151,098	205	30,749	20
1936	653	139,415	213	36,233	26
1941	592	147,481	249	44,985	30
1946	561	162,294	290	52,918	33

The cultivation map (see Fig. 3) shows the distribution of those farms on which cultivation was observed at the time of survey. It will be seen that the greatest proportion of the cultivated acreage is in the central portion of the mapped area adjacent to High Prairie. Smaller concentrations are found adjacent to the settlements at Salt Prairie, Prairie Echo, Leicester, McLennan, Reno and Snipe lake. The greater proportion of the mapped area, however, is not yet developed. Out of a total of approximately 1,830,000 acres, about 830,000 acres are either withheld from settlement or reserved for the Metis and Indians. Of the remaining one million acres only about 25 per cent is now occupied. Exclusive of those portions of the area that are either too wet or otherwise unsuitable for agricultural development, it would appear that possibilities are favorable for a very substantial increase in the acreage of improved land in this area.

The acreage sown to field crops increased correspondingly as more land was improved. Grain farming is the prevalent type of farming in the mapped area. As indicated in Table 2, wheat, oats and barley occupy by far the largest percentage of the cultivated land. Oats is the dominant grain grown in this area, and the acreage sown to coarse grains has been nearly double that sown to wheat. However, the data also indicate that about 20 percent of the improved land is left in fallow while somewhat less than 10 per cent is seeded to hay crops. The trend towards a decrease in percentage of cropped land under hay is not considered desirable.

From available records it is estimated that the average yields in this area are as follows: wheat about 22 bushels per acre, barley about 26 bushels per acre, and oats about 37 bushels per acre. These estimates include yields produced on many soil types and

Figure 3—Map Showing Present Cultivated, Abandoned and Virgin Lands in the Mapped Area.



Completely cultivated (120-160 acres) ■ Abandoned cultivation (10-160 acres) ☒

Partially cultivated (10-120 acres) ◉ Virgin lands (Idle and Pasture) □

under many different types of farm practice. Some of the better soils give higher yields and many individual farmers have exceeded these averages by considerable margins.

TABLE 2.—Total Acreage Cropped, Acreage in Fallow and Acreage by Principal Crops in the High Prairie and McLennan Sheets, 1916-1941.

Year	Total Field Crops ac.	Fallow ac.	Wheat ac.	Barley ac.	Oats ac.	Hay* ac.
1916	3,857	not reported	456	468	2,604	390
1921	10,087	1,080	402	984	5,450	2,973
1926	12,148	2,329	3,846	1,006	4,988	2,053
1931	23,889	2,522	8,713	1,528	10,189	1,364
1936	25,691	5,944	7,477	2,033	11,265	3,477
1941	33,159	7,657	11,273	5,328	12,499	2,266
1946	40,422	8,856	13,770	9,225	14,135	2,054

*Includes clover, alfalfa, and cultivated grasses.

The census returns also show that livestock play an important part in the farming operations of this area. In 1916 there were 717 horses, 1,642 head of cattle, 10 sheep, and 1,071 hogs in this area. By 1946 the livestock population was as follows: horses 2,932, cattle 5,481, sheep 732, and hogs 6,968. The increase in livestock population has been fairly steady and reasonably proportionate to the rate of land improvement except for two of the census years. In 1931 the cattle population reached a peak of 26,099 head, while in 1941 the hog population was 10,751. In the remaining census years the average livestock population per farm was approximately as follows: 5 horses, 10 head of cattle, 1 sheep and 12 hogs.

TRANSPORTATION

The main line of the Northern Alberta Railway traverses the east-central portion of the mapped area and then proceeds in a northwesterly direction to McLennan. From there the main line proceeds west en route to Rycroft and Grande Prairie while a branch line traverses the northwest portion of the mapped area via Roxana, Springburn and Reno en route to Peace River, Fairview and Hines Creek. The shipping distance from High Prairie to Edmonton is 239 miles while that from McLennan to Edmonton is 267 miles.

The main gravel highway from Edmonton to the Peace River district enters the mapped area in township 74 range 14. It proceeds west to Triangle and then branches. One branch goes northwest via Kenzie, Kathleen and McLennan whereas the other branch goes southwest and crosses the Little Smoky river in township 74 range 20. At Triangle the distance from Edmonton is approximately 270 miles. Another gravel highway branches off northeast of Enilda and proceeds to Grouard. The well settled central portion is fairly well supplied with market roads. In much of the sparsely settled northern and southern portions, however, there are very few roads and in many cases the areas are accessible only by wagon or pack trails. Many new trails and some roads have been built, dur-

ing the last few years, through the exploratory activities of numerous oil companies.

There are no ferry crossings in the mapped area. Bridges span the rivers along the routes of the main and secondary roads. Steel bridges span the East Prairie, Heart and Little Smoky rivers, whereas wooden bridges span the remaining rivers and streams. A wooden bridge, slightly over a half-mile long, spans the western arm of Lesser Slave lake on the road to Grouard. This is the longest highway bridge in Alberta. (See Fig. 4.)

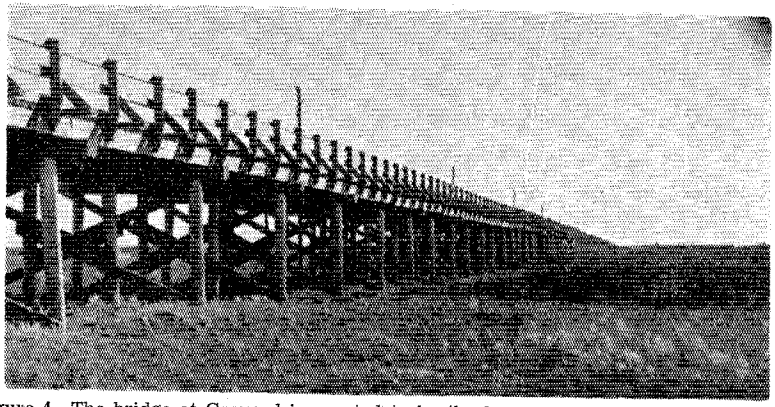


Figure 4—The bridge at Grouard is reputed to be the longest wooden bridge in Alberta.

Figure 5—Many new trails and some roads, constructed as the result of the activities of oil exploration parties, have made various parts of the surveyed area much more accessible.

RELIEF

The surveyed area consists mainly of the remnants of a till plain and a lower lying laking basin which has undergone considerable alteration adjacent to some of the main drainage channels.

Till plain remnants are found in the northern and southern parts of the area at elevations of from 2,100 feet to about 3,000 feet above sea level. In the northern part of the area the till plain reaches a maximum elevation of approximately 2,500 feet in township 80 range 17. In the southern part, elevations of a little over 3,000 feet above sea level are reached in the area south of Snipe lake. Occasional variable benches, low ridges and knolls are features characteristic of this otherwise relatively level till plain. The slopes from the plain to the lower lying basins or valleys are generally long and fairly uniform. In the greater part of the area these slopes seldom exceed a gradient of 6 per cent.

The lower lying basins occupy the central and western portions of the mapped area and adjoin many of the drainage channels. They

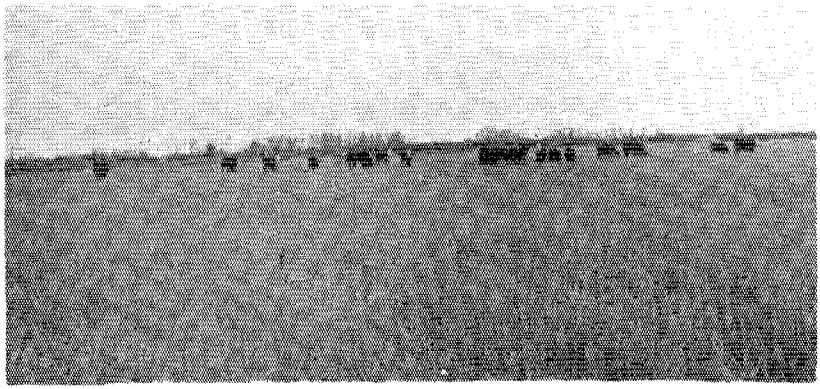


Figure 6—Smooth, level flood plain adjacent to High Prairie.

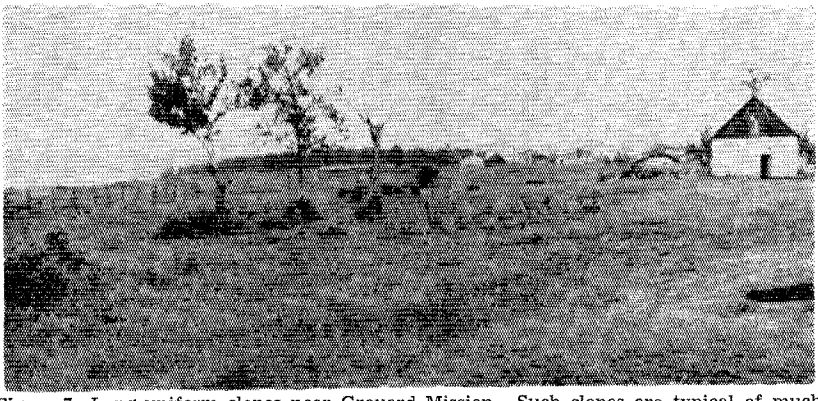


Figure 7—Long uniform slopes near Grouard Mission. Such slopes are typical of much of the area adjoining the till plain.

vary in elevation from 1,900 feet to about 2,200 feet above sea level. The higher elevations are found at the outer edges of the basins adjoining the till plain and on a slight height of land found in the western portion of the area approximately in line with the northern tip of Snipe lake and the western arm of Winagami lake. There is a long, very gentle slope from the outer edges of the basin and from the height of land to some of the lakes and drainage courses.

Some portions of the laking basin have undergone considerable alteration. Adjacent to Kathleen, Winagami lake and portions of the Heart river and Bearhead creek, the area has a variable relief featured by the occurrence of numerous low, steep-sided knolls. The portion from near High Prairie to Lesser Slave lake is a low, flat, flood plain varying in elevation from about 1,900 feet to 1,960 feet above sea level. Much of this basin is poorly drained. Between Buffalo bay and a point about 12 miles west there is a difference in elevation of only 8 feet, representing a gradient of approximately 0.01 per cent.

DRAINAGE

The external drainage of northern Alberta is effected through the Peace and Athabasca rivers and their tributaries. Both of these rivers rise in the Rocky mountains and empty into the Arctic ocean. The mapped area is commonly considered as part of the Peace River area—that is, that part of Alberta drained by the Peace river. However only a relatively small proportion of it, its extreme western portion, is part of the Peace river drainage system. The remainder is part of the Athabasca river drainage area.

Sweathouse creek, Snipe creek, Little Smoky river, and Bearhead creek together with their tributaries flow north and west and empty into the Peace river. The waters of Arcadia creek, East Prairie river, West Prairie river, Heart river, Salt creek and their tributaries drain into Lesser Slave lake which in turn is drained by the Athabasca river via the Lesser Slave river.

Most of the stream courses are fairly permanent in character and rarely become dry in the late summer or fall months. Those feeding Lesser Slave lake form a dendritic drainage pattern on entering the flood plain adjacent to High Prairie. The East and West Prairie rivers particularly, are subject to flooding during periods of rapid spring run-off or after prolonged heavy rains.

There are numerous lakes in the mapped area. The largest of the lakes, indicated on the soil map, are as follows: Snipe, Iroquois, Winagami, Kimiwan, Buffalo bay and part of Lesser Slave lake. Altogether Lesser Slave lake is about 50 miles long and has an average width of about 7 miles. Snipe lake, Buffalo bay and Lesser Slave lake are fed by streams and springs whereas Kimiwan lake, Winagami lake, and most of the small lakes appear to be replenished chiefly by run-off waters from the surrounding areas. Throughout much of the year they are stagnant. However, the Alberta Water Resources and Irrigation Department have completed a project

which will divert part of the waters of the Heart river to freshen Winagami lake. Little additional construction would be required to connect Winagami lake with Kimiwan lake.

Local drainage conditions vary greatly throughout the mapped area. Areas with long gentle slopes have the most satisfactory drainage conditions from the standpoint of agriculture. Much of the rolling and hilly land is excessively drained by the loss of precipitation through run-off. Low-lying flats and depressions are characterized by varying degrees of restricted drainage. In the mapped

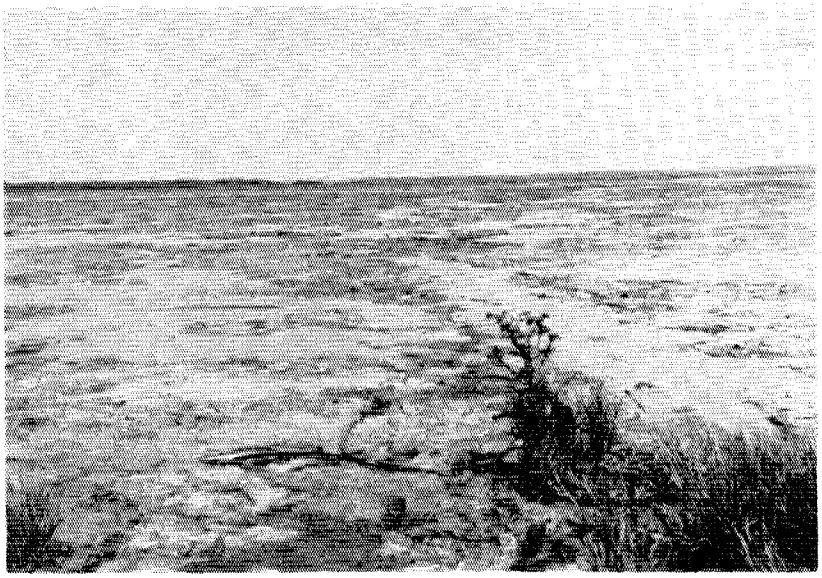


Figure 8—Winagami lake in August 1950. In the past, both Winagami and Kimiwan lakes became shallow and stagnant in the late summer months.

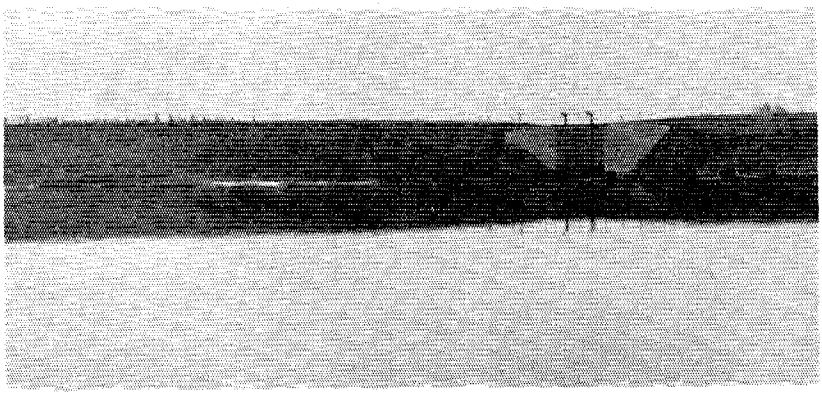


Figure 9—Dam across the Heart river completed in 1950. This dam, constructed by the Alberta Department of Water Resources, diverts part of the waters of the Heart river to freshen Winagami lake.

area conditions have been particularly favorable for the development of moss bogs or muskegs.

CLIMATE

Meteorological data compiled from the Canada Meteorological Records are given in Tables 3 to 6. Such data are available only for High Prairie and Grouard in the mapped area. Those for Beaverlodge are included for purposes of comparison. The records for Beaverlodge are of the longest duration and probably more indicative of long time averages than any other records available in this part of Alberta. The station at Beaverlodge is located at the Canada Experimental Station, about 100 miles west of the mapped area.

Table 3 gives the average monthly, seasonal and annual precipitation at the three recording stations. In this table the year is divided into three sections, namely: the previous fall, winter, spring and growing season. This is done because it is believed that the precipitation of the winter months is relatively ineffective in so far as growing crops are concerned while that of the fall, spring and growing season is closely related to the crop growth obtained. It is doubtful if April should be considered as part of the growing season in this area. However since a very considerable proportion of its moisture might be absorbed by the thawing ground, it was believed desirable to include it as a spring month whose moisture was largely available to growing crops.

TABLE 3.—Average Precipitation in Inches. Monthly and Seasonal Distribution for Stations in or near the High Prairie and McLennan Sheets.

Years	High Prairie 1927 and 1931-1944	Grouard 1925-1944	Beaverlodge 1916-1947
August	1.91	1.81	1.78
September	1.69	1.57	1.78
October	1.05	1.08	1.14
Previous Fall	4.65	4.46	4.70
November	1.22	1.08	1.30
December	0.96	1.00	1.21
January	0.91	1.15	1.35
February	0.77	0.80	0.96
March	0.95	0.70	1.13
Winter	4.81	4.73	5.95
April	0.89	0.66	0.79
May	1.58	1.71	1.55
June	2.98	2.98	2.06
July	3.02	2.43	2.31
Spring and Growing Season	8.47	7.98	6.71
Total	17.93	16.97	17.36
Percent of Total Occurring in Fall, Spring and Growing Season	73	72	66

The data in Table 3 indicate that the total annual precipitation in, at least, the central portion of the mapped area is very similar to that at Beaverlodge. The distribution of that moisture, however, differs appreciably. At both High Prairie and Grouard over 70 percent of the annual precipitation comes during the fall, spring

and growing season while Beaverlodge gets only 66 percent of its precipitation during that time. Thus it would appear that this portion of the area has a more favorable moisture distribution than the area near Beaverlodge. In that respect, it compares favorably with Edmonton and Lacombe where nearly 80 per cent of their precipitation comes at this time.

At the stations reported in Table 3 June and July are the months of greatest rainfall. These are the important growing months in this area. The total precipitation received in these two months averages 6 inches at High Prairie, 5.41 inches at Grouard and 4.37 inches at Beaverlodge. Thus there is usually sufficient moisture to produce at least a fair crop in this area. However, there must be sufficient reserve moisture to carry the crop into June. It is therefore necessary to conserve the previous fall and spring precipitation.

The data in Table 4 indicate that in much of the mapped area the average snowfall is approximately 50 inches whereas in the Beaverlodge area it is approximately 73 inches. The data also indicate that January is the month of greatest snowfall at the three recording stations. It will be observed that snow has been recorded in this area in every month except June and July whereas the data for Beaverlodge record snow in every month but July. Much of the winter snow is lost in the spring run-off, particularly on cleared and sloping land, and is relatively ineffective in so far as the growing crops are concerned.

TABLE 4.—Average Snowfall in Inches. Monthly and Seasonal Distribution for Points in or near the High Prairie and McLennan Sheets.

	Average	High Prairie 15 years	Grouard 20 years	Beaverlodge 27 years
August		0.1	0.11	0.1
September		1.4	0.51	2.9
October		4.6	3.24	5.1
Previous Fall		6.1	3.75	8.1
November		8.5	8.37	9.9
December		9.3	9.50	11.9
January		**9.7**	**10.65**	**13.7**
February		5.7	7.58	9.0
March		9.4	6.37	11.4
Winter		42.6	42.47	55.9
April		4.7	**3.06**	**5.7**
May		0.5	0.16	2.3
June		0.0	0.00	1.0
July		0.0	0.00	0.0
Spring and Growing Season		5.2	3.22	9.0
Total		53.9	49.44	73.0

Other factors are also of importance in interpreting annual precipitation data. Such factors as the soil type, the type of farm management and the amount of evaporation, exert a marked influence on the efficiency of the rainfall. Soil type and types of farm management are discussed in subsequent sections of this report. While no records are available for the amount of evaporation at High Prairie or Grouard it is believed that those of Beaverlodge may be indicative of the conditions prevailing in the mapped area. Experimental Station records show that the average evaporation

from a free water surface tank during the months of May to September inclusive is 16.89 inches at Beaverlodge as compared with 14.55 inches at Lacombe in central Alberta. The average total precipitation for those months is 9.48 inches at Beaverlodge and 12.03 at Lacombe. Thus it would appear that evaporation is roughly 76 per cent greater than precipitation at Beaverlodge and only 18 per cent greater than precipitation at Lacombe during the principal crop months of the season. While the evaporation from a free water surface may not represent field evaporation it is an indication of the relative evaporation occurring in the recording areas. It does appear probable that the evaporation in the mapped area may be considerably higher than in much of central Alberta.

The relatively high evaporation in this area may be at least partly due to the greater amount of wind that appears to prevail in the mapped area. Here again, this supposition is based on a comparison of Experimental Station records since no wind data are available for the recording stations in this area. The total average annual wind mileage at Beaverlodge is 79,643 miles as compared with 43,000 miles at Lacombe. The wind velocity averages about 7 miles per hour in the winter months increasing to a peak average of 10.5 miles per hour in May—at a time when spring seeded crops are most vulnerable.

The climate of the surveyed area is characterized by moderately warm summer and relatively cold winter temperatures. Table 5 gives the average monthly, seasonal, and annual mean temperatures for stations in or near the surveyed area. The yearly mean or average temperature is practically the same for all three stations, and it would appear that an average of 34.3°F should be fairly representative of this area. In comparison, the yearly mean temperature at Edmonton is 37°F, at Calgary it is 38.9°F and at Lethbridge 41°F. The mean growing season temperature in the surveyed area is about 51°F while the mean winter temperature is about 12°F.

TABLE 5.—Average Monthly, Seasonal and Annual Mean Temperatures (Degrees F.) for Points in or near the High Prairie and McLennan Sheets

Average	High Prairie 15 years		Grouard 20 years		Beaverlodge 27 years	
August	58.1		58.6		56.5	
September	48.6		49.0		48.0	
October	38.2		38.8		37.0	
Previous Fall		48.3		48.8		47.2
November	21.6		22.7		20.5	
December	7.9		8.2		10.1	
January	5.4		2.2		7.0	
February	8.4		7.3		13.0	
March	20.8		19.5		21.0	
Winter		12.8		12.0		14.3
April	37.8		37.1		36.9	
May	50.8		49.8		49.5	
June	55.3		56.2		55.0	
July	60.4		61.0		57.0	
Spring and Growing Season		51.1		51.0		49.6
Annual Mean Temperature		34.4		34.2		34.3

In so far as crop production is concerned, the length of growing season is very important in determining the type of crops that can be grown successfully. Similarly the length of the frost-free period has a considerable bearing on the risk of producing certain crops and on the variety of crops that can be grown. The frost-free period is generally not as long as the growing season. Most farm crops are not damaged when the temperature reaches 32°F. A killing frost is considered as 29°F. It should also be borne in mind that the amount of frost will vary locally with changes in topography. Many low-lying areas often have fall frosts considerably earlier than nearby higher land. Similarly, a dense tree cover that impedes natural air drainage appears to increase the hazards of frost. Table 6 gives the growing season and the frost-free period as reported for the stations in and near the surveyed area. The data indicate that the average growing season in at least the central portion of the mapped area is about 100 days while the frost-free period is about 80 days. Thus it would appear that frost makes crop production a considerably more hazardous undertaking in this area than in the area farther west around Beaverlodge. The latter reports a growing season of about 130 days and a frost-free period of over 90 days. The data reported for High Prairie and Grouard are averages for a relatively short period and may not be truly representative of the long time average growing season or frost-free period prevailing in the mapped area.

TABLE 6.—Average Growing Season and Frost-Free Period for Points in or near the High Prairie and McLennan Sheets.

	Years Averaged	Growing Season (over 29°F.)	Frost-Free Period (above 32°F.)
High Prairie	12	103	82
Grouard	14	99	78
Beaverlodge	19	131	96

In a recent study conducted by Currie and reported in Volume 26, Section C, of the Canadian Journal of Research, the temperature at which growth takes place in the spring is considered as 42°F. The period extending from the time that the mean daily temperatures reach 42°F in the spring to the time that they drop below 42°F in the fall is termed as the "Vegetative Period". During this period, it is pointed out, sufficient heat is available for the majority of economic plants to make some growth. Using this critical temperature as a basis the vegetative period was calculated for some representative recording stations. Currie's data show that the average length of the vegetative period is 189 days at Lethbridge, 174 days at Edmonton, 169 days at Beaverlodge, and 141 days at Fort Vermilion. His maps indicate that, in the Beaverlodge area, the average vegetative period starts in the latter part of April and finishes in the early part of October.

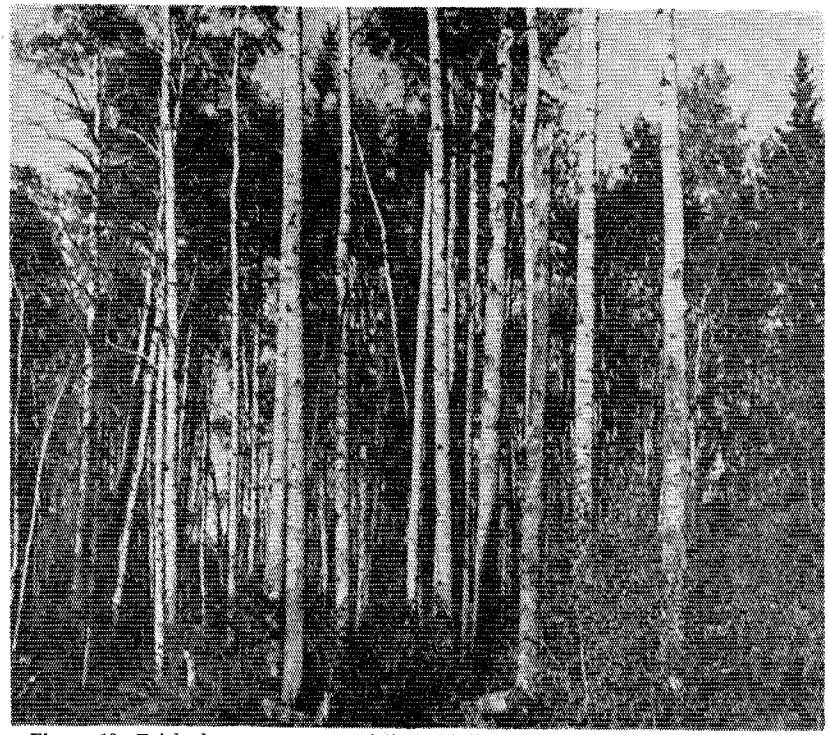


Figure 10—Fairly heavy cover, consisting chiefly of aspen poplar, is typical of a considerable proportion of the mapped area. (See Fig. 12.)

Figure 11—Open areas and areas of light tree cover are common in many of the burned over portions of the area. (See Fig. 12.)

THE SOILS' PARENT MATERIAL

The uppermost unconsolidated deposits form the parent material from which the present day soils are developed. Consequently, a consideration of their origin and a knowledge of their nature is essential in the study of soils.

The surface deposits and the surface features of the mapped area are the result of erosion and deposition during the pre-glacial, glacial and post-glacial times. The general effect of pre-glacial erosion was to remove the beds that may have been deposited subsequent to the Upper Cretaceous period. The beds exposed as the result of this erosion consist of shales and sandstones belonging to the Colorado and Montana groups of the Upper Cretaceous period. Maps and reports published by the Geological Survey, Research Council of Alberta, show that practically all of the area north of township 73 is underlain by Smoky River shale whereas most of township 73 and all of the area to the south is underlain by Wapiti sandstone. In addition, however, considering the nature of some of the soils' parent material and the evidence relative to water supply, it would appear that an island of Wapiti sandstone may occur in the area northwest of Lesser Slave lake adjoining Prairie Echo and Leicester.

The following excerpts from the reports referred to will serve to indicate some of the characteristics of the dominant formations in the mapped area:

"Marine shales underlie the greater part of the area here mapped as lower Upper Cretaceous. The thickness of these shales averages about 900 feet. . . . The greater part of this formation (Smoky River) is of Colorado age, but the upper part is of Montana age (Lower Pierre). There is no recognizable lithological difference between the upper and lower parts of the marine shale formation. . . . They are thin bedded, dark to black shales with occasional ironstone and pyrite nodules." (Allan, J.A. and Rutherford R.L., Research Council of Alberta Report No. 30.)

"Lithologically the Wapiti formation consists of sandstones and shales of fresh water deposition. . . . Light grey to buff are the prevailing colors, and on the whole fine grained textures are most common. . . . The shales are poorly stratified, a characteristic common to shales of fresh water deposition." (Rutherford R. L., Research Council of Alberta Report No. 21.) The Wapiti formation is over 1,100 feet thick and includes all the beds of the Upper Cretaceous period that lie above the upper part of the Smoky River formation. On the basis of a lithological change in the upper part of the Wapiti formation and because of the bentonitic nature of the upper Wapiti beds Allan and Rutherford (Research Council of Alberta Report No. 30) suggested a separation of the Wapiti into the Belly River and Edmonton formations.

During the Pleistocene epoch this region was overridden by the Laurentide Ice Sheet advancing from the northeastern part of the continent. In passing over the area, this ice sheet mixed the

materials accumulated from the underlying bedrock and produced large areas with a relatively flat surface by filling in the depressions left as the result of pre-glacial erosion. The materials from the underlying bedrock made up the greater proportion of the drift in this area, and it is thought that the dark colored, saline, heavy textured materials, resulting from the weathering of the Smoky River shales, contributed the greatest amount to the drift sheet and hence to the soils' parent material. It is probable also, that more than one glaciation occurred since the drift forming the parent material of Braeburn soils appears to be underlain by an older till.

Three different glacial deposits were recognized in the mapped area. The lowest of these is exposed in places along the Little Smoky river and along Snipe creek particularly in section 20, township 72, range 19, west of the fifth meridian. It consists of a yellowish brown to brownish grey, compacted, sandy clay till that is somewhat stony. The stones appear to be predominantly granites and sometimes there is an accumulation of them in the lower portion of the deposit overlying bedrock. In the exposures along Snipe creek this till has a pronounced vertical cleavage and a distinct prismatic structure particularly in the upper portion of the deposit. While this older till does not appear to form the parent material of any of the soils in this area, it seems to underlie some of the western and central portions very closely and may be responsible for some of the soil characteristics in parts of these areas.

The second glacial deposit consists of a greyish brown to yellowish brown, sandy clay loam to clay till that is somewhat stony, has numerous coal flecks, and may be at least partly derived from both the Smoky River and Wapiti formations. This till underlies many of the subsequent deposits in the mapped area and is exposed most extensively in the southern and northern parts of the area. It forms the parent material of Braeburn and Saddle soils.

The third glacial deposit, frequently lying immediately above the preceding one, consists of a well sorted, grey to dark greyish brown clay that has few stones, numerous gypsum crystals and appears to be derivel largely from the weathered products of the Smoky River shales. This deposit is remarkably uniform, has few stones and may have been laid down in a glacial lake. Pending further investigation to determine its origin, the term "lacustro-till" is used in this report in reference to this deposit. It forms the parent material of Donnelly, Esher and Landry soils, and occurs on the lower slopes of the till plain remnants at elevations rarely exceeding 2,250 feet.

In the basin, at elevations usually below 2,100 feet, much of the soils' parent material appears to be of post-glacial origin. Lacustrine, grey to dark grey, heavy clays are found in the upper part along some of the outer edges of this basin. They are stone free, very firm, unctuous clays that appear to be derived largely from the

ANIMALS AND VEGETATION

Numerous forest fires have appreciably reduced the animal population in this area. Moose and bear are found in some of the heavily wooded regions in the northern and southern parts of the mapped area. Only a few deer were observed in the Snipe lake and Leicester areas and it is concluded that these larger animals are not present in large numbers. Of the smaller animals, coyotes, red squirrels, chipmunks, porcupines, weasels and rabbits appeared to be fairly common. However, the absence of ground squirrels and of earthworms is a striking characteristic of this and other portions of the Peace River area.

Ducks were found on numerous lakes and were particularly plentiful on parts of Lesser Slave and Snipe lakes. Pelicans, cranes and large numbers of geese were also observed. Prairie chicken were numerous in the more open parklike areas while partridge were abundant in the more wooded portions.

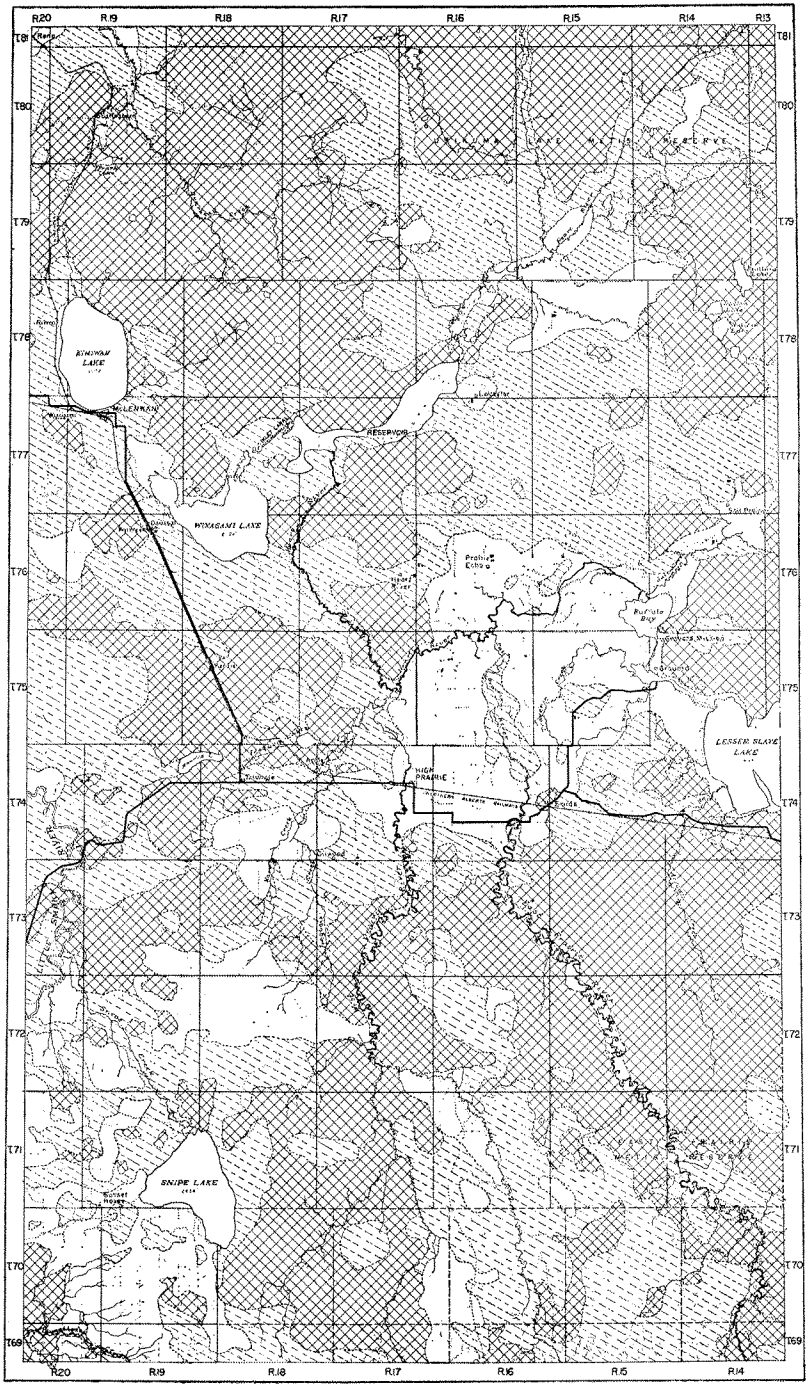
Both Snipe lake and Lesser Slave lake contained perch, pike perch (wall-eyed pike or pickerel) and great northern pike (jackfish). Lesser Slave lake also contained whitefish. In addition, some of the streams, particularly the Little Smoky river, contained arctic grayling, dolly varden and rainbow trout.

Generally the dominant native vegetation consists of a mixed tree cover in which aspen poplar is of most frequent occurrence. Balsam poplar, birch, willow, alder, spruce and pine occur either in mixtures or as the dominant cover of local areas. Such shrubs as the rose, gooseberry, raspberry, cranberry, chokecherry, saskatoon and hazelnut occur in mixtures particularly in the somewhat more open portions of the mapped area. Black spruce, occasional tamarack, scrub birch, labrador tea, sedges, rushes, reeds, coarse grasses and mosses occur in the many low-lying, ill-drained portions of the area.

Much of the native cover has been destroyed as the result of land improvement and forest fires. Prior to the severe fires of the last years there was sufficient timber in scattered patches throughout this area to supply local demand. Now, merchantable stands of spruce and pine occur only in some of the less severely fire-killed portions of the northern and southern parts of the mapped area and in the vicinity of Kenzie.

Mention has been made of some of the dominant vegetation in the mapped area. A more detailed discussion of the types of vegetation is beyond the scope of this report. Investigations to determine the species native to this and other areas in northwestern Alberta are being conducted by the Department of Botany, University of Alberta. The absence of some grass species and the presence of others in many of the more open parts of the area, together with the occurrence of hybrid pines in some of the wooded portions of the area has stimulated a great deal of interest and proved the need of further, more detailed, studies of the vegetation.

Figure 12—Map Showing the Relative Distribution of Tree Cover in the High Prairie and McLennan Sheets.



Tree Cover Absent or Light (Presents little impediment to land development).

Tree Cover Light to Medium (Some impediment to land development, may require power clearing).

Tree Cover Medium to Heavy (Serious impediment to land development, power clearing may be too costly).

Smoky River shales. Except for the fact that these clays are stone free, somewhat more uniform and generally darker colored, they differ very little from the previously described clays. In the areas surveyed to date, however, they have not been found at elevations exceeding 2,100 feet. In this area Falher and Nampa soils are developed on this dark colored, somewhat saline, lacustrine parent material.

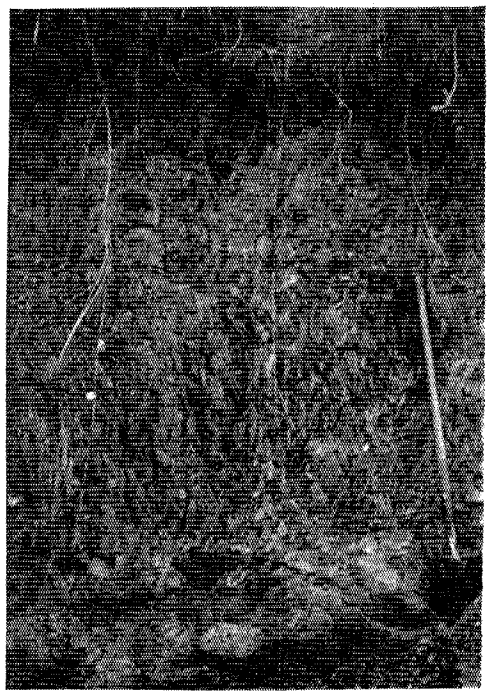


Figure 13—Roadcut along the banks of Snipe creek. The uppermost 3 feet consists of dark colored lacustrine material while the next 2 to 3 feet consists of somewhat lighter colored lacustro-till. There are then from 4 to 5 feet of compacted, sandy clay till overlying bedrock.

At elevations usually below the 1,950 contour and in the areas bordering some of the major stream courses the parent materials are brownish colored and appear to be of alluvial origin. The most recent of these deposits are found in the flood plain adjacent to High Prairie and form the parent material of the High Prairie and Enilda soils. The older alluvial deposits, adjacent to Winagami lake and the Heart river consist of sandy and silty materials that in many cases appear to have been reworked by wind. The Davis, Judah, Culp and other related soils are formed on this type of parent material.

In addition to the foregoing, there are other types of parent material that are of local importance in various portions of the mapped area. These are the gravelly outwash and shoreline materials found in association with some of the till and lacustro-till areas,

the material developed on or in very close association with the underlying bedrock, other alluvial materials deposited as relatively thin beds overlying other deposits and the recent alluvium deposited on the river flats.

The period of post-glacial erosion and deposition has continued since glacial time and is continuing at the present time. It appears probable that Lesser Slave lake may have once extended to the northwest to include Winagami and Kimiwan lakes. The eroded materials carried down by the flood waters of the tributary streams have since filled up much of the western portion of this area and resulted in the extensive alluvial and flood plain deposits. Some of these are over 100 feet thick. Flooding in many parts of the High Prairie-Enilda area is still of fairly common occurrence. Another striking example of post-glacial erosion is the deep dissection of some of the broad, nearly flat, lacustrine areas. This dissection is most apparent in the western part of the area, adjacent to the Little Smoky river and some of its tributary streams.

SOILS

SOIL DEVELOPMENT

Soils consist of variable mixtures of weathered rocks and minerals, organic matter, water and air. They are the products of the environmental conditions under which they have developed and their characteristics are dependent upon (1) the climate and vegetation, (2) the nature of the parent material, (3) the relief and drainage, (4) the biological activity (living organisms), and (5) the length of time that these forces have been in operation.

Soil development is a continuous process that goes on, to a lesser extent, even after the soils have reached a state of near equilibrium with their environment. The rocks and minerals of the parent material weather and decompose into a finely divided condition. Percolating waters carry down the soluble and finely divided materials and redeposit them at lower depths. Concurrent with this there is a return of plant materials by way of the grass and tree roots from the lower portions of the profile. When the plant dies its remains decay and the humus formed tends to collect on or near the surface giving it a dark color. During decomposition plant nutrients are liberated and may be carried down by percolating rain water or re-used by the growing plants and other living organisms. Under natural conditions, therefore, soil development is a complex and continuous process. On cultivation, however, a completely new environment may be established and as a result the whole process may undergo a change and have to attain a new equilibrium.

The characteristics that a soil acquires, as the result of the interaction of the various soil-forming factors, are reflected in the development of more or less distinct layers or horizons. A cross section of these horizons from the surface to the relatively unaltered

parent material is known as a soil profile. (See Fig. 14.) The A horizon is the portion of the profile from which materials are leached by the percolating rain water and in which, in most soil profiles, the organic matter accumulates. The B horizon is the portion in which the materials carried down from horizon A are deposited. As a result of this accumulation the B horizon often tends to be somewhat heavier textured and more compact than the A horizon. Taken together the A and B horizons form the solum, which represents the true soil formed by the soil building agencies. The C horizon is the relatively unaltered parent material. Where the underlying material is different from that in which the solum has formed, it is designated as the D horizon. Soil profiles developed under the influence of excessive moistening may have a greyish, more or less sticky G horizon in the lower part of the solum.

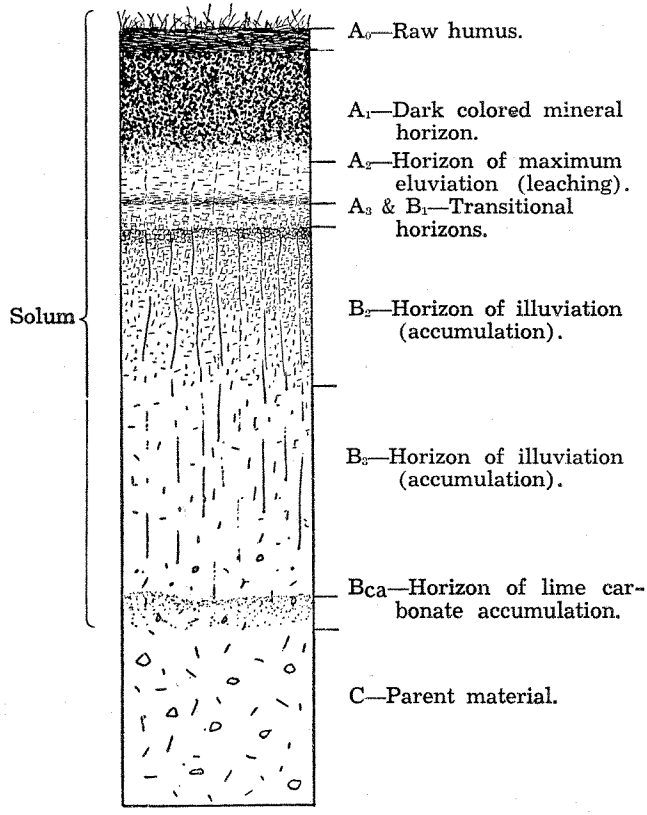


Figure 14—Diagram of a soil profile showing various horizons. (Some profiles may not have all these horizons clearly developed.) Where it is necessary to subdivide a horizon a second digit is used, for example, the B-2 horizon may be subdivided into B-21, B-22, etc.

The degree of profile development is dependent on the intensity of the activity of the different soil forming factors, on the length of time they have been active and on the nature of the materials from which the soils have developed. Characteristic horizons are not the result of chance. Mature soils developed on similar parent material under the influence of similar conditions of climate, vegetation and relief will have horizons of similar thickness possessing similar characteristics. Soils developed from similar materials that have been acted upon by environmental factors that are different in kind or intensity will have different profiles.

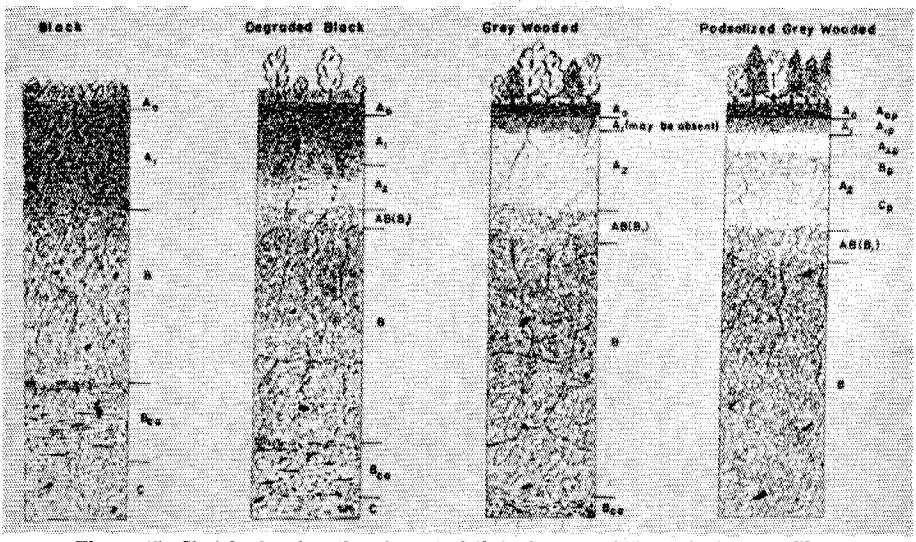


Figure 15—Sketch showing the characteristics of some of the principal profiles found in the mapped area.

In the High Prairie and McLennan sheets the interaction of the various soil forming factors has resulted in the development of many different soil profiles. Each profile has its own specific characteristics and offers its own agricultural problems and potentialities. Some of the principal profile types are illustrated in Fig. 15. The following summary shows the relation of some of the soil forming factors to the major profile types found in the mapped area. The first three profiles are typical of zonal soil types. The remainder are modifications of zonal soils. They are the result of various local differences such as differences due to topographic position (drainage) or to parent matrial.

A. Vegetation and Relief.

1. Well drained to moderately well drained topographic positions.

(a) *Black Soil Profiles*: Developed on non-saline parent materials in areas characterized by a long continued absence of tree cover. The profiles have a very dark brown to black A horizon

and a prismatic or granular structure in the B horizon. The lower portion of the B horizon has an accumulation of lime carbonate. (See Fig. 15.) Such profiles are of infrequent occurrence in the mapped area.

(b) *Degraded Black Soil Profiles (Grey Black or Transition)*: Developed in areas in which the woodland vegetation has not been as dense nor as well established as that of the grey wooded soil areas. The woodland may be a comparatively recent development on former grassland areas. The profiles have a dark grey to brown A_1 horizon that is well developed and usually several inches thick. The underlying A_2 horizon is grey to greyish brown in color and rarely exceeds a thickness of six inches in this area. The B horizon generally has a nuciform structure and lime carbonate is usually present in the lower part of this horizon. (See Fig. 15.)

(c) *Grey Wooded Soil Profiles*: Developed under a mixed deciduous and evergreen woodland vegetation on calcareous parent materials. The profiles have a thin or almost imperceptible A_1 horizon, a thick, ashy, grey to brownish grey A_2 horizon and a well developed textural B horizon. Lime carbonate is usually present in the C horizon and may occur in the lower portion of the B horizon. (See Fig. 15.)

(d) *Podsolized Grey Wooded Soil Profiles*: These profiles are characterized by the development of what appears to be a secondary, podsol-like profile in the A horizons of soils that otherwise resemble grey wooded soils. The secondary profile is readily distinguished by its white to pinkish white A_2 horizon that is usually thin and much lighter colored than the remainder of the A_2 horizon of the primary profile. There is a slightly compacted brown to reddish brown B horizon which is underlain by the grey to brownish grey remnants of the former grey wooded A_2 horizon. (See Fig. 15.) The B horizon of the primary profile usually undergoes some alteration with a resultant deterioration of its pronounced textural characteristics. Such profiles are of infrequent occurrence, being found only in the more sandy portions of the mapped area.

2. Moderately well drained to poorly drained topographic positions.

(a) *Meadow Soil Profiles*: These profiles have a fairly thick, dark colored A horizon and a lighter colored, often iron-stained B or G horizon. The A horizon is rich in organic matter and in heavy textured soils it has a fine granular structure.

(b) *Depression Podsol Soil Profiles*: These profiles are distinguished by their thick, grey A_2 horizon underlain by a heavy "sticky" B horizon. Rusty streaks and mottling are found in the B horizon and often in the A_2 horizon. Frequently the uppermost horizon consists of a fairly thin, dark colored accumulation of peat.

(c) *Peat Soil Profiles*: These profiles have an accumulation of organic material (peat) overlying a mottled and often rusty streaked mineral subsoil. They are identified by the depth and nature of the peat accumulation. *Thin peat profiles* usually have less than 12

inches of peat and are often classified according to the nature of the underlying mineral subsoil. Thick peat profiles are typical of true organic soils and the underlying mineral horizon may be regarded as a D horizon. Depending on the kind of organic material in the accumulation, they are referred to in this report as *sedge peat* or *moss peat soil profiles.*

B. Nature of the Parent Material.

The following profile types are of fairly common occurrence in the mapped area and are believed the result of the predominating influence of a saline to somewhat saline parent material.

(a) *Solonetz Soil Profiles*: May occur as the dominant soil profiles of fairly large areas or in association with other degraded black or black soils. These profiles have a dark grey to greyish brown A_1 horizon and sometimes a thin, grey A_2 horizon. The upper part of the B horizon is very hard and compact and has a distinct columnar structure. The columns often have a well rounded cauliflower-like top that is capped with a grey, dense, very hard layer. Dark colored, organic staining is common in the upper part of the B horizon, while lime carbonate and salts are usually present in the lower part of the B horizon.

(b) *Solodized Solonetz Soil Profiles*: Similar to the previously described profiles except that the upper part of the B horizon is not as hard nor as dark colored and there is usually a thick grey A_2 horizon. The lower B horizons are often much more friable than the upper. Depending on the characteristics of their A_1 horizon they are further designated as black, degraded black or grey wooded solodized solonetz profiles. Such profiles are of extensive occurrence in the mapped area.

(c) *Solod Soil Profiles*: Appear to be remnants of solodized solonetz profiles. They generally have a fairly thick A horizon of which the grey, platy A_2 horizon is usually well developed. There is often an A_3 or B_1 horizon that consists of fairly loose, blocky to nuciform aggregates. The B_2 horizon does not have the pronounced columnar characteristics of the former profiles but is more friable and has a small blocky to nuciform structure. While the distinguishing features of solod soil profiles are not as apparent as those of the two preceding profiles, there is usually a fairly abrupt break between the A and B horizons. Depending on the characteristics of their A_1 horizons they are referred to as black, degraded black or grey wooded solod soil profiles.

SURVEY METHODS, CLASSIFICATION AND MAPPING

Survey Methods

The soil survey of the High Prairie and McLennan sheets was essentially a reconnaissance survey carried out by making traverses at intervals of one mile wherever possible. Traverses were made by car, on foot and, where necessary, by saddle horse. In the last case, both the traverse interval and the route was very irregular

and the information thus obtained was of an exploratory nature. The boundary lines between different soil areas were determined along the lines of traverse and then projected between the lines of traverse. Further inspection should be made if information of a more detailed nature is required.

Test holes were dug at frequent intervals in order to determine the texture, color, depth and structure of the various soil horizons. Additional notes were made on the nature and density of tree cover, stones, topography and other features believed pertinent to the agricultural development of the area. This information was supplemented by laboratory analyses of representative profile samples. The classification adopted to describe the various features noted on the field map and referred to in the descriptions to follow is given in the appendix to this report. The color descriptions used in the field and in this report are those given in the Munsell Soil Color Name charts. All the descriptions and analyses referred to in this report are of virgin soils.

Classification

The soils of the High Prairie and McLennan sheets were classified and grouped according to the scheme outlined in Table 7. Soils developed from similar parent material and having similar profile characteristics received a soil series name. The name was taken from the locality in which those soils were found and includes the names of rivers, lakes, towns and districts. Features that were believed of importance to the growth of native or crop plants formed the principal basis of soil series separation. Those which affected mainly the external characteristics of the soils, but not the principal profile characteristics, were separated as phases. Thus, soils belonging to the Braeburn series, for example, are assumed to have similar characteristics relative to crop production. If some of them are excessively stony or gravelly, or have a significantly different topography, they may be indicated or outlined on the soil map as appropriate phases of the Braeburn series. Further separations based on the texture of the surface soil or A horizon were not made in this area. Soils developed on similar parent material usually have a narrow range of texture and beyond indicating the range common to each series, further separations into soil classes were believed unnecessary.

The various soil series in Table 7 are grouped according to the type of parent material on which they have developed. Such groups of soils, whose different characteristics are believed to be due to differences in relief and drainage, are called catenas. The classification proposed in Table 7 might therefore be considered as essentially a catenary classification. It will be noted that in some cases soils of the same series are included in two or more catenas. Soils formed in poorly drained areas acquire profile characteristics that show little difference over a fairly wide range of parent materials. In the descriptions to follow and in the map legend such soils are

assigned specific parent materials merely for convenience of reference.

Table 7.—Classification of Soils in the High Prairie and McLennan Sheets.

A. Soils developed on glacial till:

1. Till yellowish brown to greyish brown, slightly calcareous, somewhat sandy, clay loam to loam.
   (a) **Braeburn** (Bb.)—Grey Wooded loam to heavy loam.
   (b) **Saddle** (Sa.)—Degraded Black (solodic) loam to heavy loam.
   (c) **Snipe** (Sn.)—Depression Podsol, often peaty (poorly drained) loam.
2. Till grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam to clay with few stones. (Lacustro-till.)
   (a) **Donnelly** (Do.)—Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam.
   (b) **Esher** (Es.)—Degraded Black (solodic to solodized solonetz) silt loam to clay loam.
   (d) **Snipe** (Sn.)—Depression Podsol often peaty (poorly drained) loam to silt loam.
   (e) **Goose** (Go.)—Meadow (somewhat poorly drained) silt loam to silty clay loam.
   (f) **Prestville** (Pr.)—Thin Peat (poorly drained) silt loam to clay loam.

B. Soils developed on lacustrine deposited materials:

1. Slightly to moderately calcareous, somewhat saline, unctuous, grey to dark grey clay.
   (a) **Nampa** (Np.)—Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam.
   (b) **Falher** (Fa.)—Degraded Black (solodized solonetz) silt loam to clay loam.
   (c) **Goose** (Go.)—Meadow (somewhat poorly drained) silt loam to silty clay loam.
   (d) **Prestville** (Pr.)—Thin Peat (poorly drained) silt loam to clay loam.
2. Moderately calcareous, brown, friable, silty clay loam to silty clay.
   (a) **Kathleen** (Kt.)—Grey Wooded silt loam to silty clay loam.
   (b) **Judah** (Ju.)—Degraded Black silt loam to silty clay loam.

C. Soils developed on alluvial and aeolian deposited materials:

1. Very calcareous, variable, silty parent material.
   (a) **Davis** (Dv.)—Grey Wooded loam to silt loam.
   (b) **Tangent** (Ta.)—Degraded Black loam to silt loam.
2. Moderately calcareous, variable, sandy parent material.
   (a) **Culp** (Cu.)—Grey Wooded loamy sand to sandy loam.
   (b) **Leith** (Le.)—Degraded Black loamy sand to sandy loam.
   (c) **Codner** (Cn.)—Meadow (somewhat poorly drained) sandy loam to silt loam.
3. Slightly calcareous, fairly loose sand parent material.
   (a) **Heart** (Ht.)—Podsolized Grey Wooded sand to loamy sand.
4. Slightly calcareous, comparatively recent river and flood plain deposited materials.
   (a) **Spirit River** (S.R.)—Black (weakly structured) sandy loam to silt loam.
   (b) **High Prairie** (H.P.)—Dark colored (moderately well drained), sandy loam to clay loam.

(c) **Enilda** (En.)—Poorly drained, often peaty, sandy loam to clay loam.
(d) **Alluvium** (A.)—Undifferentiated river flat and river bench deposits.

5. Relatively thin, slightly calcareous, light to medium textured deposits that overlie other heavier textured deposits.
   (1) Fairly uniform sandy or silty material overlying till or lacustrine deposits.
      (a) **Peoria** (Pe.)—Degraded Black to Black (weakly structured) sandy loam to silt loam.
      (b) **Codner** (Cn.)—Meadow (somewhat poorly drained) sandy loam to silt loam.
   (2) Variable, sandy to silty often gravelly material usually overlying till deposits.
      (a) **Codesa** (Co.)—Grey Wooded (weakly structured) sandy loam to loam.
      (b) **Belloy** (Be.)—Degraded Black to Black (weakly structured) sandy loam to silt loam.
      (c) **Codner** (Cn.)—Meadow (somewhat poorly drained) sandy loam to silt loam.

D. Soils developed on coarse outwash and shoreline materials:
(a) **Clouston** (Cl.)—Grey Wooded (weakly structured) gravelly or stony loamy sand to sandy loam.
(b) **Grouard** (Gr.)—Degraded Black to Black (weakly structured) gravelly or stony loamy sand to sandy loam.

E. Soils developed on residual and modified residual materials:
1. Somewhat saline sandy shales.
   (a) **Kavanagh** (Kv.)—Degraded Black to Black (solonetz) loam to heavy loam.
   (b) **Valleyview** (Vv.)—Degraded Black to Black (solodized solonetz to solonetz) loam to heavy loam.

F. Organic soils:
(a) **Eaglesham** (Eg.)—Peat fine and mainly of sedge origin.
(b) **Kenzie** (Kz.)—Peat coarse and mainly of moss origin (muskeg).

Classification of Typography

Percent Slope	Mapped Phases
0.0 - 0.5	Level and Undulating
0.5 - 1.5, 2 - 5	Gently Rolling
6 - 9, 10 -15	Rolling
16 -30	Hilly
Irregular, often steeply sloping banks adjacent to drainage courses	Rough and Broken

The topographic classes, representing additional elements of the classification and mapping system are appended to Table 7. The classification of topography involves the appreciation of important variations in surface features. These include steepness of slope, which is related to differences in elevation between the highest and lowest points; and the shape and frequency of various slopes, which determine the comparative roughness of the surface. The more important types of topography have been grouped into five mapping

units and these are indicated by appropriate symbols on the soil map. The relationship of these groups to the slope classes recommended by the National Soil Survey Committee is shown in Table 7. The overlapping indicates the range of slopes found in the topography classes referred to in this report.

Over 60 percent of the mapped area is classed as level to undulating. This class includes the level areas, some of which are poorly drained and those whose slopes are fairly uniform and rarely exceed 1 percent. The long smooth slopes may be broken at infrequent intervals by minor irregularities whose slopes do not exceed 2 percent.

The gently rolling areas are generally more irregular and often have a "humpy" appearance. The irregular portions have variable slopes usually not exceeding 9 percent whereas the smooth portions have slopes that rarely exceed 6 percent. Long, smooth slopes are characteristic of many of the gently rolling areas indicated on the soil map. Approximately 26 percent of the mapped area is classed as gently rolling.

Rolling land is characterized by a succession of ridges and knolls whose slopes are between 8 and 15 percent or by long uniform slopes having a gradient of between 6 and 15 percent. If other conditions are favorable rolling land is considered as arable. About 6 percent of the mapped area, chiefly in the northeast and southern portions, consists of land whose topography has been classed as rolling.

Hilly land makes up less than 1 percent of the mapped area. Such land is characterized by slopes that exceed 15 percent and is considered as non-arable.

Rough broken land makes up about 4 percent of the mapped area. It consists of the rough land, with variable slopes that borders and forms the valley banks of drainage courses.

Mapping.

Abbreviations and symbols are used to designate the predominant soil series and some of the characteristics of each of the areas outlined on the accompanying soil map. Rarely does one soil series occur to the practical exclusion of all other soil series. Soils having different profile types occur in close association throughout most of the mapped area. In some cases this is due to local differences in relief and drainage, while in others it is due to the close association of different parent materials. Donnelly and Esher soils are good examples of the former, whereas Judah and Davis soils are good examples of the latter association. Separation of such intimate mixtures was not always practical or possible on the scale of mapping used in this survey. Thus most of the soil areas outlined on the soil map consist of two and sometimes three soil series. The first named is believed predominant and in naming the soil areas only the dominant soil series are indicated. Those that make up less than

about 20 to 25 percent of the outlined areas are rarely indicated in the area designations.

The soil map is colored on the basis of similar parent materials. Areas consisting of more than one soil series receive the color designating the parent material of the predominant series. In the mapped area only the larger areas of organic soils are outlined. They are indicated by color. No attempt is made to indicate the relative distribution of the many small peat areas that were not possible to outline on this scale of map. The same considerations apply to other small areas which cannot always be accurately established or suitably designated on a map of the scale of three miles to the inch. Thus in all cases, further inspection should be made in determining the soils on individual quarter sections.

SOIL RATING

In describing the soils of the High Prairie and McLennan sheets, reference is made to a comparative rating as regards their inherent productivity. This rating is based on a consideration of such factors as the type of soil profile, the degree of stoniness, and the topography. It is an interpretation of the morphological features as they may affect plant growth and agricultural use. On the basis of this numerical rating, the soils are tentatively grouped according to their suitability for grain production, especially wheat. The past performance of somewhat similar soils under the prevailing grain cropping systems of management is used as a guide in determining this productivity grouping. It serves only to compare the inherent productivity of the soils in this area and is not intended to indicate present or potential capabilities. Changing methods of management and cultivation and the steadily increasing use of commercial fertilizers will greatly affect the future productivity of any of the soils discussed in this report..

In view of the fact that most of the soil areas that appear on the soil map consist of more than one soil series and that each of these series may have a different soil rating, it is necessary to indicate averages when referring to the rating of the various soil areas outlined on the soil map. Thus the accompanying rating map must be regarded as giving an average rating for an area rather than a specific rating for individual land parcels. It is prepared on the scale of four miles to the inch and divides the mapped area into five productivity groups: one pasture and four arable. The groups are indicated by numbers that appear on the legend of the rating map. Since the density of the native tree cover is quite variable, no attempt is made to subdivide the pasture lands according to their carrying capacity. The following is the approximate acreage of each of the five groups outlined on the accompanying map:

Group 1.	Pasture and Woodland (non-arable)	370,000 acres.
Group 4.	Poor to Fair Arable Land	140,000 acres.
Group 5.	Fair to Fairly Good Arable Land	820,000 acres.
Group 6.	Fairly Good to Good Arable Land	360,000 acres.
Group 7.	Good to Very Good Arable Land	70,000 acres.

In considering the rating and productivity grouping of the soils in the mapped area, it must be borne in mind that this area has had a relatively brief agricultural history with the result that long time average yields of crops grown in the recommended crop rotations are not yet available. However, wheat has been grown for a considerable length of time on some of these soils and on some similar soils in other areas, and it is believed that a rating and grouping related to average wheat yields will serve to indicate the inherent productivity of these soils. On this basis Group 4 soils in other areas have produced less than 10 to 12 bushels of wheat per seeded acre; Group 5 soils from 12 to 15 bushels; Group 6 soils from 15 to 20 bushels, and Group 7 soils have produced 20 to 25 bushels of wheat per seeded acre. These are tentative limits suggested to give an approximate relationship between the various groups. They are not to be used to indicate the productive capacity of the soils in this area. It is generally recognized that grey wooded soils are not as well adapted to good quality wheat production as they are to a variety of other crops. Furthermore, while their inherent fertility may be quite low they respond very favorably to good management practices supplemented, when necessary, with amendments of commercial fertilizer. The continued improvement of farming and the introduction of new varieties of farm crops will raise the productive capacity of these soils and may shift the dividing line between pasture and arable land.

DESCRIPTION OF SOILS

A. Soils Developed on Glacial Till.

1. Till yellowish brown to greyish brown, slightly calcareous somewhat sandy, clay loam to loam.

Braeburn and *Saddle* soils are the dominant better drained soils formed on this material which appears to be derived largely from the weathered products of the Wapiti and Smoky River formations. Soils of the Snipe, Goose, Prestville, Eaglesham and Kenzie series are often found on similar but somewhat altered parent material. They are formed in the depressions and poorly drained lowlands that are frequently associated with areas of Braeburn and Saddle soils. In addition, Donnelly and Codesa soils are commonly found in close association with Braeburn soils on many of the lower slopes of the till areas. The following is a description of the two principal soil series formed on this till:

(a) Braeburn Series (Bb.): Grey Wooded loam to heavy loam.

Extent and Occurrence: In the northern and southern parts of the mapped area there are about 650,000 acres in which Braeburn soils are predominant.

Topography: Approximately 85 percent of the Braeburn soils have an undulating to gently rolling topography, 13 percent have a rolling topography and 2 per cent have a hilly topography. For the most part the Braeburn soil areas have long, fairly uniform slopes.

The various topographic phases are indicated on the accompanying soil map.

Drainage: Braeburn soils are moderately well drained and frequently have a somewhat excessive surface run-off.

Native Vegetation: These soils appear to have developed under a fairly heavy tree cover consisting of aspen poplar, and spruce with some pine and birch and various shrubs. In many of the western and northern portions of the area much of the tree cover is fire-killed.

Profile Description: Braeburn soils have a moderately thick, greyish, leached A_2 horizon and a yellowish brown to greyish brown fairly heavy textured B horizon in which a lime concentration horizon is often found at depths of 36 to 48 inches. Occasional stones of variable sizes are found throughout the profile. The accompanying illustration and the following description are typical of an average Braeburn soil profile.

Horizon	Thickness in inches	Description
A_0	1-2	Dark greyish brown to very dark brown decomposed and semi-decomposed leaf litter. pH 6.6 to 7.0.
A_1	0-2	Greyish brown loam with very little definite structure. Usually too thin to be sampled and often absent. pH 6.2 to 6.6.
A_2	2-6	Light yellowish brown very fine sandy loam that is often gritty and sometimes contains iron concretions. Friable and has a fairly well developed platy structure. pH 5.8 to 6.2.
$A_3(B_1)$	2-3	Yellowish brown silt loam, fairly loose, somewhat porous, medium nuciform. pH 5.2 to 5.8.
B_2	6-10	Dark yellowish brown clay loam to clay, weakly columnar, nuciform with some staining on the cleavage faces. pH 5.0 to 5.3.
B_3	12-24	Dark yellowish brown to greyish brown loam to clay loam that has occasional streaks or pockets of sandy loam or silty clay loam. Fairly loose, nuciform aggregates that are somewhat smaller than those in the B_2 horizon and frequently contain imbedded coal flecks. pH 5.8 to 7.0.
B_{ca} at 36-48 below surface		Greyish brown loam to clay loam with occasional bands of dark grey clay. Often spotted or streaked with lime. pH 7.5 to 8.0.
C		Greyish brown to yellowish brown clay loam till. pH 7.8 to 8.2.

Soil Rating: The undulating to gently rolling portions are fair to fairly good arable land. The rolling portions are poor to fair arable land while the hilly portions are non-arable.

Agricultural Use: Only a very small proportion of the Braeburn soils are being farmed at the present time. (See Cultivation Map, Fig. 3.) Appreciable portions in the northern and southern parts of the mapped area are being withheld from settlement to serve as watersheds.

Braeburn soils are relatively low in natural fertility. As a result of the leaching process by which these soils have been formed, many of the soluble plant nutrients have been removed from the upper horizons and redeposited in the lower horizons. Consequently the B horizons are generally better supplied with mineral plant nutrients than are the leached A horizons. Furthermore, the organic matter developed under a woodland vegetation is not as fibrous nor as stable as that developed under a grass cover. The addition of organic matter and occasional supplementary applications of commercial fertilizer appear to be the prime requirements associated with the successful cropping of Braeburn soils.

The reluctance to farm these soils has probably been due to the presence of a relatively heavy native tree cover and to their lower fertility. Stones are not usually present in sufficient numbers to be a serious hindrance to cultivation. Little experimental work has been done to determine the fertility requirements of these soils. However, the results of experiments on somewhat similar soils indicate that very favorable responses can be expected from good management practices.

(b) Saddle Series (Sa.): Degraded Black (solodic) loam to heavy loam.

Extent and Occurrence: Soils of the Saddle series predominate in about 21,000 acres of the mapped area. They occur on some of the better drained, sparsely wooded portions of the area in association with Braeburn and often with Esher soils. No estimate is made of the extent of their occurrence in those areas in which they are not predominant.

Topography: The greater proportion of the Saddle soils have an undulating to gently rolling topography. However rolling phases are of common occurrence near Salt Prairie.

Drainage: Generally they are well drained soils that in some cases may have a somewhat excessive surface run-off.

Native Vegetation: Saddle soils appear to have developed under a more open, parkland type of cover consisting mainly of shrubs and fairly open stands of aspen poplar.

Profile Description: These soils have a well developed, dark colored A_1 horizon and a yellowish brown A_2 horizon that is rarely more than 6 inches thick. In addition the upper part of the B

horizon is often more compact than that of Braeburn soils. The following is a profile description of an average Saddle soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown to black leaf litter. pH 7.0.
A_{11}	4	Dark brown to black loam, weakly prismatic, crushes easily to small crumbs. pH 6.0.
A_{12}	2-3	Greyish brown loam, weakly prismatic. pH 5.5.
A_2	3	Yellowish brown very fine sandy loam, platy in upper 2 inches to vescular nuciform in the lower 1 inch. pH 5.3.
$A_3(B_1)$	2	Yellowish brown clay loam, vesicular nuciform. Aggregates occur in clusters and may be the tops of old columns. pH 4.5.
B_2	8	Dark yellowish brown clay loam to clay, weakly columnar, nuciform to blocky, firm. pH 4.8.
B_3	12	Dark yellowish brown to brown clay loam, weakly prismatic, nuciform to blocky, friable. pH 6.5.
B_{Ca}	at 30-36 below surface	Brown to greyish brown clay loam, small nuciform to blocky, friable, moderate lime. pH 7.8.
C		Greyish brown clay loam till. pH 7.8.

Soil Rating: The undulating and gently rolling portions are good arable soils whereas the rougher portions are fair to fairly good depending on the variability and percentage of slope.

Agricultural Use: Except for some of the rougher phases, most of the Saddle soil areas are under cultivation. (See Cultivation Map, Fig. 3.) Grain crops are being grown to the practical exclusion of all others.

These soils have a fairly high native fertility and as a result are quite desirable for agricultural purposes. However, every precaution should be taken to see that their native fertility is maintained. Preference should therefore be given to a mixed farming agriculture which includes legumes and grasses in the crop rotation. Since many of these soils are on sloping land they are subject to water erosion. The inclusion of organic matter in the surface and the elimination of cultivation up and down the slopes should both receive consideration.

2. Till grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam to clay with few stones. (Lacustro-till.)

Donnelly, Esher and *Landry* soils are the principal soils formed in the better drained positions while soils of the *Snipe* and *Goose* or Prestville, Eaglesham and Kenzie series may be formed in the poorly drained positions on this parent material. In a previous report ("Soil Survey of the Rycroft and Watino Sheets") this till

was referred to as "stratified till" or "modified lacustrine" material. While descriptive, these terms are not generally acceptable since they have been used to describe materials having very different characteristics. This material (lacustro-till) is very similar to the lacustrine deposited material except that it is somewhat browner, less compact and has a few stones. It is often stratified and frequently the sandy clay loam to silty clay strata are quite stony. The soils formed on this material may merge gradually with those formed on the yellowish brown to greyish brown till or those formed on the dark colored lacustrine material or they may be separated from them by soils formed on relatively shallow overlying deposits of gravelly or sandy materials.

The following is a description of the principal soil series formed on this till-like parent material:

(a) **Donnelly Series (Do.): Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam.**

Extent and Occurrence: Donnelly soils are found on the lower slopes of the till plain adjoining the High Prairie basin in the central portion of the area and some of the stream courses in the northern and southern parts of the mapped area. There are approximately 178,000 acres in which Donnelly soils are predominant. No estimate is made of the extent of their occurrence in the many areas in which they are not predominant.

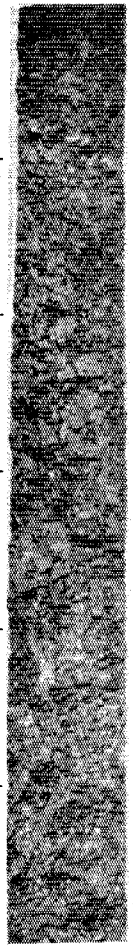
Topography: They have an undulating to gently rolling topography that consists mainly of long fairly uniform slopes.

Drainage: Imperfectly or somewhat poorly drained. In some cases they may have an excessive surface run-off.

Native Vegetation: Aspen poplar in which there are variable proportions of black poplar, spruce, willow, alder, birch and various shrubs.

Profile Description: Donnelly soils usually have a thin A_1 horizon, a grey A_2 horizon that seldom exceeds a thickness of about 4 inches and a grey to greyish brown, nuciform A_3 or B_1 horizon. The remainder of the solum consists of a dark yellowish brown to dark greyish brown clay that is fairly compact. The lower part of the B horizon is often much darker colored than the upper part, and this color change may be quite abrupt. The following is a description of an average Donnelly soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown leaf litter. pH 6.7.
A_1	1	Dark greyish brown to dark grey heavy loam to clay loam with little definite structure. This horizon may absent. pH 6.6.
A_2	2-3	Light yellowish brown very fine sandy loam, medium to coarse platy, easily crushing to small irregular fragments. pH 5.9.



Horizon	Thickness in inches	Description
$A_3(B_1)$	2-3	Light yellowish brown loam to clay loam, medium nuciform, vesicular, friable. pH 5.3.
B_{21}	6-8	Dark yellowish brown clay, medium columnar, fine nuciform to blocky, firm to very firm. pH 5.1.
B_{22}	6-8	Dark yellowish brown to dark brown clay, fine to medium blocky, firm. pH 5.1.
B_3	6-8	Greyish brown to dark grey clay, fine to medium blocky, firm. pH 7.2.
Bca	at 24-36 below surface	Greyish brown to dark grey clay with occasional yellowish brown sandy clay loam strata that may be somewhat stony. Moderate lime. pH 8.0.
B_{SO_4}		As above, but with an accumulation of salts. pH 7.8.
C		Grey clay with occasional strata of yellowish brown sandy clay loam in which small stones are common. pH 7.8.

Soil Rating: Donnelly soils are fairly good to good arable soils.

Agricultural Use: Only a relatively small proportion of the Donnelly soil areas are under cultivation at the present time. (See Cultivation Map, Fig. 3.) While grain crops are the principal crops grown, increasing attention is being given to the growth of legumes in various portions of the area. Yields of 200 pounds alfalfa seed or 800 pounds sweet clover seed per acre are not uncommon.

Donnelly soils are relatively low in organic matter and their subsoils tend to have a restricting influence on the penetration of water and of plant roots. Consideration must therefore be given to the inclusion of organic matter in the surface and to the improvement of the rate of percolation in the subsoil. Crop rotations that include deep-rooted crops such as legumes will help to open up and thereby improve the structure of these soils.

Fertility experiments are being conducted on similar soils by the Beaverlodge Experimental Station. While these experiments have not been continued long enough to be conclusive they do indicate a marked response to applications of manure and to applications of phosphate fertilizers.

(b) Esher Series (Es.): Degraded Black (solodic to solodized solonetz) heavy loam to clay loam.

Extent and Occurrence: There are approximately 58,000 acres in which Esher soils are predominant. They are found mainly in

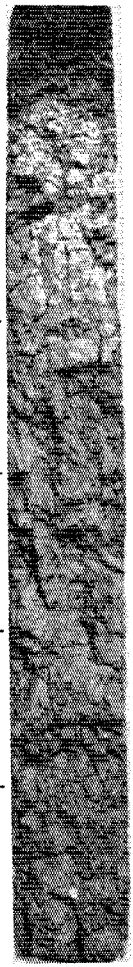
association with Donnelly soils and often with Saddle soils. No attempt is made to determine the acreage of Esher soils in those areas in which they are not predominant.

Topography: Generally undulating to gently rolling, consisting of long fairly uniform slopes that rarely exceed a gradient of 5 percent.

Drainage: Moderately to imperfectly drained soils usually found in positions that are somewhat better drained than those of the Donnelly soils. Surface run-off may tend to be excessive on some of the long slopes.

Native Vegetation: Apparently similar to that of Donnelly soils, but much less dense and tending to parkland.

Profile Description: Esher soils are distinguished by their well developed dark colored A_1 horizon that is usually from 2 to 6 inches thick. The B horizon is often very compact although it tends to break fairly readily into fine blocky to nuciform aggregates. The following is a description of an average Esher soil profile:



Horizon	Thickness in inches	Description
A_0	1	Dark brown to black decomposed to semi-decomposed leaf litter. pH 7.0 to 7.6.
A_1	2-6	Dark brown to brown silt loam to clay loam, weakly prismatic breaking readily to weakly nuciform aggregates. pH 5.9 to 6.3.
A_2	2-4	Light yellowish brown silty loam, platy in the upper portion, coarse platy to nuciform in the lower portion. pH 6.0 to 6.2.
$A_3(B_1)$	1-3	Light yellowish brown silt loam to silty clay loam, nuciform, vesicular, friable. May be tops of old columns. pH 5.7 to 6.2.
B_{21}	4-8	Dark yellowish brown clay, often silty. Medium columnar breaking into fine blocky to nuciform aggregates. Cleavage faces stained a dark brown. pH 5.0 to 6.0.
B_{22}	4-8	Dark yellowish brown to dark brown clay, compact, weakly nuciform to massive. pH 5.5 to 6.5.
B_{31}	5-7	Greyish brown to dark grey clay, compact, weakly nuciform to massive. pH 7.0 to 7.5.
B_{32}	4-8	Greyish brown to dark grey clay with occasional somewhat stony strata of yellowish brown clay loam. Friable, fine nuciform. pH 7.5 to 8.0.
B_{ca}	at 30-36 below surface	Greyish brown to dark grey clay loam to clay. Moderate lime content. pH 7.9 to 8.1.
C		Greyish brown to yellowish brown clay loam to clay frequently mixed with strata of dark grey clay in which salt pockets are of common occurrence. pH 8.0 to 8.3.

Soil Rating: Good arable soils.

Agricultural Use: Esher soils are among the more desirable soils of this area. Those portions in which they are predominant, particularly in the vicinities of Reno, Leicester, Prairie Echo and Snipe lake are largely under cultivation and producing reasonably good crops. (See Cultivation Map, Fig. 3.)

The maintenance of organic matter and improvement of the permeability and structure of these soils are essential considerations to continued successful cropping. Water erosion losses are becoming serious in many of the older settled areas and unless the organic matter and fibre content of these soils is maintained or improved, these losses may seriously curtail crop production. Rotations that include grasses and legumes and the elimination of cultivation up and down slopes would appear to be basic to the development of a successful cropping plan on these soils.

(c) Landry Series (La.): Black (solodic to solodized solonetz) silty loam to clay loam.

Extent and Occurrence: Relatively small areas of these soils, totalling about 4,000 acres, are found in the vicinities of Prairie Echo and Leicester.

Topography: Undulating to gently rolling, long fairly uniform slopes.

Drainage: Imperfectly drained soils found in well drained positions which often tend to have an excessive surface run-off.

Native Vegetation: Fairly open parkland type of vegetation consisting of native grasses and shrubs with bluffs mainly of aspen poplar.

Profile Description: Very similar to that of an Esher soil except that the A_1 horizon is usually thicker and darker in color. It is very dark brown to black and its average thickness is about 6 inches. The following is a description of an average Landry soil profile:

Horizon	*Thickness in inches*	*Description*
A_1	6	Very dark brown to black silt loam to clay loam, crushes easily to fine crumbs. pH 6.8.
A_2	2	Dark greyish brown grading to yellowish brown silty loam, fine to medium platy, very friable. pH 6.2.
$A_3(B_1)$	2	Yellowish brown clay loam, nuciform, vesicular, fairly firm, often occurs in loose clusters. pH 6.2.
B_2	8	Dark yellowish brown to dark brown clay, often silty. Medium columnar breaking into very firm nuciform to small blocky aggregates that often have a waxy or glazed appearance. pH 6.0.
B_3	8	Very dark greyish brown and dark brown clay, coarse nuciform to blocky, firm. While the vertical cleavage lines are usually indistinct, there are often very pronounced horizontal cleavage lines at varying intervals in this and the succeeding horizons. pH 7.0 to 7.5.

Horizon	*Thickness in inches*	*Description*
Bca	at 26-36 below surface	Dark grey clay in which yellowish brown sandy clay loam strata are of common occurrence. Moderate concentrations of lime and some stones are found in these lighter colored strata and salt inclusions are common in the lower part of this horizon. Sharp, angular stone fragments are often found imbedded in the dark colored clay aggregates of this and the preceding horizons. pH 8.0.
C		Dark grey and yellowish brown stratified clay to clay loam till-like material.

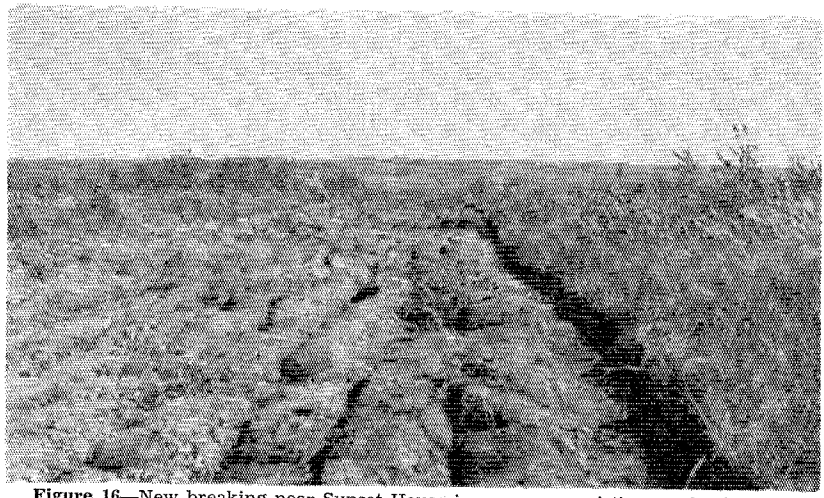


Figure 16—New breaking near Sunset House in an area consisting predominantly of Esher soils.

Figure 17—Alfalfa crop in a Donnelly soil area near McLennan. August 1950.

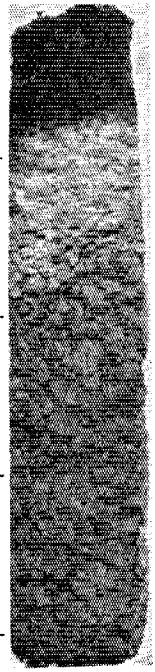
Soil Rating: Good to very good arable soils.

Agricultural Use: Landry soils are among the most productive soils in the mapped area and among the first to be farmed. Grain crops are being grown to the practical exclusion of all others.

These soils have a fairly high natural fertility and every precaution should be taken to ensure that their natural fertility be maintained. Unfortunately, however, it would appear that the best soils are the last to receive conservation attention. Whereas in the newer areas Landry soils have yielded in excess of 25 bushels of wheat per acre, the same soils in the older settled districts are not averaging much over 15 bushels per acre. The prevalent grain-summerfallow system of farming has resulted in a very marked decline in fertility, and serious consideration should be given to the early inclusion of legumes and grasses in the crop rotation.

(d) Snipe Series (Sn.): Depression Podsol, often peaty (poorly drained) loam to silt loam.

Extent and Occurrence: Snipe soils are of extensive occurrence throughout most of the mapped area. However, areas in which they predominate are outlined only in the western and southwestern portions of the High Prairie and McLennan sheet and make up a total of about 36,000 acres. No attempt is made to determine the extent of their occurrence in those areas in which they are not believed to be predominant. They are found in many of the low, poorly drained areas associated with soils developed on till and lacustro-till deposits.



Topography: Level and depressional.

Drainage: Poor and may be ponded for considerable periods.

Native Vegetation: Coarse grasses and sedges, occasional willows, scrub birch and black poplar.

Profile Description: Snipe soils are distinguished by a peaty A_0 horizon and by a fairly thick, iron stained, A_2 horizon. Rarely is the iron staining particularly apparent in the B horizons.

The following is a description of a profile typical of the Snipe series:

Horizon	*Thickness in inches*	*Description*
A_{00}	4	Brown to dark brown sedge peat. May be destroyed in burned over areas. pH 5.9.
A_0	1-2	Very dark brown to black decomposed sedge peat. pH 6.2.
A_1	1-2	Dark greyish brown loam to silt loam, high in organic matter, with very little structure. pH 5.6.
A_2	4-6	Light grey to very pale brown very fine sandy loam to silt loam with brownish yellow streaks or mottling, platy, friable. pH 5.2.

Horizon	Thickness in inches	Description
B_1	2-3	Grey to dark grey clay, nuciform, firm when dry. pH. 4.9.
B_{2g}	10-12	Grey to dark grey clay that has a waxy or glazed appearance when dry, fine blocky, fairly firm. pH 5.3.
B_{3g}	10-12	Dark grey clay, nuciform, friable. pH 6.9.
Bca	at 32 to 36	Greyish brown to dark greyish brown clay loam to clay, blocky, till. pH 7.3.
C		Greyish brown to yellowish brown clay loam till. pH 7.5.

Soil Rating: Snipe soils are suitable for pasture crop production, but until their drainage is improved they are not suitable for grain crop production.

Agricultural Use: Most of the larger areas of Snipe soils remain uncultivated. Small areas that are associated with better drained soils are usually cultivated along with the other portions of the field if drainage has been sufficiently improved to permit such a practice. However, the crops grown in such lower areas are much slower in maturing and of an inferior quality as compared to those grown on the adjacent better drained soils. Heavy applications of manure, supplemented by occasional applications of phosphate fertilizer have proven beneficial.

In many of the larger areas the removal of tree cover by clearing and burning and the construction of roads has resulted in a marked improvement in drainage and permitted agricultural development of these soils. However, even with the improvement of drainage it is doubtful if grain crops can be grown successfully for at least several years after breaking. Grasses, legumes and coarse grains should receive first consideration. The successful utilization of these poorly drained soils will depend upon the ability to improve their fertility and their physical condition.

Much remains to be done in finding the best methods of handling Snipe and other poorly drained soils and in determining the most desirable crops for such soils. Many farmers have had marked success with alsike clover. The possibility of improving the quality of forage on some of the native hay flats is receiving the attention of the Experimental Station at Beaverlodge. Additional work of this nature is needed to determine the successful utilization of these soils.

(e) Goose Series (Go.): Meadow (somewhat poorly drained) silt loam to silty clay loam.

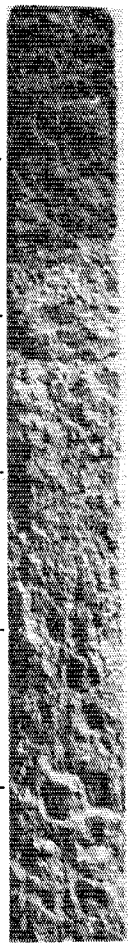
Extent and Occurrence: In the southwest portion of the mapped area there are about 6,000 acres in which Goose soils predominate. Elsewhere they are found in many of the low, poorly drained areas associated with soils that are developed on till, lacustro-till and lacustrine materials.

Topography: Level and depressional.

Drainage: Poorly drained soils that are usually wet in the spring of the year.

Native Vegetation: Meadow grasses, willow, scrub birch and occasional black poplar.

Profile Description: Goose soils are variable with respect to the thickness of the surface horizons and the characteristics of the subsurface horizons. Usually the surface horizons are greyish and often mottled. Frequently the upper part of the grey subsoil is yellowish in color and becomes quite hard on drying. These soils are often found in what appear to be old beaver meadows and their profile sometimes appears to be the result of a more recent clay deposition overlying a grey, heavy textured, somewhat mottled material. The following is a description of an average Goose soil profile:



Horizon	Thickness in inches	Description
A_0	2	Dark brown organic debris, often peaty. pH 5.6.
A_1	6	Very dark grey to black silt loam to silty clay loam, fairly high in organic matter. The upper portion has a weak crumb structure which grades into loose, fine granular or shot-like structure in the lower portion of this horizon. pH 5.4.
B_g	6	Dark grey and very dark grey silty clay to clay, fine nuciform, loose. The thickness of this horizon is quite variable and the colors may occur as splotches or as streaks. pH 5.1.
G	7	Yellowish brown mottled with dark grey silty clay to clay, massive, very firm when dry. The uppermost part of this horizon and some of the cleavage faces are often stained a very dark grey. Occasional iron staining may be apparent throughout this horizon. pH 4.8.
C_g		Grey to dark grey clay with occasional yellowish brown mottling, massive tending to medium blocky, occasional pronounced horizontal cleavage, firm. pH 5.0.
C at 24 to 36		Dark grey to very dark grey clay. On drying, breaks readily into blocky fragments that are somewhat friable. pH 6.5.

Soil Rating: Goose soils may be rated as very good for pasture crop production, but until their drainage is improved they are not suitable for grain crop production.

Agricultural Use: Little agricultural use is being made of the Goose soils in the mapped area. However, rather extensive areas in which Goose soils are of significant or predominant occurrence are being settled in the vicinity of Snipe lake. Experience elsewhere has shown that such soils, even after draining, are "cold" and not immediately suitable for grain crop production. After raising green-

feed, grasses or deep-rooted legumes for a few years, the aeration and drainage can be improved and coarse grains can then be grown very successfully. In many cases the removal of native vegetation and the levelling off of old beaver dams are the major steps in improving the drainage on these soils.

B. Soils Developed on Lacustrine Deposited Material.

1. Slightly to moderately calcareous, somewhat saline, unctuous, grey to dark grey clay.

Nampa, Falher and *Prestville soils* are the principal soils formed on this material in the mapped area. Frequently associated and formed on similar parent material are soils of the Snipe, Goose, Eaglesham and Kenzie series.

This parent material appears to be derived mainly from the weathered products of the Smoky River formation. It is a dark colored, heavy textured material that is quite compact and has a waxy or glazed appearance. The deposit is usually very uniform, but may contain thin strata of yellowish brown silty loam to silty clay loam. While it is quite similar to the previously described lacustro-till deposit, it is generally more compact, darker in color and stone-free. Sometimes it is separated from the lacustro-till deposits by areas in which there is a relatively shallow overlying deposition of sandy or gravelly material.

The soils developed on this material have a solodized solonetz or clay pan type of profile in which salts are often found just below the horizon of lime accumulation. Areas of these soils have a parkland type of vegetation. It would appear that the growth of a heavier woodland vegetation has been retarded, and it has been suggested that the clay pan characteristics of the soils may be at least partly responsible for inhibiting tree growth in these areas.

These soils are imperfectly to somewhat poorly drained and have a level to undulating and depressional topography. It would appear that micro relief is an important factor determining the type of profile that is formed on this parent material. Grey wooded soils are found in the lower positions, degraded black soils on the better drained slopes and black soils on the crowns and best drained positions. The grey wooded soils formed in the lower positions are not unlike depression podsols, but their profile is difficult to distinguish from that of other grey wooded soils developed in large areas in which drainage deficiencies are less apparent.

Following is a description of the principal soil series developed on this lacustrine deposited material in the mapped area:

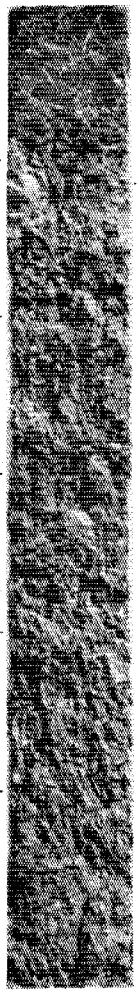
(a) Nampa Series (Np.): Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam.

Extent and Occurrence: In the west-central and northwest portions of the mapped area there are about 45,000 acres in which Nampa soils are predominant.

Topography: Level and depressional.

Drainage: Imperfectly to poorly drained with a low to very low surface run-off.

Native Vegetation: Fairly open stands of poplar in which willows, alders and coarse grasses are of common occurrence.



Profile Description: Similar to that of Donnelly soils except that the B horizon tends to be more compact and usually not as brown in color. The following is a description of an average profile typical of the Nampa series:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown leaf litter. pH 5.8.
A_1	1	Greyish brown heavy loam to clay loam, fine nuciform, friable. pH 5.5.
A_2	3	Light brownish grey very fine sandy loam to silt loam, medium to coarse platy, friable, often iron stained. pH 5.2.
$A_3(B_1)$	3	Light brownish grey to light yellowish brown silt loam to silty clay loam, nuciform, vesicular, fairly firm. Aggregates often occur in clusters and may be the tops of old columns. pH 5.0.
B_{21}	7	Dark greyish brown to dark yellowish brown clay to silty clay, weakly columnar, medium nuciform to blocky, very firm. pH 5.2.
B_{22}	7	Dark greyish brown to dark grey clay, coarse nuciform to blocky, very firm. pH 7.6.
B_3	4	Dark grey clay, fine to medium blocky, firm. pH 7.5.
Bca	at 26	Dark grey to very dark grey clay to silty clay loam, fine to medium blocky, friable. Lime in pockets or in thin silty strata when these are present. pH 7.6.
B_{SO_4}	at 30	As above, but with gypsum accumulation. pH 8.0.

Soil Rating: Nampa soils are generally fairly good arable soils.

Agricultural Use: An appreciable proportion of the Nampa soil areas is under cultivation. (See Cultivation Map, Fig. 3.) While grain crops are predominant it would appear that increasing emphasis is being given to grain-legume rotations.

These soils tend to be low in organic matter and they have an unfavorable subsoil that tends to retard the penetration of water

and of plant roots. Water penetration is slow and during heavy rains the surface of Nampa soil areas often becomes submerged. Deep breaking, followed by the periodic inclusion of deep-rooted legumes in the crop rotation should help to open up and materially improve the structure and the permeability of these soils.

Field trials on Nampa soils are being conducted at the Beaverlodge Experimental Sub-Station near McLennan. Substantial increase in yields of grain crops have been obtained from the applications of farmyard manure and from the application of nitrogen-phosphorus commercial fertilizers.

(b) Falher Series (Fa.): Degraded Black (solodized solonetz) silt loam to clay loam.

Extent and Occurrence: There are about 21,000 acres in which Falher soils are predominant. They are found chiefly in the central and west-central portions of the mapped area.

Topography: Level and undulating.

Drainage: Imperfectly or somewhat poorly drained soils that are found in better drained positions than are the Nampa soils.

Native Vegetation: Sparsely wooded, consisting of native grasses, willow, alder and occasional poplar bluffs.

Profile Description: Falher soils are distinguished by a well developed dark colored A_1 horizon that seldom exceeds a thickness of 6 inches. The depth to the B horizon is quite variable and the break between the A and B horizons is wavy, very abrupt and very distinct. They are degraded black soils having a well developed solodized solonetz type of profile that is relatively free of stones. The following is a description of an average Falher soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown leaf litter. pH 7.5 to 7.7.
A_1	4	Dark brown to dark greyish brown silt loam to clay loam, granular, loose. pH 6.2 to 6.7.
A_2	2	Yellowish brown to light yellowish brown very fine sandy loam to silt loam, platy, friable. pH 5.2 to 5.5.
$A_3(B_1)$	3	Greyish brown silt loam to silty clay loam, nuciform, vesicular but fairly firm. Aggregates sometimes have a dark brown staining on the under sides. pH 5.3 to 5.8.
B_{21}	6	Dark greyish brown clay, medium to coarse columnar, nuciform to blocky, hard. pH 5.5 to 6.0.
B_{22}	8	Dark greyish brown to dark grey clay, massive, hard when dry, and has a waxy or glazed appearance. pH 7.0 to 7.5.
B_3	6	Dark grey clay, massive, firm. pH 7.4 to 7.8.
B_{Ca}	at 28 to 36 below surface	Dark grey clay with occasional silty laminae. Lime low to medium, spotty, often mainly in lighter laminae. pH 7.9 to 8.1.
B_{SO_4}		As above with gypsum accumulation. pH 8.0 to 8.2.

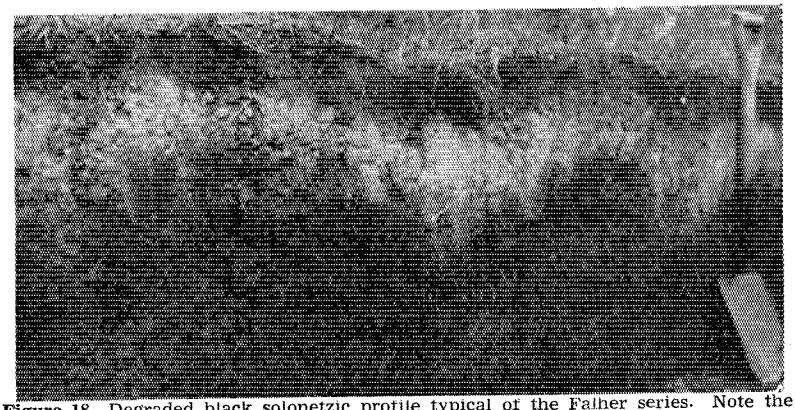


Figure 18—Degraded black solonetzic profile typical of the Falher series. Note the variability in depth to the darker colored heavy textured B horizon.

Figure 19—Wheat crop in a Falher soil area near Gilwood. August 1950.

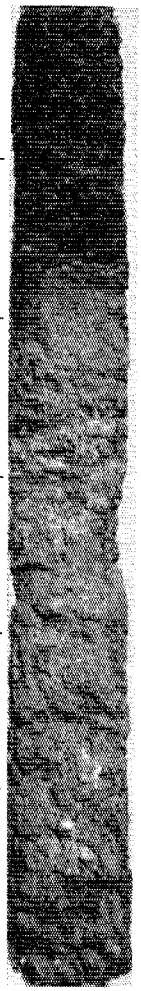
Soil Rating: Good arable soils.

Agricultural Use: The more accessible areas are largely under cultivation at the present time. (See Cultivation Map, Fig. 3.) While grain crops are predominant, increasing attention is being given to legume crop production.

Falher soils require careful management. Their loose surface soil is vulnerable to both wind and water erosion—particularly sheet erosion. The relatively tight subsoil absorbs water very slowly with the result that during heavy rains the surface may become

water-logged. The incorporation of organic matter and the growing of deep-rooted legumes will help to improve the structure and increase the rate of percolation in the B horizons of these soils. While there is usually a salt concentration layer in the lower part of the solum, alkali does not appear to be a problem in the management of Falher soils.

(c) Prestville Series (Pr.): Thin Peat (poorly drained) silt loam to clay loam.



Extent and Occurrence: In the western portion of the mapped area, near the Smoky river, there are about 1,000 acres in which Prestville soils predominate. However, they are found with, and often make up significant proportions of areas in which Falher, Nampa, Esher, Donnelly and Goose soils predominate.

Topography: Depressional.

Drainage: Poor and may be ponded for considerable periods.

Native Vegetation: Coarse grasses and sedges with occasional bluffs of willow and scrub birch.

Profile Description: Prestville soils have an accumulation of sedge peat that rarely exceeds a depth of 12 inches. They usually have an A_1 horizon but seldom an A_2 horizon. The following is a description of a profile typical of the Prestville series:

Horizon	*Thickness in inches*	*Description*
A_{oo}	7	Brown to dark brown sedge peat. pH 5.8.
A_o	3	Dark brown semi-decomposed sedge peat. pH 6.8.
A_1	2	Very dark brown to black silt loam to clay loam with little definite structure. pH 7.2.
B_g	1	Dark greyish brown clay loam, fairly firm. pH 7.4.
G	6	Dark grey clay, firm, iron stained, massive, breaking into blocky fragments. pH 7.8.
C_g	8	Grey clay which on drying tends to have a loose granular to shot-like structure. pH 7.6.
C_{ca}	at 26 to 30 below surface	Grey to dark grey clay, nuciform, friable, spotted with lime concentrations. pH 8.0.

Soil Rating: In their native state they are suitable for pasture crops. With improved drainage they may be developed into good arable soils.

Agricultural Use: Prestville soils are among the first of the peat soils to be cultivated. They do not have a deep accumulation of peat, and with their lack of tree cover they can be prepared for cropping very economically. However, after draining, they are

"cold" soils that are not immediately suitable for grain production. Elsewhere in the Peace River district, the general practice on such soils is to raise oats for greenfeed or sweet clover for the first few years after breaking. With increased aeration and improved drainage, legume-grain rotations have proved very satisfactory. After they have been cropped for a number of years, fields of Prestville soils are difficult to distinguish from fields of Falher soils.

2. Moderately calcareous, brown, friable silty clay loam to silty clay.

The parent material of *Kathleen* and *Judah* soils is found at elevations that are usually somewhat lower than those of the previously described lacustrine deposits. It frequently adjoins the latter and often occurs adjacent to the main drainage courses on what appear to be the uppermost terraces. The material is stratified and the greater proportion of the strata consist of brown to greyish brown silty clay loam to silty clay. The other, generally thin strata, consist of yellowish brown silt loam to very fine sand. Till, lacustro-till or dark grey lacustrine material usually underlies these deposits at variable depths.

These and other brown colored silty areas are often characterized by a humpy and dune-like topography consisting of irregular and variable slopes whose gradient sometimes exceeds 10 percent. Usually the slopes are short and from a distance the areas appear to be part of an undulating plain. In some of the knolls of such areas stratification is much less apparent in the parent material, and it may be that some of these deposits have been reworked and redeposited by wind. In recent studies* of the soils and vegetation of Alaska, somewhat similar topography is described and attributed largely to frost heaving. It may be that at some former time conditions favorable to a similar phenomenon prevailed in the mapped area and found their best expression in some of the brown, friable, silty to very fine sandy deposits.

The soils formed on this material have a distinctive brown colored solum whose structure is granular to nuciform. They sometimes occur in association with Nampa, Falher, Donnelly and Esher soils and often with soils formed on similar but more variable parent material. In addition thin peat and organic soils are commonly found in many of the lower positions of these areas. Following is a description of the dominant soils formed on this brown, friable, lacustrine material:

(a) Kathleen Series (Kt.): Grey Wooded silt loam to silty clay loam.

Extent and Occurrence: There are about 24,000 acres in which Kathleen soils are predominant. They are found in association with Donnelly and Nampa soils in the western part of the mapped area adjacent to the areas of Davis and Judah soils.

*The Principal Soils Groups of Alaska. C. E. Kellog and I. V. Nygard. U.S.D.A. Agricultural monograph No. 7, 1951.

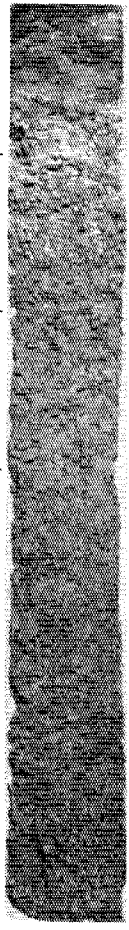
*Frost Action and Vegetation Patterns on Seward Peninsula Alaska. D. M. Hopkins and R. S. Sigafoos. U.S. Geological Survey Bulletin, 974.C, 1950.

Topography: Generally quite variable, but in the mapped area mostly gently undulating and consisting mainly of long fairly uniform slopes.

Drainage: Moderately well drained soils which often have a moderately high surface run-off.

Native Vegetation: Mixed woodland in which aspen poplar is predominant. Bluffs of spruce and pine are of common occurrence in many parts of the Kathleen soil areas adjacent to Kenzie.

Profile Description: Kathleen soils are distinguished by their pale brown A_2 horizon and brown B horizon. While the latter is often fairly compact in the upper portion, it is more friable and browner in color than that of either the Nampa or Donnelly soils. The following is a description of an average Kathleen profile found in the mapped area:



Horizon	Thickness in inches	Description
A_0	1-2	Dark brown to dark greyish brown leaf litter. pH 6.4.
A_1	1-2	Dark greyish brown to greyish brown loam, granular, friable. pH 5.0.
A_2	2	Pale brown to light brownish grey very fine sandy loam, medium platy. pH 4.5.
$A_3(B_1)$	2-3	Brown silt loam to silty clay loam, nuciform, fairly firm aggregates that have a light brownish grey coating on the top and sides. pH 4.4.
B_2	8	Dark greyish brown to brown silty clay, weakly columnar, medium blocky to nuciform, firm. pH 4.5.
B_3	6	Brown silty clay, medium blocky, fairly friable. pH 5.3.
Bca	at 24-30 below surface	Dark grey silty clay and light yellowish brown silt loam to very fine sandy loam laminae that vary in thickness and have little apparent continuity. Often laminations are not apparent and horizon consists of mixed grey and yellowish brown fine blocky aggregates. Lime concentrations particularly in the lighter colored portions. pH 7.5.
D		Dark grey to grey clay, medium blocky, fairly firm. Often found at depths of 36 to 48 inches, and resembles the C horizon of Nampa or of Donnelly soils. pH 7.8.

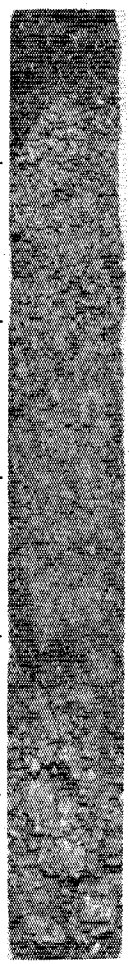
Soil Rating: Generally fairly good arable soils.

Agricultural Use: At the present time very few of the Kathleen soil areas are under cultivation. (See Cultivation Map, Fig. 3.) This is probably due to their fairly heavy tree cover.

While these soils are somewhat low in native fertility they should respond very favorably to good cropping and soil management practices. Crop rotations that include both grasses and legumes will not only increase the fibre and organic matter content of these soils but will also help to increase the available supply of some of the nutrient elements. Supplementary applications of manure or commercial fertilizers should result in significant increases in crop yields. The replenishment of the fibre and organic matter will also help to curtail serious losses from wind and water erosion. In connection with the latter, the elimination of cultivation up and down the slopes should become a basic practice of farm management.

(b) Judah Series (Ju.): Degraded Black silt loam to silty clay loam.

Extent and Occurrence: There are only a few areas, chiefly in the vicinity of Leicester, in which Judah soils are predominant. However, they are also found in association with Davis soils and form very significant proportions of the latter areas.



Topography: Generally quite variable but an undulating to gently rolling somewhat humpy topography is typical of the larger areas of Judah soils. When associated with Davis soils they are usually found on the lower slopes while Davis soils are found on the upper portions and crowns of gently rolling and rolling areas.

Drainage: They are well drained soils in which both the internal and external drainage is usually good.

Native Vegetation: A mixed woodland in which aspen poplar and small shrubs are predominant.

Profile Description: Judah soils can be recognized by the brown colored surface horizon and by a brown, friable, fairly heavy textured, usually stone-free subsoil. The structural aggregates of the subsoil lack the cohesion typical of most of the previously described soils. There is often a gradual greying of the lower part of the A horizon rather than a distinct A_2 horizon. Both with respect to their color and their structure they are unlike other degraded black soils of this area. The following is a description of an average Judah soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Dark brown decomposed and semi-decomposed leaf litter. pH 7.3 to 7.6.
A_{11}	3	Dark brown to brown silt loam to silty clay loam, fine granular to crumb, friable. pH 6.9 to 7.2.
A_{12}	2	Yellowish brown very fine sandy loam to silt loam, fine granular to crumb, friable. pH 6.5 to 6.8.

Horizon	Thickness in inches	Description
B_1	6	Brown to dark yellowish brown silty clay loam to silty clay, granular to nuciform, friable. pH 5.8 to 6.2.
B_2	6	Similar to above but somewhat more compact. pH 5.6 to 6.2.
B_3	6	Dark yellowish brown silty clay loam to silty clay, nuciform, friable. Occasionally has thin yellowish brown silty and very fine sandy laminae. pH 7.0 to 7.4.
B_{ca}	at 24 to 36 below surface	Brown to yellowish brown silty clay, nuciform, friable, frequently laminated, usually fairly high in lime. pH 8.1 to 8.3.
C		Greyish brown silty clay loam to silty clay, granular to nuciform, friable. Brownish yellow laminae of very fine sand or silt are often present. pH 8.1.

Soil Rating: Depending on topography Judah soils rate as fairly good to good arable soils.

Agricultural Use: The areas in which Judah soils predominate are largely under cultivation and producing chiefly grain crops.

These soils tend to be low in plant fibre and organic matter. In other areas, water erosion—particularly gully erosion—is becoming increasingly troublesome. Judah soils are quite friable and it would appear desirable to replenish the fibre and organic matter in order to increase the adhesion of the soil aggregates. Cultivation on the contour wherever possible, the introduction of grass and legume crops into the crop rotation and applications of fertilizer, when needed, appear to be the basic requirements for a successful management of Judah soils.

C. Soils Developed on Alluvial and Aeolian Deposited Materials.

These water and wind sorted deposits are found associated with present or past water courses. They are often stratified. The strata are usually fairly thick and may consist of alternating beds of sand, silt and clay. Some of the strata are cross-bedded, and it would appear that wind may have been at least partly responsible for sorting and redepositing some of this parent material. The depth of these deposits over the underlying till or lacustrine materials varies, but is usually in excess of 3 feet. Frequently the best examples of the humpy, variable topography, described on page 55, are found in areas in which this variable parent material is predominant.

The soils formed on this type of material may be grouped according to the dominant textural characteristics of their parent material. These groups are as follows:

1. Very calcareous, variable, silty, parent material.

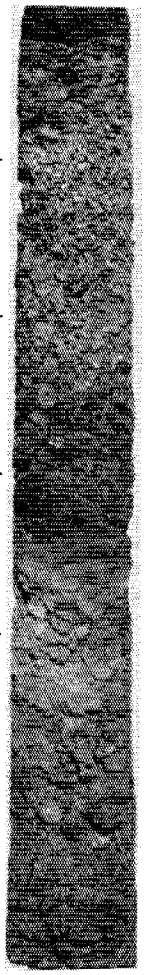
Davis and *Tangent* soils are the principal better drained soils formed on this yellowish brown material. Poorly drained soils of the Eaglesham, Kenzie and Codner series can be formed on similar stratified material. The strata are rarely less than 6 inches thick and vary considerably. Silt and silty clay strata generally pre-

dominate. Following is a description of the dominant soils formed on this variable material:

(a) Davis Series (Dv.): Grey Wooded loam to silt loam.

Extent and Occurrence: In the vicinity of Winagami lake and adjacent to the Heart river there are about 81,000 acres in which Davis soils predominate.

Topography: Generally humpy, gently rolling to rolling. The knolls are low but often steep-sided. In the depressional areas associated with this humpy terrain, sedge and moss peat bogs are of common occurrence. Some of the topographic features characteristic of Davis soil areas in this region bear a striking resemblance to those described and attributed to frost action by Hopkins and Sigafoos in United States Geological Survey Bulletin 974-C.



Drainage: Moderately well drained soils that often have an excessive surface run-off.

Native Vegetation: A mixed woodland vegetation consisting of aspen poplar, spruce, shrubs and generally coarse grasses.

Profile Description: While Davis soils are classified as grey wooded their profiles are usually much browner in color than those of other grey wooded soils. Often the darkest part of the solum is the lower part of the B horizon lying immediately above the lime horizon. In addition, thin strata that are reddish brown in color sometimes occur at varying intervals in the B horizon. However, Davis soil profiles are quite variable. There is little uniformity as regards the depth to the different strata or as regards the thickness of the respective strata. A solum that is predominantly silty is characteristic of these soils. Following is a description of an average Davis soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1-2	Dark brown organic debris. pH 7.2.
A_1	1	Brown loam to silt loam, often absent. pH 7.0.
A_2	3	Light brown to very pale brown very fine sandy loam to silt loam, platy, very friable. pH 6.4 to 6.8.
B_{11}	3	Pale brown silt loam to silty clay loam, nuciform, vesicular, friable. pH 6.2 to 6.6.
B_{12}	8	Yellowish brown silt loam to silty clay loam, nuciform, friable. pH 5.4 to 5.8.
B_2	6	Brown to strong brown silty clay, somewhat more compact than the previous horizon. pH 5.6 to 6.0.

Horizon	*Thickness in inches*	*Description*
B_{Ca}	at 22 to 30 below surface	Light brownish grey silt clay and light yellowish brown silt and very fine sand strata that often exceed 12 inches in thickness. Fairly high to high lime accumulation. pH 8.0 to 8.6.
C		Light yellowish brown very fine sandy loam to silt loam in upper 8 inches. Remainder very fine sand to silt with occasional bands of silty clay or silty clay loam. pH 8.0. to 8.6.

Soil Rating: Depending on topography, Davis soils rate as fair to fairly good arable soils.

Agricultural Use: At present little agricultural use is being made of most of the Davis soil areas in the High Prairie and McLennan sheets.

These friable, medium textured soils are vulnerable to both wind and water erosion. In addition they are generally fairly low in organic matter, nitrogen and phosphorus.

Grasses and legumes must be included in the crop rotations to build up the fibre and organic matter content of Davis soils. Experience has shown that such grasses as brome, crested wheat, and creeping red fescue can be grown successfully. Alfalfa, sweet clover and altaswede are very desirable soil improving crops, and legume seed production has met with marked success on many of the Davis soils of other areas.

Since these soils tend to have a low reserve of mineral plant nutrients they ought to respond to fertilizer amendments. Field trials conducted on similar soils by the Beaverlodge Experimental Station and by the Department of Soils, indicate a very marked response to nitrogen-phosphate fertilizers.

(b) Tangent Series (Ta.): Degraded Black loam to silt loam.

Extent and Occurrence: There are no areas outlined on the soil map in which Tangent soils are predominant. They occur associated with Davis soils and often with Judah or Leith soils. An example of the latter may be found in an area west of Heart River.

Topography: Variable, generally gently rolling to rolling.

Drainage: Usually well drained soils that may have a somewhat excessive surface run-off.

Native Vegetation: A sparse woodland or parkland type of vegetation consisting predominantly of shrubs and aspen poplar.

Profile Description: Except for the thicker and darker colored A_1 horizon, Tangent soils are similar to Davis soils. The prevailing brown color of the solum is a distinctive characteristic of these soils and in that respect they are unlike various other degraded black soils. Following is a description of an average Tangent soil profile:

Horizon	Thickness in inches	Description
A_1	3	Very dark brown to brown fine sandy loam to silt loam with little definite structure. A thin A_0 horizon is often found above this horizon. pH 7.6 to 7.8.
A_2	2	Pale to very pale brown very fine sandy loam, weakly platy. pH 7.4 to 7.6.
$A_3(B_1)$	3	Light yellowish brown very fine sandy loam to silt loam, weakly platy to small granular, loose. pH 7.2 to 7.6.
B_2	8	Yellowish brown to brown silt loam to silty clay loam, weakly prismatic, weakly nuciform, friable. Lower 2 to 3 inches often darker colored. pH 7.4 to 7.8.
B_{ca}	at 16-30 below surface	Grey to light brownish grey very fine sandy loam to silt loam. Fairly high in lime. pH 8.6.
C		As above, occasionally finely laminated or cross bedded.

Soil Rating: Depending on topography, Tangent soils are fairly good to good arable soils.

Agricultural Use: Tangent soils are vulnerable to both wind and water erosion. Fibre is needed to bind the loose soil aggregates and to increase the water-holding capacity of these soils. It is essential therefore that the organic matter and fibre content be maintained at a fairly high level. Tangent soils are fairly fertile soils that will respond profitably to good management.

2. Moderately calcareous, variable, sandy parent material.

Culp and *Leith* soils are the dominant better drained soils formed on this yellowish brown, stratified material which is somewhat similar to that of the preceding group. However, its strata are predominantly sandy. The sand to loamy sand strata are usually thick whereas the sandy clay to clay loam strata generally do not exceed a thickness of about 2 inches. The following is a description of the principal soils formed on this type of parent material:

(a) Culp Series (Cu.): Grey Wooded loamy sand to sandy loam.

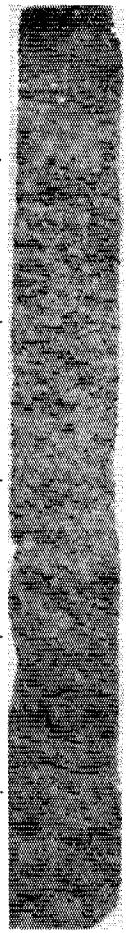
Extent and Occurrence: There are about 33,000 acres in which Culp soils are predominant. They are found adjacent to some of the principal stream courses in the southeastern and northern parts of the mapped area, and often occur in close association with Davis and with Heart soils.

Topography: Variable, gently rolling to rolling, often humpy.

Drainage: Well drained to somewhat excessively drained soils.

Native Vegetation: Woodland vegetation consisting of aspen poplar, occasional spruce and pine bluffs, shrubs and coarser grasses.

Profile Description: Culp soils are grey wooded soils that have a brownish colored sandy profile in which there is a fairly well developed, compact B horizon at depths of 12 to 18 inches below the surface. The following is a description of a typical Culp soil profile:



Horizon	Thickness in inches	Description
A_0 & A_1	2	Dark brown to dark greyish brown leaf litter with a thin greyish brown sandy loam horizon in the lower portion. The latter is often absent. pH 7.5.
A_2	6	Light brownish grey to light yellowish brown loamy sand, loose. pH 7.3.
$A_3(B_1)$	3	Light yellowish brown to yellowish brown loamy sand, darker colored and firmer than the A_2 horizan. pH 7.0.
B_{21}	6	Yellowish brown to brown sandy clay loam to sandy loam, blocky, firm. pH 6.4.
B_{22}	6	Dark yellowish brown sandy clay loam to sandy loam, blocky to massive with sand along cleavage faces and in root channels. pH 6.7.
B_3	6	Yellowish brown sand to loamy sand with occasional clay loam laminae. pH 8.0.
B_{Ca}	at 26-40 below surface	Similar to the preceding horizon but with a moderate concentration of lime particularly in the heavier textured laminae. pH 8.3.
	at 48 below surface	Similar to above but higher in lime. pH 8.4.

Soil Rating: Culp soils with a fairly uniform topography are rated as fair arable soils. However, in many cases they have a choppy topography consisting of fairly steep slopes. In such cases sedge and moss bogs are of very common occurrence in the depressions and the areas should be withheld from cultivation or seeded permanently to grass.

Agricultural Use: Only a very small proportion of the Culp soil areas is under cultivation at the present time. They appear to respond favorably to management practices that include frequent legume crops and periodic applications of a nitrogen-phosphorus fertilizer.

Culp soils are sufficiently sandy to be very vulnerable to wind erosion. Organic matter and fibre must therefore be maintained at a fairly high level to cut down losses due to soil erosion. The steep, rough and patchy areas of Culp soils should be left in their virgin state or seeded down to permanent pasture.

(b) Leith Series (Le.): Degraded Black loamy sand to sandy loam.

Extent and Occurrence: Leith soils predominate in a small area, comprising about 700 acres, which is outlined west of Heart River. They are also found in association with Culp soils adjacent to some of the main drainage courses of the mapped area.

Topography: Variable, undulating to rolling, much of it has a dune-like appearance.

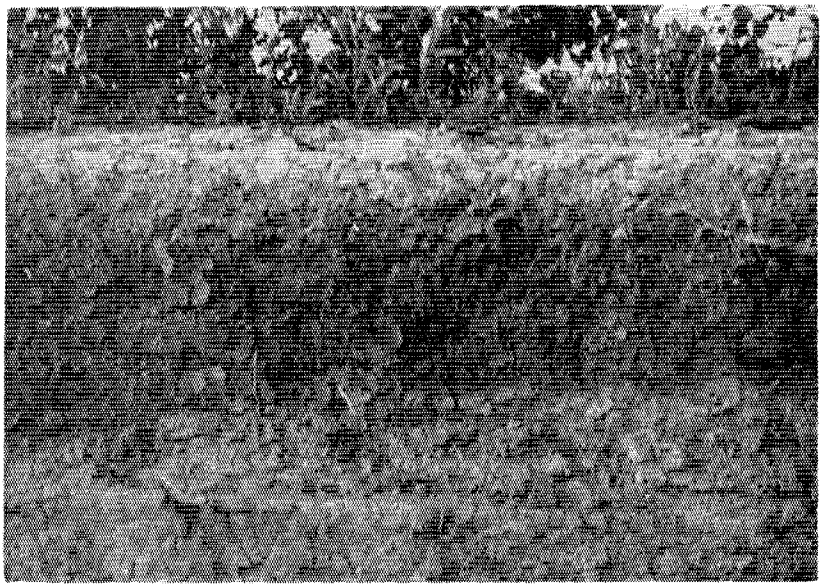


Figure 20—Grey wooded profile typical of the Davis series.

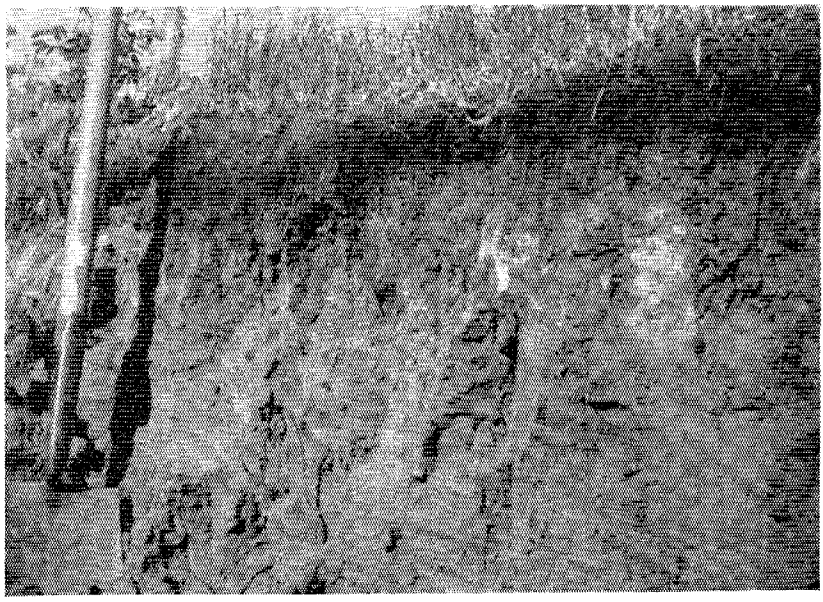


Figure 21—Profile typical of the High Prairie series.

Drainage: Well drained to somewhat excessively drained soils.

Native Vegetation: A more open cover than that of Culp soils. Found under a parkland vegetation particularly on the more exposed south slopes.

Profile Description: Leith soils are brownish colored, sandy soils that usually have a well developed compact B horizon. The following is a description of a typical Leith soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown organic debris. pH 7.0.
A_1	6	Brown to dark brown fine sandy loam, weakly blocky. pH 7.6.
A_2	6	Pale brown to yellowish brown loamy sand, loose. pH 7.8.
B_2	12	Yellowish brown to brown sandy clay loam to sandy loam, weakly columnar, nuciform, friable. Has occasional sandy lenses. pH 7.6.
B_{ca}	at 24-36 below surface	Greyish brown very fine sandy loam to silt loam. Fairly high in lime. pH 8.4.
C		Brown to yellowish brown loamy sand with occasional laminae—rarely over 2 inches thick—of sandy or silty clay loam. pH 8.2.

Soil Rating: Leith soils on undulating to gently rolling topography are fairly good arable soils.

Agricultural Use: Much of the Leith soil area is under cultivation and producing fairly satisfactory crops of grains and legumes. However, Leith soils are vulnerable to wind erosion and soil drifting is already apparent in the area. Organic matter and fibre will need to be replenished and maintained at a fairly high level to help curtail the losses due to soil erosion. The maintenance of a trash cover and the elimination of much of the summerfallowing will also do much towards controlling soil drifting.

3. Slightly calcareous, fairly loose sand parent material.

Heart soils are the dominant soils formed on this water and wind sorted, highly siliceous, sandy material which is found in relatively small areas adjacent to some of the main drainage courses. It varies from fine to coarse sand and is sometimes underlain by heavier textured materials at depths of 4 to 6 feet below the surface.

(a) Heart Series (Ht.): Podsolized Grey Wooded sand to loamy sand.

Extent and Occurrence: Adjacent to some of the main drainage courses in the mapped area there are about 16,000 acres in which Heart soils predominate. They often occur in close association with Culp soils.

Topography: Undulating to rolling. Much of the area appears to consist of old dunes that are now fairly well grassed over.

Drainage: Well drained to excessively drained soils.

Native Vegetation: Woodland vegetation consisting of good stands of pine, spruce and aspen poplar. Sedges and mosses are of

common occurrence in many of the poorly drained portions of these areas.

Profile Description: Beyond recognizing the occurrence of differing profile types and differing textural types, no attempts were made to make further series separations of the soils formed on this material. The following is a description of a Heart soil profile that is commonly found in the undulating to gently rolling well drained portions of the sand areas. The upper portion of this profile has characteristics that appear to be typical of a podsol profile. In the lower horizons, however, the heavier textured accumulations may be remnants of a former Grey Wooded B horizon.

Horizon	Thickness in inches	Description
A_0	½	Brown organic debris. pH 6.0.
A_{2P}	3	White to pinkish white in upper portion, grading to light grey in lower portion, fine sand, loose but held together by plant roots. pH 5.6.
B_P	7	Pale brown in upper portion grading to brownish yellow in lower portion, fine sand, slight evidence of compaction. pH 5.4.
C_P	6	Light yellowish brown fine sand, weakly blocky. pH 5.6.
$A_3(B_1)$	10	Very pale brown fine sand, weakly blocky with occasional soft spheroidal aggregates of loamy sand to sandy loam. pH 5.7.
B_2	13	Very pale brown fine sand to loamy fine sand with strong brown clusters of soft spheroidal aggregates of loamy sand to sandy loam. Lime flecks are sometimes found in the lowest part of this horizon. pH 5.4. Generally more pronounced evidence of lime accumulation is found at depths of about 48 inches.

Soil Rating: Heart soils are not arable.

Agricultural Use: Areas of Heart soils should not be cultivated. Any disturbance of the protective vegetative cover and binding will bring about rapid deterioration of the organic matter and result in serious soil drifting in these areas. There are at present practically no active dunes, and every effort should be made to preserve or re-establish the native tree cover and to withhold the sand areas from settlement. They should be set aside as timber and game reserves.

4. Comparatively recent river and flood plain material.

The dominant soils formed on recent river and flood plain material are those of the *Spirit River, High Prairie* and *Enilda* series.

Those formed on the *Alluvium* in river valleys have not been differentiated into series. These soils usually have weakly developed profiles in which there is little apparent evidence of horizons formed as the result of illuviation. However, there is usually a marked difference particularly in the color and depth of the A horizons of those soils found on the upper and older terraces and those found on the lowest and most recent flood plains. The former are often darker colored as the result of a greater accumulation of organic matter. The following are descriptions of the principal soils formed on this comparatively recently deposited parent material:

(a) Spirit River Series (S.R.): Black (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are two areas, comprising about 2,000 acres, in which Spirit River soils are predominant. These occur near Reno in the northwestern part and near the Smoky river in the central part of the mapped area. Spirit River soils are also found in association with some of the High Prairie soils.

Topography: Level to undulating, very gently sloping.

Drainage: Usually well drained soils.

Native Vegetation: Fairly open parkland consisting of grasses and occasional bluffs of aspen poplar and various shrubs.

Profile Description: Spirit River soils are distinguished by a thick A horizon that is very dark brown to black in color. The brownish colored B horizon has little definite structure, and often consists of a sequence of depositional strata. The texture varies from a sandy loam to a silt loam depending on the thickness and nature of the various strata. Following is a description of a typical Spirit River profile:

Horizon	*Thickness in inches*	*Description*
A	6	Very dark brown to black sandy loam to silt loam, weakly granular. Some firmness largely due to organic fibre. pH 7.2.
B	24	Brown to yellowish brown depositional strata that have very little definite structure but do have some evidence of leaching and accumulation. pH 6.8.
		The following are typical of these strata:
	4	Brown to yellowish brown silt loam.
	10	Yellowish brown very fine sandy loam.
	2	Light yellowish brown loamy sand.
	8	Brown to yellowish brown clay loam—weakly nuciform.
Bca	at 24-36 below surface	Yellowish brown silt loam—low to moderate lime content. pH 8.1.

Soil Rating: Very good arable soils.

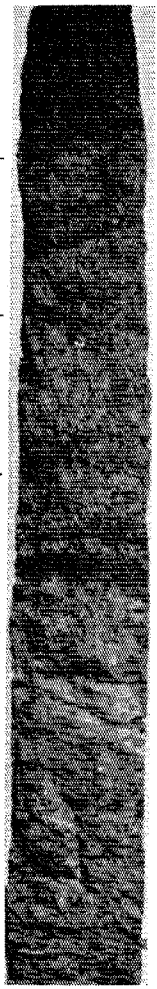
Agricultural Use: Spirit River soils have a fairly high native fertility and are very desirable agricultural soils. However, they appear to be vulnerable to wind erosion and soil drifting is becoming a problem. Rotations that include grasses and legumes should replace the present continuous grain-fallow rotations.

(b) High Prairie Series (H.P.): Dark colored (moderately well drained) sandy loam to clay loam.

Extent and Occurrence: On the large flood plain in the central part of the mapped area there are about 82,000 acres in which High Prairie soils predominate. Significant proportions of some of the Spirit River and Enilda soil areas consist of High Prairie soils.

Topography: Level to gently undulating with long gentle slopes.

Drainage: Moderately well drained to somewhat poorly drained. Generally iron stains are found at depths of 12 to 18 inches, and it would appear that periodically there is a fairly high water table in these soils. Flooding may occur in various portions of the area, particularly those portions adjacent to the East Prairie and West Prairie rivers.



Native Vegetation: Parkland in which coarse grasses, black poplar, willow and scrub birch are of common occurrence.

Profile Description: High Prairie soils are quite variable. Some are light textured and others are fairly heavy textured. The lighter textured members are often found at slightly higher elevations adjoining some of the drainage courses. They are stone-free soils that have a brown to very dark brown A horizon. The material below the A horizon is brown in color, consists of varying strata and shows little evidence of horizon development. The following is a description of a medium textured High Prairie soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1-2	Dark to very dark brown leaf and grass litter. pH 7.2.
A	4	Dark greyish brown with splotches of dark grey silt loam, medium blocky, friable. pH 7.0.
B	8	Brown to pale brown silt loam, weakly fine blocky to nuciform, friable. This horizon is usually not as compact as the A, and the upper portion is often splotched with dark grey stains. pH 6.3.
C & C_g		Pale brown to brown stratified material with little uniformity as to thickness or texture of the various strata. Buried profiles are common. The following are typical strata:
	4	Brown to pale brown silt loam, coarse plate-like strata, weakly nuciform, friable. pH 6.1.
	2	Brown very fine sandy loam to loam. pH 6.1.
	4	Brown to pale brown silt loam, coarse plate-like strata, weakly nuciform, friable. pH 6.0.
	3	Pale brown silt loam, weak medium nuciform with numerous iron stains. pH 6.3.

Horizon	Thickness in inches	Description
	½	Grey to dark grey loam to silt loam, high in organic matter. May be a buried A horizon. pH 6.8.
	3	Pale brown loam, weakly nuciform, numerous iron stains. pH 7.2.
	12	Pale brown very fine sandy loam to loam with very distinct horizontal cleavage, giving it a fine platy appearance. Iron stained and may occasionally have small lime concretions. pH 7.6.

Soil Rating: Generally good arable soils.

Agricultural Use: Most of the High Prairie soil areas are under cultivation. (See Cultivation Map, Fig. 3.) Grain crops are grown to the practical exclusion of all others and very good yields are reported. However, these soils tend to be loose and low in plant fibre, and early consideration will have to be given to the addition of organic matter. Recent field trials conducted by both the Beaverlodge Experimental Station and by the University of Alberta, Department of Soils, also indicate that a marked response can be expected from applications of nitrogen-phosphorus fertilizers.

A serious impediment to the agricultural utilization of these soils is the lush growth of horsetail (equisetum arvense). It tends to crowd out the young crops and its deep-rooted habits make it very difficult to eradicate. While considerable study has been given to the control of horsetail it would appear that further investigations are needed to determine satisfactory control measures.

(c) Enilda Series (En.): Poorly drained, often peaty sandy loam to clay loam.

Extent and Occurrence: Occupying the east-central portion of the mapped area, there are about 93,000 acres in which Enilda soils predominate. They are also of significant occurrence in many of the adjacent High Prairie soil areas.

Topography: Level and depressional, subject to periodic flooding.

Drainage: Poor, frequently wet for considerable periods.

Native Vegetation: Coarse grasses and some sedges, bluffs of willow and scrub birch.

Profile Description: Except for a dark colored surface horizon that is usually high in organic matter and often peaty, there is little horizon development in these soils. Below the dark surface the profile is a drab greyish color, consists of varying depositional strata and has iron stains. Enilda soils occupy the lower positions and tend to have a somewhat heavier textured surface than do the High Prairie soils. The following is a profile description of an average Enilda soil profile:

Horizon	Thickness in inches	Description
A_{00}	1	Dark brown sedge peat. pH 7.2.
A_1	3	Very dark brown silt loam high in organic matter with occasional grey to dark grey splotches. Weak medium nuciform. pH 7.1.

Horizon	Thickness in inches	Description
B_g	3	Greyish brown to grey silty clay loam, weak fine granular to nuciform, fairly loose. pH 6.5.
C_g	3	Light brownish grey silt loam, weakly nuciform, friable, iron stained. Both the top and bottom portions of this stratum are bounded by thin, dark grey strata. pH 6.7.
	2	Grey to light brownish grey silt loam, weak fine granular, loose. pH 6.7.
	1	Dark grey to very dark grey loam high in organic matter. May be a buried A horizon. pH 6.4.
	5	Light brownish grey silty clay, weak medium blocky, friable. Thin mats of organic matter along some of the cleavage faces and numerous iron stains. pH 6.3.
	8	Pale brown to light yellowish brown loamy sand, weak fine to medium platy, friable, iron stained. pH 6.9.
	6	Pale brown and grey alternating strata of silt loam and clay loam with occasional thin lenses of fine sand. pH 6.9.
	6	Grey to greyish brown alternating strata of silt loam and very fine sandy loam, highly iron stained. pH 6.9.

Figure 22—Alsike clover crop in a mixed High Prairie-Enilda soil area near High Prairie. August, 1950.

Figure 23—Native and seeded hay crop in a mixed Eaglesham-Enilda soil area near Buffalo bay. August 1950.

Soil Rating: Until their drainage is improved Enilda soils are not suitable for grain crop production. They are suited to pasture crop production.

Agricultural Use: Native hay is cut on many of the Enilda soil areas—particularly those associated with or adjoining Eaglesham soil areas. In many portions of this area seedings of red top have been made to improve the native pastures.

On cultivation, early consideration should be given to maintaining the organic matter content of these soils at a fairly high level. Applications of nitrogen-phosphorus fertilizers might be useful in hastening the maturity of grain crops. Alsike clover should receive early consideration in the crop rotation.

The area in which Enilda soils are predominant is located close to transportation facilities. It has an adequate water supply for stock watering purposes and appears to be particularly suited to pasture crop production. Livestock or dairying enterprises should receive consideration in the agricultural development of this area.

(d) Alluvium (A.): Undifferentiated river flat and river bench deposits.

Alluvium refers to material, deposited by rivers, that occurs on the terraces and flood plains in the valleys of those rivers. This material is of fairly recent origin and has variable characteristics. Consequently a wide variety of immature soils is found in these valleys. Many are similar to those of the Spirit River, High Prairie and Enilda series, but because the valley flats are usually very variable in size and often badly cut up by oxbows and old stream courses, no attempt is made to delineate the various different soil areas. Usually the soils in these flats are greyish brown to dark brown in color and vary in texture from a fine sandy loam to a silt loam. The subsoils are often sandy and sometimes gravelly. Since a wide variety of soils are found on this material and since a variety of conditions prevail on these river flats, the following is only a general description of some of the larger areas of alluvium outlined in the High Prairie and McLennan sheets.

Extent and Occurrence: There are about 3,000 acres, mainly adjoining the Little Smoky river in the west-central portion of the mapped area.

Topography: Usually level to undulating flats or benches that are often badly cut up by stream channels, oxbows, etc.

Drainage: Variable—usually good, often excessive.

Native Vegetation: Variable, often heavy cover consisting of spruce, black poplar, some aspen poplar and a dense undergrowth of willows and alders. Some of the flats have a parkland vegetation consisting of coarse grasses and scattered bluffs of poplar and willow.

Profile Description: Soils developed on alluvium are quite variable. Usually they are sandy and often they have a gravelly subsoil. The following is a description of a profile found on one of the

upper benches of the Little Smoky river just north of the bridge in township 74, range 20:

Horizon	*Thickness in inches*	*Description*
A	6	Black grading to dark brown, silt loam to very fine sandy loam, weak nuciform. Some firmness largely due to organic fibre. pH 6.8.
C	12	Brown to yellowish brown silt and very fine sand strata. pH 5.7.
	at 18	Gravel.

Soil Rating: Usually fair to good arable soils.

Agricultural Use: Soils formed on alluvium are often excessively well drained and tend to be droughty. Organic matter has a high water-holding capacity and it would be desirable that the organic matter content of these soils be maintained at a fairly high level. While the larger, more uniform of these areas often consist of good agricultural land, the smaller and often cut up areas are not particularly desirable. Moreover, many of these small areas appear to be extremely vulnerable to water and wind erosion. It would therefore seem desirable to exercise extreme caution in the utilization of some of these flats and benchlands.

5. Relatively thin, slightly calcareous light to medium textured deposits that overlie other heavier textured deposits.

The parent material of this group of soils consists of somewhat sandy material overlying other heavier textured material. The variable sandy deposits are generally shallow and rarely exceed a depth of 30 inches. Frequently they are about 12 to 18 inches thick. They occur on many of the lower slopes of the till areas or adjoining some of the drainage courses. Thus they may be either shallow beach or flood plain deposits. Sandy deposits that are somewhat gravelly and often stony are most frequently underlain by till, whereas the more uniform, often stone-free deposits are usually underlain by lacustrine material. Further study may show that some of the profiles developed on this type of parent material are the shallow counterparts of other profiles developed on similar but deeper deposits. For example, in many cases Peoria soils may be referred to as shallow phase Spirit River soils. Meanwhile, for the purposes of this report, the soils formed on these relatively thin alluvial deposits are grouped as follows:

(i) Fairly Uniform Sandy or Silty Material Overlying Till or Lacustrine Deposits.

Such deposits are found in parts of the area near Prairie Echo and near Snipe lake. They may be the result of a flooding over of adjacent stream courses.

(a) Peoria Series (Pe.): Degraded Black to Black (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are no areas outlined in which Peoria soils are predominant. However, they are of significant occurrence in association with Landry, Esher or Donnelly soils in the vicinity of Prairie Echo, and in some portions of the area adjoining Harvey, Iroquois and Sweathouse creeks.

Topography: Level and undulating.

Drainage: Generally moderately well drained soils but the underlying heavier textured material tends to restrict drainage with the result that the lower part of the overburden often appears to be poorly drained.

Native Vegetation: Parkland consisting of grasses and scattered bluffs of black poplar, aspen poplar, willow and occasional spruce.

Profile Description: Peoria soils are often very similar to Spirit River soils except that at depths of up to about 30 inches they are underlain by dark grey or dark greyish brown clay. The upper part of their A horizon is dark brown to black in color while the lower part is usually yellowish brown in color and maybe weakly platy. They do not usually have a well developed profile. Following is a description of an average medium textured Peoria soil profile:

Horizon	*Thickness in inches*	*Description*
A_1	6	Dark brown to black loam to silt loam, weakly prismatic. pH 6.7.
B	6	Yellowish brown to dark yellowish brown very fine sandy loam to silt loam. Slight evidence of platy structure in upper part of this horizon. pH 6.7.
C_{11}	6	Brown to yellowish brown fine sandy loam to loam, weakly blocky. pH 7.5.
C_{12}	8	Yellowish brown to reddish brown loamy sand, often iron stained and may have a thin gravelly lens in the lower portion. pH 8.0.
D	at 26 below surface	Dark grey clay, mottled and frequently laminated. Lime is often found in the upper 6 inches of this material. pH 8.2.

Soil Rating: Generally good arable soils.

Agricultural Use: Most of the Peoria soils are being used for grain crop production. However, the inclusion of fibre and the maintenance of organic matter are essential to the continued successful utilization of these soils. Moreover, while the heavy textured substratum tends to improve the moisture-holding capacity of the deeper Peoria soils, it may restrict water and root penetration when it occurs at depths of about 18 inches below the surface. Deep-rooted legumes that will penetrate and open up this substratum should improve this soil.

(ii) Variable sandy to silty often gravelly material usually overlying till deposits.

Better drained soils of the *Codesa* and *Belloy* series and poorly drained soils of the *Codner,* Eaglesham or Kenzie series are formed

on this light to medium textured, variable material. The deposit is shallow, however, and rarely exceeds a thickness of 24 inches. It is found on many of the lower slopes and benches of the till areas, particularly in the south-central portion of the mapped area. The following are the principal soils formed on these shallow, variable deposits:

(a) Codesa Series (Co.): Grey Wooded (weakly structured) sandy loam to loam.

Extent and Occurrence: There are about 88,000 acres in which Codesa soils are predominant. They are found in association with Braeburn and Donnelly soils and are of most extensive occurrence on the lower slopes of the till plain in the south-central portion of the mapped area. They are frequently of significant occurrence in association with Braeburn soils in various other portions of the mapped area.

Topography: Level to undulating consisting mainly of long uniform slopes.

Drainage: Usually imperfectly drained soils in which drainage deficiencies are most apparent in the horizons immediately above the heavier textured substratum.

Native Vegetation: Woodland consisting of variable stands of aspen poplar, black poplar, spruce, occasional pine and willows. There is frequently a dense undergrowth of native shrubs.

Profile Description: Codesa soils are sandy and may be gravelly or stony. They usually have a brownish grey to yellowish brown weakly developed profile in which the lighter colored A_2 horizon has a platy or weakly platy structure. At depths of 18 to 30 inches there is often a gravelly layer at the contact with the underlying heavier textured material. Following is a description of a profile typical of the Codesa series:

Horizon	*Thickness in inches*	*Description*
A_0	2	Dark brown to black organic debris. pH 7.6.
A_1	2	Light brownish grey loam to sandy loam having some firmness. Often absent. pH 7.4.
A_2	4	Light yellowish brown loamy sand to fine sandy loam, coarse platy to weakly platy. pH 5.7.
B-C	10	Yellowish brown loamy sand to sandy loam, weak blocky to nuciform, occasionally stratified and usually some evidence of compaction. Gravel lenses and stones of common occurrence. pH 5.6.
D	at 18 below surface	Dark greyish brown to brown till in which lime is found at depths of 30 to 36 inches below the surface. pH 7.0.

Soil Rating: Generally fair to fairly good arable soils. The gravelly or stony phases are usually non-arable.

Agricultural Use: Very few of the Codesa soil areas are under cultivation in the mapped area. Those that are predominantly gravelly or stony should not be cultivated. Codesa soils are fairly loose and tend to have a low fertility reserve. It is essential therefore that the fibre and organic matter content of these soils be maintained at a fairly high level. The heavy textured and often compact underlying material is usually better supplied with the required mineral plant nutrients than the sandier upper deposit. Deep-rooted legumes will help to open up this compact substratum and will help to replenish the supply of plant nutrients in the upper deposit. Supplementary applications of fertilizer may also prove beneficial in establishing a mixed farming agriculture on these soils.

(b) Belloy Series (Be.): Degraded Black to Black (weakly structured) sandy loam to silt loam.

Extent and Occurrence: There are several small areas, making up a total of about 9,000 acres, in which Belloy soils are predominant. They are found near the headwaters of Iroquois creek, on the north shore of the High Prairie basin, and adjacent to portions of the Heart river.

Topography: Level and undulating, frequently consisting of long uniform slopes.

Drainage: Generally imperfectly drained soils in which there is an impervious substratum and often a fairly high water table.

Native Vegetation: Parkland consisting of grasses and scattered bluffs of black poplar, aspen poplar, willow and occasional spruce.

Profile Description: Belloy soils are generally more variable than Peoria soils and frequently have gravelly lenses and stones. The depth to the underlying heavier textured material is quite variable but usually somewhat shallower than that of Peoria soils. They are found in association with other soils developed on till or residual materials particularly those found adjacent to stream courses or laking basins. Following is a description of an average Belloy soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown to black organic debris. pH 7.8.
A_1	6	Black in the upper part grading to brown in the lower part, sandy loam to silt loam, weakly prismatic, friable. pH 7.0.
A_2	3	Light yellowish brown sandy loam, weakly platy to coarse platy, friable. pH 5.8.
B-C	6	Yellowish brown sandy or silt loam, very little structure, occasional gravelly lenses or some stones. This horizon varies considerably in texture and thickness. Gravelly or stony layer is very common at contact with underlying material. pH 6.3.
D	at 12 to 24 below surface	Dark greyish brown to yellowish brown till in which lime is found at depths of 24 to 30 inches. pH 7.4.

Soil Rating: Generally good arable soils. The stony or gravelly phases are not particularly desirable.

Agricultural Use: Belloy soils have a fairly high native fertility but they can deteriorate fairly rapidly unless the fibre and organic matter content are maintained at a fairly high level. Wherever possible they should be cultivated across rather than up and down the slope. The inclusion of grasses and deep-rooted legumes should improve this soil considerably. Grasses will return fibre while the legumes will also aid in opening up the compact D horizon, and in replenishing the nutrient reserves in the upper horizons.

(c) Codner Series (Cn.): Meadow (somewhat poorly drained) sandy loam to silt loam.

Extent and Occurrence: There are only about 3,000 acres in which Codner soils are predominant. However, they are frequently found in association with Belloy, Peoria and other light to medium textured soils.

Topography: Level and depressional, generally low-lying basins.

Drainage: Somewhat poorly to poorly drained.

Native Vegetation: Coarse grasses and scattered bluffs of willow, black poplar and occasional spruce.

Profile Description: Codner soils can be distinguished by their dark colored highly organic A horizons which are underlain by yellowish brown B horizons in which iron stains are of common occurrence. They are found in low-lying areas in which drainage deficiencies are quite apparent. The depth to the underlying heavier textured and darker colored substratum is variable, averaging about 24 inches. They are lighter textured meadow soils than those of the Goose series and have a distinctly browner and more variable B horizon. Following is a description of a profile typical of the Codner series:

Horizon	*Thickness in inches*	*Description*
A_0	2	Very dark brown to black semi-decomposed sedge peat. pH 6.8.
A_1	5	Very dark grey to very dark greyish brown loam, weak granular to crumb, friable. Some firmness due to organic fibre. pH 6.4.
B	3-5	Brown to yellowish brown loam to silt loam, weak granular. Variable thickness. pH 6.4.
B_g	12	Brown and greyish brown very fine sandy loam to loam, weak fine granular to fine nuciform, friable. Different colored and different textured materials often occur in streaks and the upper inch of this horizon is often grey in color and fairly firm. Iron stains may occur throughout this horizon and sometimes the lowest portion may be somewhat gravelly. pH 6.9.

Horizon	Thickness in inches	Description
D_1	8	Dark grey and yellowish brown varves of clay and silt that rarely exceed a thickness of 1/4 inches. This horizon varies in thickness and is often absent. pH 7.4.
Dca	at 24 to 36	Greyish brown to dark greyish brown clay loam till that has a fine nuciform to blocky structure and is fairly friable. Numerous small stones and ironstone nodules. Medium lime. pH 7.5.

Soil Rating: Until drainage has been improved these soils are not desirable for grain crop production. They are very well suited for pasture crop production.

Agricultural Use: Little use is being made of Codner soils in the mapped area. They are found largely in some of the newer areas that are just coming under cultivation. In such areas, if the removal of tree cover and the construction of roads are adequate to improve the drainage of Codner soil areas, grain crop production should ultimately prove very satisfactory on these soils. If, however, the Codner soil areas continue to remain wet for varying periods, it would appear that such areas should be devoted to pasture crop production. Elsewhere in the Peace River area Codner soils appear to be particularly desirable for the production of alsike clover seed.

D. Soils Developed on Coarse Outwash and Shoreline Materials.

These materials are coarse textured and often quite gravelly or stony. They are found as islands of varying size associated with the till areas, along some of the lower slopes of these areas or along the shore line of some of the laking or flood plain basins. Soils of the *Clouston* and *Grouard* series are formed on such coarse textured, variable material. They are usually sandy and may be gravelly or stony. Their subsoil may contain thick gravel lenses or may be a deep deposit of gravel and cobble stones. The following are descriptions of the principal soils formed on this type of parent material:

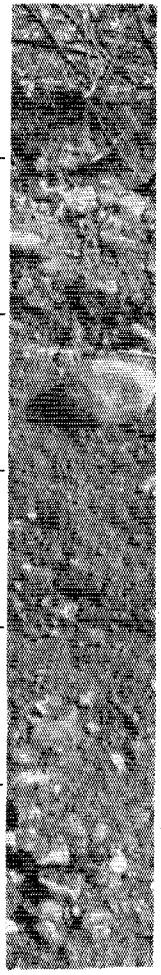
(a) Clouston Series (Cl.): Grey Wooded (weakly structured) gravelly or stony loamy sand to sandy loam.

Extent and Occurrence: There are about 5,000 acres in which Clouston soils are predominant. They occur as relatively small islands in various parts of the mapped area and are generally found associated with Codesa and Braeburn soils.

Topography: Variable, may consist of low ridges or long uniform slopes.

Drainage: Well drained to excessively drained soils.

Native Vegetation: Woodland consisting of fairly heavy stands of aspen poplar and spruce.



Profile Description: Clouston soils are gravelly and stony soils that have a leached profile similar to that of other grey wooded soils. They usually have a lime accumulation horizon within 48 inches of the surface. Following is a description of an average Clouston profile:

Horizon	*Thickness in inches*	*Description*
A_0	2	Very dark greyish brown leaf litter. pH 7.4.
A_1	2	Greyish brown to brown coarse sandy loam, stony, weak blocky. pH 7.2.
A_2	3	Pale brown to light yellowish brown loamy coarse sand, weak platy. pH 5.3.
B	24	Brown and yellowish brown coarse sandy loam and loamy sand. Weak structure but some evidence of compaction. Gravelly and stony. pH 6.0.
Bca	at 31	As above but with lime accumulation particularly on the undersides of the stones or pebbles. pH 7.0.

Soil Rating: Generally poor to fair arable soils.

Agricultural Use: Soils with gravelly subsoils are droughty since they have a low water-holding capacity. They also have a low fertility reserve. Unless the gravel and stone accumulation occurs at depths greater than 12 inches below the surface such soils are not suited for crop production. If the gravel is deeper and the topography suitable they may be fair arable soils. There are some gravel pits in the Clouston soil areas and some of these appear to be of commercial importance.

(b) Grouard Series (Gr.): Degraded Black to Black (weakly structured) gravelly or stony loamy sand to sandy loam.

Extent and Occurrence: There are about 4,000 acres in which Grouard soils are predominant. They are found chiefly along the north shore of Lesser Slave lake and in the vicinity of Grouard.

Topography: Level to undulating, often consisting of long uniform slopes.

Drainage: Well drained to excessively drained soils.

Native Vegetation: Parkland consisting of grasses and bluffs of poplar, willow and occasional spruce.

Profile Description: Except for a thicker and darker colored A_1 horizon Grouard soils are otherwise the same as Clouston soils. Following is a description of an average Grouard soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown leaf litter. pH 7.2.
A_1	6	Brown to very dark brown coarse sandy loam, weak blocky, stony or gravelly. pH 7.0.
A_2	2	Pale brown to yellowish brown loamy sand, weak platy. Variable in thickness and may be absent. pH 6.2.
B	18	Brown and yellowish brown sandy loam and loamy sand strata that are often gravelly and stony. Weak structure but some compaction. pH 6.8.
Bca	at 27	Pale brown to yellowish brown coarse sandy loam to loamy sand very little structure, gravelly and stony. Lime accumulation particularly on undersides of pebbles and stones. pH 7.8.

Soil Rating: Poor to fairly good arable soils.

Agricultural Use: These soils have a low water-holding capacity and are, as a consequence, droughty soils. They range from non-arable to fairly desirable agricultural soils depending on the topography and on the nearness of the gravel to the surface. If gravel is deeper than 12 inches below the surface and the soils are cultivated, consideration should be given to maintaining organic matter at fairly high levels. The inclusion of both grasses and clovers in the crop rotation will help to maintain the organic matter content and improve the water-holding capacity of these soils. Generally those soils in which the gravel is closer than about 12 inches from the surface, should be seeded to permanent pasture.

Gravel pits of commercial importance are found in some of the Grouard soil areas. One such pit occurs on the north shore of Lesser Slave lake near Shaw Point.

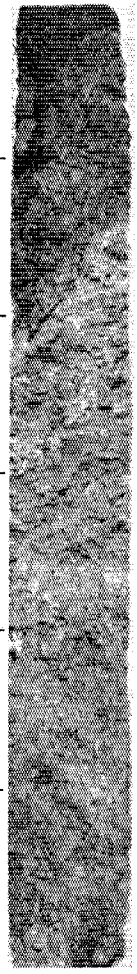
E. Soils Developed on Residual and Modified Residual Materials.

Solonetz-like soils of the *Kavanagh* and *Valleyview* series are formed on materials derived primarily from the Wapiti formation. In some cases the unaltered bedrock may be found within a few feet of the surface. Following is a description of the principal soils formed on this type of parent material:

(a) Kavanagh Series (Kv.): Degraded Black to Black (solonetz) loam to heavy loam.

Extent and Occurrence: There are about 2,000 acres in which Kavanagh soils are predominant. They are found chiefly in the vicinity of Prairie Echo, in the north-central part of the mapped area.

Topography: Level and undulating—consisting of long uniform slopes and often slight basins at the foot of those slopes.



Drainage: Imperfectly to poorly drained soils.

Native Vegetation: Parkland consisting of coarser grasses that may include some of the salt grasses and scattered bluffs of willow and stunted or scrub poplar.

Profile Description: Kavanagh soils have a thin, dark colored surface horizon underlain by a sub-surface horizon that is relatively impervious to both root and water peneration. While there is usually a fairly heavy concentration of salts in the lower part of the B horizon there appears to be very little lateral movement of these salts. Soils with surface salt concentrations or salt crusts do not often occur in association with Kavanagh soils. Following is a description of an average Kavanagh soil profile:

Horizon	*Thickness in inches*	*Description*
A_1	4	Greyish brown to very dark brown loam to silt loam. Very little structure but considerable firmness due to organic fibre. The lower part of this horizon may be somewhat greyer in color or it may sometimes have a thin A_2 horizon. pH 6.7.
B_2	8	Dark greyish brown to dark grey clay loam, very firm to indurated round topped columns, strong fine to medium blocky. Very dark grey to black staining along cleavage faces. pH 8.1.
B_3	6	Greyish brown to dark greyish brown clay loam, massive, blocky to nuciform, fairly firm, variable till-like material. pH 9.2.
Bca & SO_4	at 12 to 20	Greyish brown to dark greyish brown clay loam to loam, nuciform, friable. Occasional sandy streaks, ironstone nodules and coal flecks. pH 8.9.

Soil Rating: Poor to fair arable soils.

Agricultural Use: Kavanagh soils are inferior agricultural soils. Their very firm dark colored subsurface horizon is relatively impervious to both water and root penetration. To cultivate them with any degree of satisfaction this hard layer must be opened up either at the time of breaking or by growing deep-rooted crops such as sweet clover. The former method does not appear too satisfactory since the power required for deep plowing in these soils tends to make the operation too costly. Deep-rooted crops, how-

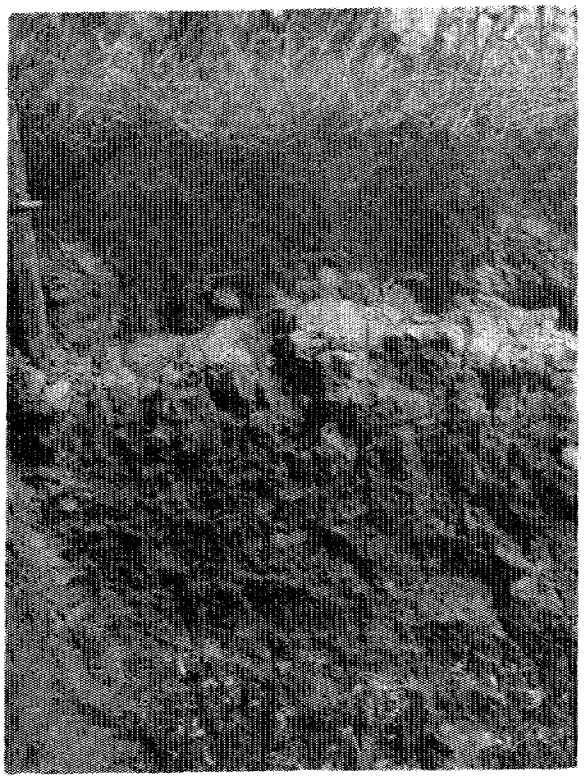


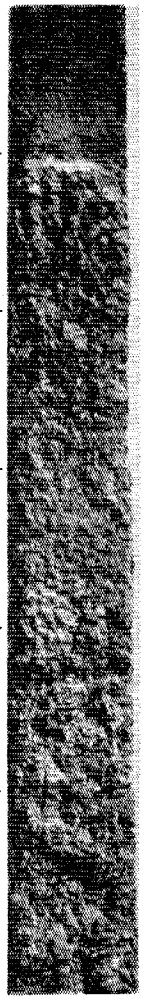
Figure 24—Black solodized solonetz profile typical of the Valleyview series.

Figure 25—Organic soil profile typical of the Kenzie series.

ever, can often be grown to very good advantage. Their long tap roots tend to penetrate the hard layer and facilitate drainage and aeration. The addition of green manure and the gradual mixing in of the surface soil and organic matter will in time improve the structure of this undesirable subsoil. The undesirable characteristics of Kavanagh soils are particularly apparent following heavy rains and during prolonged dry spells.

(b) Valleyview Series (Vv.): Degraded Black to Black (solodized solonetz to solonetz) loam to heavy loam.

Extent and Occurrence: There are about 2,000 acres in which Valleyview soils are predominant. They occur near the Kavanagh soil areas in the north-central part of the mapped area and are often found in association with some of the Esher or Landry soils.



Topography: Undulating to gently rolling consisting usually of long fairly uniform slopes.

Drainage: Imperfectly drained soils that may have a somewhat excessive surface run-off.

Native Vegetation: Parkland consisting of grasses and often sparse stands of aspen poplar, willow and occasional spruce.

Profile Description: Valleyview soils are somewhat similar to Kavanagh soils but they usually have a thicker A horizon. Their B horizon is not as compact nor does it usually have the dark stained cleavage faces common to Kavanagh soils. Following is a description of an average Valleyview soil profile:

Horizon	*Thickness in inches*	*Description*
A_0	1	Very dark brown organic debris. pH 6.1.
A_{11}	3	Very dark grey loam, weak granular to crumb. pH 5.0.
A_{12}	3	Dark greyish brown to brown loam to very fine sandy loam, weak granular to platy. pH 5.3.
A_2	1	Grey very fine sandy loam, platy. pH 5.2.
B_{21}	2	Very dark greyish brown clay, very hard to indurated blocky upper portion of columns. pH 5.4.
B_{22}	10	Dark reddish brown to very dark greyish brown clay, hard, fine to medium blocky with occasional very dark grey stains on the cleavage faces and frequent root mats. pH 6.2.

Horizon	Thickness in inches	Description
Bca	8	Greyish brown to brownish grey clay to clay loam, weak blocky, fairly firm, moderate lime. pH 8.1.
B_{SO_4}	8	As above, but tending to more pronounced horizontal cleavage. Contains chips of sandy shale and pockets of salts. pH 7.6.
C	at 30 to 40 from surface	Dark grey clay loam, nuciform to blocky, firm, horizontal cleavage tending to occasional laminations. Chips of sandy shale, coal and angular stone fragments common. pH 7.6.

Soil Rating: Fair to fairly good arable soil.

Agricultural Use: Areas of Valleyview soils are being farmed with some success in the High Prairie and McLennan Sheets.

While the subsoil is not as impervious usually as that of Kavanagh soils, it nevertheless seriously interferes with root and water penetration. This subsurface layer must be rendered more friable through the incorporation of additional organic matter. Deep-rooted crops such as sweet clover should materially assist in opening up and thereby improving the structure of these soils.

Most of the areas now under cultivation have long, fairly uniform slopes. Such areas of Valleyview soils are particularly vulnerable to water erosion. Maintaining the organic matter at fairly high levels, improvement of water penetration through the growing of deep-rooted crops and cultivation across the slopes wherever possible, are essential considerations to the successful utilization of these soils.

F. Organic Soils.

Organic soils of the *Eaglesham* and *Kenzie* series are found in many of the low-lying poorly drained areas. They occur in patches of varying size associated with practically all of the soil series mapped in this area.

Organic soils have an accumulation of organic matter that exceeds a thickness of about 12 inches. The organic matter may be derived mainly from the partial decomposition of sedges and grasses or of mosses. For the purposes of this report organic soils are classified as sedge peat or moss peat soils depending on the dominant characteristics of the organic accumulation. No attempt is made at classifying them according to the textural characteristics of the D horizon. Following is a description of the principal organic soils mapped in the High Prairie and McLennan sheets.

(a) Eaglesham Series (Eg.): Peat fine and mainly of sedge origin.

Extent and Occurrence: Occurring in scattered patches throughout the mapped area there are about 47,000 acres in which Eaglesham soils are predominant. They are also of very significant occurrence in association with Enilda soils in the central portion of the mapped area.

Topography: Level and depressional.

Figure 26—Cover typical of the Kenzie soil areas (moss peat bogs).

Figure 27—Cover typical of the Eaglesham soil areas (sedge peat bogs).

Drainage: Poor to very poor.

Native Vegetation: Sedges and coarse grasses with occasional willow bluffs.

Profile Description: The solum of Eaglesham soils consists of an accumulation of peat the greater part of which appears to be derived from sedge and grass remains. Separation into horizons is made on the basis of color and degree of decomposition. The thickness of the peat varies but seldom exceeds 36 inches in the mapped area. Following is a description of an Eaglesham profile commonly found in some of the poorly drained portions of medium to heavy textured soil areas:

Horizon	*Thickness in inches*	*Description*
1	16	Dark brown to brown partially decomposed sedge and rush remains. pH 5.8.
2	8	Dark brown to black fairly well decomposed sedge and rush remains. May be wet. pH 6.8.
3	4	Black, well decomposed peat in which there are few recognizable leaf and stem remains. Usually very wet. pH 7.3.
G	10	Light brownish grey to grey clay, usually wet and very sticky. Fine granular and fairly compact when dry. Numerous rusty stains or streaks. pH 7.8.
Dca	at 30 to 40	Grey to dark grey clay, fine granular, moderate lime. Rusty stains or streaks are common particularly in the upper part of this horizon. pH 7.9.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: In many portions of the wooded areas some of the shallower Eaglesham soils are among the first soils to be cultivated, particularly if they occur in areas of sufficient size to be farmed. Usually tree growth is not an impediment to cultivation and the only requirement is that of trenching to provide drainage. However, they are "cold" soils on which oats are often grown for green feed during the first few years of cultivation. When they become opened up and their drainage and aeration sufficiently improved, coarse grains can be grown successfully.

The deeper Eaglesham soils in which the organic accumulation exceeds a thickness of about 30 inches and those in which the D horizon may be excessively stony or sandy should not be cultivated. They can usually be of great value in storing and conserving water. The conservation of such areas will do much towards replenishing the ground water supplies of this area.

(b) Kenzie Series (Kz.): Peat coarse and mainly of moss origin (muskeg).

Extent and Occurrence: There is a total of about 188,000 acres in which Kenzie soils are predominant. They occur in patches of varying size scattered throughout the mapped area. Only the larger areas of these soils were outlined in this survey.

Topography: Level and depressional.

Drainage: Very poor, may be wet to the surface.

Native Vegetation: Sphagnum moss, occasional sedges, labrador tea, cranberries and variable stands of black spruce, tamarack, birch and willow.

Profile Description: The organic material of Kenzie soils is usually much coarser and woodier than that of Eaglesham soils. It consists predominantly of moss peat which is usually much more acid in reaction than the sedge peat. The thickness of the peat accumulation is quite variable. It seldom exceeds 60 inches and may average about 36 inches. The following is a description of an average Kenzie soil profile found in association with many of the medium to heavy textured soils:

Horizon	*Thickness in inches*	*Description*
1	12	Dark brown to brown moss and moss peat that is usually coarse and woody and often contains tree root and stem remains. pH 4.7.
2	6	Strong brown to dark yellowish brown peat containing recognizable remains of mosses and tree roots. Occasional thin, darker colored bands of sedge peat are common. Often wet. pH 4.3.
3	8	Dark brown to very dark brown fairly well decomposed peat that often contains recognizable stem and woody remains. Often very wet. pH 4.8.
G_{11}	9	Light yellowish brown to light brownish grey fine sandy loam, coarse blocky and very firm when dry. Occasional rusty streaks. pH 6.8.
G_{12}	6	Grey and light brownish grey clay, wet and very sticky. When dry it is massive, very firm tending to fine granular. Contains rusty stains and streaks. pH 7.0.
D_g	8	Greyish brown clay, fine granular, firm. pH 7.2.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: After drainage Kenzie soils are inferior agricultural soils. The woody nature of the peat makes it difficult to prepare a desirable seed bed. Their acid condition tends to interfere with the proper decomposition of the peat and may adversely affect the growth of some crops. Most of the Kenzie soil areas are not being cultivated at the present time.

Natural peat deposits play a very important part in the storage and conservation of water. They act like sponges in soaking up much of the spring run-off and rain water and holding it in storage.

This water is then released gradually to streams and drainage basins. Peat bogs therefore tend to have a regulating effect in maintaining the water level of streams and local water tables, and in preventing the erosion that occurs when large volumes of water are suddenly spilled into a stream channel. From the standpoint of moisture conservation and flood control, it would appear extremely desirable that at least the larger and deeper of these natural reservoirs be protected and permanently withheld from cultivation.

DESCRIPTION OF MAPPED AREAS

The various soil areas outlined on the accompanying soil map are usually designated by more than one series name. In each case soils of the first named series are predominant and make up at least 50 percent of the outlined area. The other series designated in each area generally refer to the most significant of the associated series. Those soils that make up relatively small proportions, generally less than 20 percent, of the area under consideration, are not designated. Reference then to the series descriptions will enable the reader to familiarize himself with the dominant characteristics of each mapped area. However, the reader must not overlook the fact that in a reconnaissance survey it is not possible to outline all the small areas and there will be many instances in which soils that are not of significant occurrence in the outlined area may be of major importance in some individual farm units.

In addition to designating each soil area by a series name or a combination of series names to indicate the dominant characteristics of that area, other supplementary characteristics are indicated on the soil map. Areas of somewhat similar topography are outlined and designated by means of hatchuring. Other features, that are important from the standpoint of land use, are indicated wherever possible. For example, some excessively stony areas adjacent to the Heart river are designated as Codesa—Donnelly or Belloy—Esher *stony phase*. In other sketches and maps accompanying this report such features as the relative distribution of tree cover, the present extent of cultivation and the soil rating are indicated. The following brief general descriptions of some of the larger mapped areas will illustrate some of the features and considerations previously referred to and may be a helpful aid in interpreting the accompanying soil map.

1. Areas Consisting Predominantly of Braeburn Soils.

Relatively large areas of Braeburn soils are found in the northern and southern parts of the High Prairie and McLennan sheets. There is little agricultural development in these areas and most of them are difficultly accessible. Most of these areas were traversed on horseback with the result that the traverse intervals were wide and many of the soil boundaries were conjectured.

Generally Braeburn soil areas have a fairly uniform topography consisting of relatively large benches and long fairly uniform slopes.

The gradient of these slopes is variable and in the southern part of the mapped area, some of the slopes are quite steep. Occasional small knolls or ridges are characteristic of benches having an undulating to gently rolling topography. While the tree cover in most of these areas is generally fairly heavy, there are extensive portions in which it has been destroyed by fire. There are stones throughout these areas, but usually they are not too numerous.

Various other soils commonly occur in association with soils of the Braeburn series. Saddle soils are found on some of the more open slopes. Donnelly soils may be found in many of the better drained basins or on the lower slopes of the till areas. Codesa and sometimes Clouston soils may be found on some of the small knolls or ridges or on the slopes from the benches. In addition, most of the Braeburn soil areas have varying proportions of low-lying poorly drained areas that often form a very complicated pattern. Soils of the Snipe, Goose, Eaglesham or Kenzie series are commonly found in such poorly drained portions.

The larger areas of such associated soils are outlined and separated from the Braeburn soil areas. Otherwise their occurrence, when significant, is indicated in the designations of various portions of the Braeburn soil areas. Thus, those portions in which the associated Snipe soils are of significant occurrence may be designated as Braeburn-Snipe areas, those in which Codesa soils are found in considerable frequency may be designated as Braeburn-Codesa and so on. The use of such additional series names in the designation of various soil areas serves to indicate only the more significant of the associated series. It does not imply the absence of soils other than those indicated in the designation.

2. Areas Consisting Predominantly of Donnelly Soils.

Most of these areas are found at or near the base of the slopes from the Braeburn soil areas. They adjoin the flood plain and some of the main drainage courses. Such areas usually have long, very gentle slopes. While they have developed under a fairly heavy tree cover, much of this has been destroyed by fires. Most of the areas are fairly accessible and reasonably close to transportation facilities.

The parent material of Donnelly soils is often closely underlain by that of Braeburn soils. On many of the upper slopes the latter may come close to the surface in many places and as a consequence Donnelly and Braeburn soils may be found in very close association. Such areas are frequently stonier than other Donnelly soil areas and they may contain appreciable proportions of Codesa soils. These characteristics are particularly apparent in much of the south-central part of the mapped area.

Poorly drained soils of the Snipe, Goose, Prestville, Eaglesham or Kenzie series are frequently associated with the better drained soils of the Donnelly series. Such associations are very common in the area previously referred to and in the area adjoining Kathleen. Many of the larger poorly drained soil areas are outlined and separ-

Figure 28—Most of the Donnelly soil areas contain varying proportions of low-lying, often peaty areas in which Snipe or Prestville soils are predominant. (Left foreground.)

Figure 29—On this flood plain High Prairie and Spirit River soils are found in the better drained areas of the foreground and far background, while soils of the Enilda and Codner series are found in the poorly drained central area under a cover of coarse grasses and willows.

ated from the Donnelly soil areas. Otherwise an attempt is made to designate various portions of the areas in a way that will indicate, at least partially, the combination and order of the series prevailing in each outlined area.

In addition Esher and sometimes Landry soils are found in close association with Donnelly soils or they may prevail in some of the better drained, less heavily wooded portions of the areas. Wherever possible such portions have been outlined and separated from areas consisting predominantly of Donnelly soils.

Where readily cleared, many of the Donnelly soil areas are being developed fairly rapidly. In the more uniform of these areas stones are usually of insignificant occurrence and the topography is very desirable. Recommended cropping practices are providing very satisfactory returns in these areas.

3. Areas Consisting Predominantly of Codesa Soils.

Reference has already been made to the occurrence of these soils in association with Braeburn and Donnelly soils. They are found frequently along the slopes from the Braeburn soil areas and occasionally on small ridges, knolls or islands in the Braeburn soil areas. Codesa soils are quite variable, usually sandy and gravelly and sometimes quite stony. Their shallow profile is underlain at varying depths by heavier textured material. In addition, the mantle of light textured variable material is usually discontinuous with the result that soils of the Donnelly or Braeburn series commonly occur in areas in which Codesa soils are predominant. Generally such areas also contain variable and often very significant proportions of poorly drained soils of which those of the Snipe series are most common. Considering that the depth of the overlay is often quite variable, one should also expect to find patches of other light or coarse textured soils in association with Codesa soils. Wherever possible, patches of Clouston soils have been indicated when they occur in areas large enough to be outlined on this scale of mapping. Thus areas consisting predominantly of Codesa soils are variously designated as Codesa-Braeburn, Codesa-Donnelly, Codesa-Donnelly-Snipe or Codesa-Donnelly stony phase depending on the most significant occurrence of these soils that are commonly associated with Codesa soils.

Recommendations regarding the agricultural use of Codesa soils can only be very general. Some of the more uniform portions of Codesa soil areas are fairly desirable for agricultural purposes. The gravelly and stony portions on the other hand are generally inferior or non-arable. The prospective settler would be well advised to make a careful inspection of any lands that may be under consideration in areas consisting predominantly of Codesa soils.

4. Areas Consisting Predominantly of Davis Soils.

These areas are found in the northern part of the mapped area adjacent to Winagami and Kimiwan lakes and to some portions of

the Heart river. The areas are largely undeveloped and relatively inaccessible. They have a variable topography that consists of low rolls or low discontinuous humps. The latter are often steep sided and separated by small poorly drained areas. Davis soils are commonly found on the upper portions of the humps or rolls while Judah soils are often found on many of the lower slopes and in some of those portions of the area that have a more uniform or undulating type of topography. Eaglesham and Kenzie soils are found in many of the low poorly drained patches associated with areas of Davis soils.

Providing that the topography is not too variable or rough, areas in which Davis soils are predominant, appear to be fairly desirable for agricultural purposes. They are stone-free areas that on development appear to be favored for legume seed production. However, it would also appear that such areas are vulnerable to water erosion, particularly gully erosion. Early consideration should therefore be given to contour tillage wherever possible, and to the incorporation of organic matter in these soils.

5. Areas Consisting Predominantly of High Prairie and Enilda Soils.

A large area of High Prairie and Enilda soils is found in the east-central portion of the High Prairie and McLennan sheets, while smaller areas are found adjacent to both the East Prairie and West Prairie rivers. These areas are essentially level and various portions are still subject to periodic flooding. Both High Prairie and Enilda soils have been described as immature and somewhat variable. The latter are not as well drained as the former, and many have a peaty surface horizon. The two are often closely associated in the southern part of the flood plain. In this portion of the area an attempt is made to separate those areas in which High Prairie soils are predominant. The northern portion of the area is low-lying and not nearly as well drained. Much of this portion of the area may be wet for considerable periods in the spring or after prolonged rains. Here Enilda soils are associated principally with Eaglesham soils, and are utilized mainly for the production of native or seeded hay crops.

In the southern portion, particularly in those parts where High Prairie soils are predominant, very satisfactory yields of grain crops are reported. At the present time the biggest problem in this area appears to be the control of horsetail. This weed is a serious menace for which no satisfactory control has yet been developed.

6. Areas Consisting of Rough and Broken Land (Eroded Land).

The steeply sloping, rough and broken land formerly designated as Eroded Land borders many of the larger stream courses in the mapped area. Most of this land has a fairly good grass and tree cover and serves a very useful purpose as pasture or woodland. However, over-grazing, indiscriminate removal of tree cover or cultivation should not be permitted on this land. If left bare for any length of time, such banks may erode down to bedrock. Further-

more, river banks that are devoid of tree cover lose their snow very rapidly, with the result that many of the stream courses flood in the spring but are practically dry by midsummer. There are approximately 65,000 acres of such rough broken land indicated on the accompanying soil map.

AGRICULTURAL PROBLEMS

Land Development.

Tree cover is the major impediment to agricultural development in this area. Through the use of adaptable power equipment, however, methods are being developed to bring about a rapid, efficient and more economical improvement of bush lands. The costs of clearing, piling and breaking vary with the size and density of tree cover, the size of the equipment and the efficiency of the operator. In the mapped area, the custom charges in 1951 averaged about $16.00 per hour for clearing and piling and about $9.00 per acre for breaking. Fairly open areas or areas with a light tree cover can be cleared at the rate of about 4 acres per hour, whereas in those areas that have a fairly heavy tree cover the rate of clearing may not exceed 1 acre per hour.

While power clearing has speeded up the development of new areas, it still is a relatively costly undertaking to the average new settler. As a result, desirable soil areas that have a fairly heavy tree cover are often passed up in favor of areas that are open or have a light tree cover. Frequently such areas are at considerable distance from transportation and market facilities. Some also consist of inferior agricultural land. In many cases, the absence of tree cover is the direct result of repeated forest fires. Since there are numerous suitable soil areas, adjacent to settlement, that have a fairly dense stand of both fire-killed and green poplar, some consideration might be given to opening up such areas through a program of supervised and controlled burning. Such a program supplemented by a broadcast seeding of burned over areas with a grass-legume mixture should result in the development of well grassed over fairly open areas at a fraction of the cost required for power clearing. It could also serve to protect areas in which there are stands of commercial timber.

Water Supply.

Throughout most of the Peace River area the difficulties experienced in obtaining a suitable well-water supply have long been a matter of grave concern. Dr. R. L. Rutherford's study, as reported in Research Council of Alberta Report No. 21, was made in order to obtain data on the possible underground water resources in the area west of McLennan. While no similar study has been made in most of the mapped area it is believed that the results reported are also applicable to much of the High Prairie and McLennan area. Since the Wapiti formation may have water bearing strata it would

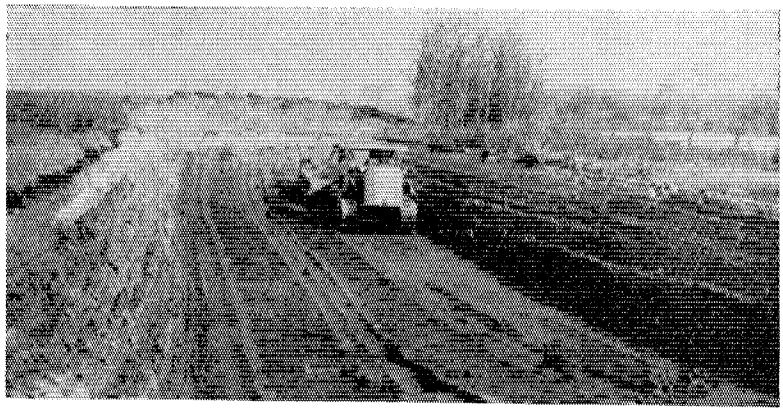


Figure 30—The lack of a suitable well water supply is a major problem in much of the area. Farm reservoirs, such as this, are satisfactory provided they are of adequate size and suitably located.

appear that in the area south of township 73 there might be some likelihood of obtaining suitable water supplies from reasonably deep wells. In the vicinity of Sunset House adequate water supplies have been obtained from wells that are from 100 to 200 feet deep. Elsewhere in the mapped area it would appear that the probability of obtaining water from the underlying Smoky River formation is very remote and that the settlers might be well advised to resort to the construction of dugouts or dams to assure themselves of an adequate water supply.

However, there are some noteworthy exceptions in various portions of the mapped area. In the High Prairie-Lesser Slave lake flood plain adequate stock-water supplies have been obtained from wells that seldom exceed a depth of 75 feet. In some cases this water is not suitable for domestic purposes. North of the flood plain, in the vicinities of Prairie Echo, Heart river and Leicester adequate and suitable water supplies have been obtained from wells that are from 75 to 150 feet deep. There are some flowing wells with a fairly steady flow of water, near Prairie Echo and near Leicester. Since this water seems to be coming from the underlying bedrock it would appear probable that much of the area bordering on the flood plain and extending northwest from Lesser Slave lake may be underlain by Wapiti sandstone at relatively shallow depths.

Soil Conservation.

An enduring agriculture can be established only if constant attention is given to the conservation of our soil resources. This involves careful consideration of the selection of a sequence of crops, the maintenance of soil fertility, and the use of soil and moisture conserving practices that will make the most effective use of rainfall and prevent serious permanent injury to the land.

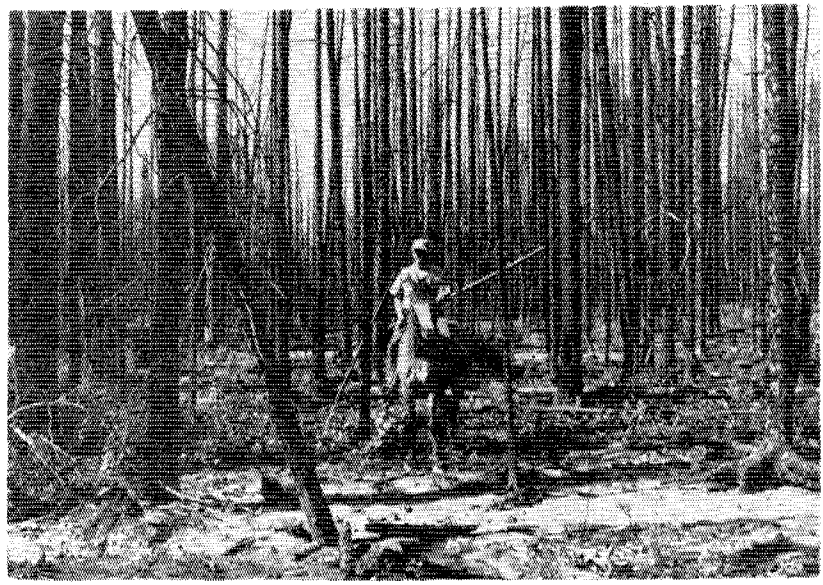


Figure 31—Fires often destroy much valuable timber and seriously curtail the regulating effect that tree cover has in controlling run-off, particularly the heavy spring run-off common to the mapped area.

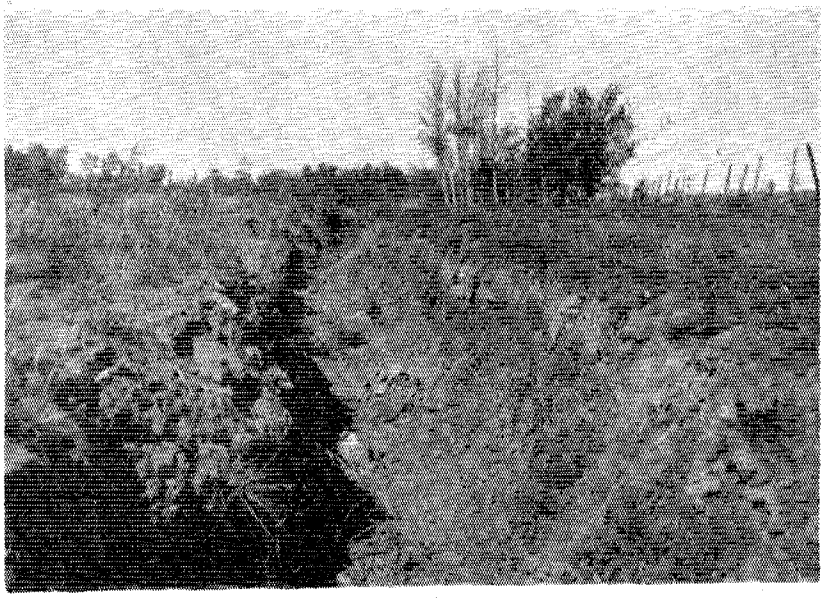


Figure 32—Soil erosion resulting from the spring run-off in 1950 on an Esher soil area having a 2 percent slope.

Throughout the foregoing part of this report reference has been made to considerations that are believed pertinent to the development of an enduring agriculture in this area. Details regarding recommended cropping practices may be obtained from the District Agriculturist, the Experimental Station at Beaverlodge or the University of Alberta. The following brief discussion of some of the considerations previously referred to may serve as a helpful guide in establishing a profitable and permanent agriculture in this area.

Usually, under native conditions in which the land has a good protecting vegetative cover, erosion is a gradual, normal process that aids in the formation and redistribution of soils. In this area, with its long uniform slopes, it would appear that normal erosion has been quite severe. The depth and extent of the flood plain deposit at the confluence of several comparatively short and small rivers, and the depth and width of the coulees associated with the Little Smoky river provide proof of the severity of normal erosion in this area. Under cultivation there is a likelihood of much greater losses from soil erosion. Unless adequate measures are taken to guard against such accelerated erosion it can become the most potent factor contributing to the deterioration of productive land.

Soils developed under a woodland vegetation are generally low in plant fibre, humus and nitrogen. In addition a large proportion of the soils in the mapped area have a heavy textured subsoil through which water percolates very slowly. Fortunately both characteristics can be improved through the judicious use of organic material. The maintenance of an adequate supply of organic material, in the soils of this area, is therefore fundamental to good husbandry.

Available plant nutrients are released during the decomposition of organic material. This is one of the principal sources of nitrogen which is obtained from the air by soil bacteria and by bacteria associated with leguminous plants. Nutrient requirements beyond those made available in this way can be supplied through applications of chemical fertilizers.

Humus is another product of the decomposition of organic material. It consists of the very small, more stable portion that remains in the soil. Good tilth and a lasting crumb structure, that is resistant to the destructive action of water and wind, cannot be maintained unless there is a good supply of humus in the soil. Since plowing and cultivation speeds up the rate of decomposition, a continuous systematic return of all available residue is needed to ensure an adequate supply of humus in the soil. Fibrous residues and legume residues appear to be particularly desirable from the standpoint of improving the tilth and aeration of soils and increasing their resistance to soil erosion.

In an area that has a fairly heavy spring run-off and a growing season in which moisture can be a limiting factor in crop production, the conservation of that moisture will not only ensure better yields

but will also help to cut down soil losses due to water erosion. Organic material acts much like a sponge in soaking up water, and maintaining a good supply of organic material will do much towards making the best use of all available moisture. In addition crop residues that are left on the surface appear to provide adequate protection for the soil against the action of raindrops during hazardous periods of high impact storms. Such cover absorbs the energy of the falling raindrops and prevents the destructive action of rain beating on bare ground. The repeated impact of the falling raindrops and the damaging reactions which the splashing raindrops set in motion may be the chief factors responsible for starting erosion.

In consideration of the foregoing it should be apparent that grasses and legumes must have a place in the crop rotations. An awareness of these requirements might also stimulate a greater interest in livestock production. Diversification provides for a stability of income consistent with the best use and continued productivity of our soil resources.

PHYSICAL AND CHEMICAL CHARACTERISTICS OF SOME REPRESENTATIVE SOIL PROFILES

Physical Characteristics.

The sand, silt and clay fractions were determined on a few of the soil profiles taken in the mapped area. The profiles reported in Table 8 were selected to give a fairly representative coverage of the principal soil series and to show similarities or differences between the parent materials of the soils in the High Prairie and McLennan sheets. The modified Bouyucos method was used in making the mechanical analyses. The results are expressed in terms of percentage and the clay fraction includes all particles below 0.002 mm. in diameter. In the last column of Table 8, each horizon of the profiles analyzed is given a textural classification based on the recent guide proposed by the U.S. Bureau of Soils.

From the practical standpoint the most important characteristics of the soil relating to its physical ability to hold moisture, maintain a good tilth, and to resist erosion, are expressed in the amount of organic matter present and in the clay content. Light textured soils that have a relatively low clay content have the advantage of being easily tilled. However, they are often droughty and may drift readily. They must be carefully farmed so that the organic matter will increase their water-holding capacity and render them less vulnerable to wind erosion.

Heavy textured soils that are high in clay may be intractable to work and slow to drain especially if they are low in organic matter. Maintaining an adequate supply of organic matter will improve their tilth and permit better drainage and aeration. This is a factor of particular importance especially in some of the Donnelly and Nampa

soils. Preliminary investigations have shown that percolation is very slow in soils that have a compact, hard B horizon.

TABLE 8.—Mechanical Analysis of Some Representative Soil Profiles

Depth in inches	Horizon	Sand above 0.05 mm.	Silt 0.05-0.002 mm.	Clay less than 0.002 mm.	Texture as per U.S. guide
		Calculated on a percentage basis			
Braeburn Series—Grey Wooded silt loam, 13-80-21 W5.					
0- 2	A_0 & A_1	45	50	5	Si.L.-S.L.
2- 6	A_2	37	55	8	Si.L.
6- 8	$A_3(B_1)$	26	56	18	Si.L.
8-18	B_2	25	39	36	C.L.
18-34	B_3	30	46	24	L.
34-40	Bca	25	48	27	C.L.-L.
Donnelly Series—Grey Wooded (solodic to solodized solonetz) silt loam, 26-74-19 W5.					
0- 2	A_0 & A_1	29	59	12	Si.L.
2- 4	A_2	21	61	18	Si.L.
4- 6	$A_3(B_1)$	13	45	42	Si.C.
6-10	B_{21}	13	39	48	C.
10-16	B_{22}	12	37	51	C.
16-24	B_3	22	44	34	C.L.
Nampa Series—Grey Wooded (solodic to solodized solonetz) silt loam, 2-78-20 W5.					
2- 6	A_2	18	64	18	Si.L.
6- 9	$A_3(B_1)$	12	49	39	Si.C.L.
9-15	B_{21}	10	43	47	Si.C.
15-21	B_{22}	10	34	56	Si.C.-C.
21-24	B_3	10	43	47	Si.C.
25-30	Bca	4	54	42	Si.C.-Si.C.L.
Kathleen Series—Grey Wooded silt loam, 16-75-18 W5.					
1- 5	A_1 & A_2	9	66	25	Si.L.
5- 9	B_1	3	67	30	Si.C.L.
9-17	B_{21}	1	53	46	Si.C.
17-24	B_{22}	2	44	54	Si.C.
24-32	B_{31}	2	39	59	C.
32-36	B_{32}	1	29	70	C.
36-40	Dca	0	56	44	Si.C.
Davis Series—Grey Wooded silt loam, 11-78-23 W5.					
2- 6	A_2	24	65	11	Si.L.
6-12	B_1	19	44	37	Si.C.L.
12-20	B_2	15	45	40	Si.C.L.-Si.C.
20-32	Bca	19	58	23	Si.L.
32-40	C	20	56	24	Si.L.
Culp Series—Grey Wooded sandy loam, 21-76-17 W5.					
0- 3	A_0 & A_1	58	36	6	S.L.
3-11	A_2	45	47	8	S.L.
11-14	$A_3(B_1)$	52	37	11	S.L.-L.
14-17	B_{21}	30	45	25	L.
17-21	B_{22}	76	15	9	S.L.
21-25	B_{31}	67	14	19	S.L.-S.C.L.
25-37	B_{32}	86	4	10	L.S.

TABLE 8.—Continued

Depth in inches	Horizon	Sand above 0.05 mm.	Silt 0.05-0.002 mm.	Clay less than 0.002 mm.	Texture as per U.S. guide
		Calculated on a percentage basis			
High Prairie Series——Dark colored (moderately well drained) silt loam, 13-74-17 W5.					
0- 4	A_1	37	56	7	Si.L.
4- 8	B_{11}	28	57	15	SiL.
8-12	B_{12}	28	59	13	Si.L.
12-14	C_{11}	43	46	11	L.
14-19	C_{12}	21	62	17	Si.L.
19-22	C_{13g}	11	67	22	Si.L.
Enilda Series—Poorly drained, often peaty silty clay loam, 36-74-16 W5.					
4- 7	B_g	7	62	31	Si.C.L.
7-10	C_{11g}	4	68	28	Si.C.L.-Si.L.
10-11	C_{12g}	12	54	34	Si.C.L.
11-16	C_{13g}	6	44	50	Si.C.
16-24	C_{14g}	54	27	19	S.L.-S.C.L.
24-30	C_{15g}	10	64	26	Si.C.L.-Si.L.
30-39	C_{16g}	6	61	33	Si.C.L.
Goose Series—Meadow (somewhat poorly drained) silty clay loam, 1-70-20 W5.					
0- 3	A_0 & A_{11}	18	48	34	Si.C.L.
3- 6	A_{12g}	15	45	40	Si.C.L.-Si.C.
6- 9	B_{1g}	5	38	57	C.-Si.C.
9-19	B_{2g}	1	26	73	C.
19-29	G	18	30	52	C.
29-37	C_g	19	18	63	C.
37-47	C	4	18	78	C.
Codesa Series—Grey Wooded (weakly structured) sandy loam, 5-73-19 W5.					
3- 7	A_2	47	43	10	L.-S.L.
7-12	B_{11}	74	13	13	S.L.
12-17	B_{12}	62	20	18	S.L.
17-23	D_{11}	32	26	42	C.-C.L.
23-31	D_{12}	25	35	40	C.L.-C.
31-37	D_{13}	29	33	38	C.L.
at 40	Dca	22	33	45	C.
Valleyview Series—Black (solodized solonetz to solonetz) loam, 24-76-16 W5.					
0- 4	A_1	41	45	14	L.
4- 7	A_{21}	36	47	17	L.
7- 8	A_{22}	39	41	20	L.
8- 9	B_{21}	38	19	43	C.-C.L.
9-15	B_{22}	35	19	46	C.
15-27	B_3	25	19	56	C.
27-35	Bca	11	23	66	C.
35-47	C_{SO^4} & C	17	27	56	C.

TABLE 8.—Continued

Depth in inches	Horizon	Sand above 0.05 mm.	Silt 0.05-0.002 mm.	Clay less than 0.002 mm.	Texture as per U.S. guide
		Calculated on a percentage basis			
Kavanagh Series—Black (solonetz) loam, 23-76-16 W5.					
0- 1	A_0	46	37	17	L.
1- 2	A_1	46	31	23	L.
2-10	B_2	37	26	37	C.L.
10-12	Bca	43	25	32	C.L.
12-14	C_{11}	48	30	22	L.
14-16	C_{12}	20	38	42	C.
16-23	C_{13}	33	40	27	L.-C.L.
23-34	C_{14}	9	37	54	C.

Chemical Characteristics.

Nitrogen, phosphorus, sulphur, calcium, magnesium and soil acidity analyses were made on some representative profiles from the High Prairie and McLennan sheets. The relative proportions of such nutrient elements must be considered in determining both the present and future productivity of soils. Analyses typical of a number of virgin soil profiles are reported in Table 9.

The nitrogen content, given in the first column of the analytical data in Table 9, varies greatly in this area. There is an appreciable difference not only between soils of different zonal groups but also between soils of the same zonal groups. Grey wooded soils have the lowest nitrogen contents in the surface horizons while black and organic soils have the highest nitrogen contents. Degraded black soils are intermediate. In addition, within the same zonal group, light textured soils generally have less nitrogen than heavy textured soils.

The A_0 horizon has the highest nitrogen content of any horizon. In nearly all of the soils analyzed there is a pronounced decrease in nitrogen from the A_0 and A_1 horizons to the A_2 and B horizons. There is, however, a marked similarity in the nitrogen content of the B horizons of the heavy textured soil profiles in this area. Frequently it is appreciably higher than that of the leached A_2 horizons.

Phosphorus is a mineral element and the total amount in the soils is related directly to the soils' parent material. Analyses of the parent materials in this area indicate that while they cannot be considered deficient in phosphorus the natural supply of many of them tends to be low. The total phosphorus content in the lower horizons ranges from a high of 0.085 per cent in the heaviest textured soils to a low of 0.026 in the lightest textured soils. Soils of the Heart, Culp, Davis and Braeburn series are inclined to have a much lower phosphorus content than soils of the Donnelly, Nampa and Kathleen series. A consideration of both the total nitrogen and the total phosphorus content of these soils indicates that these elements tend to be in relatively short supply.

Further comparison of the data in Table 9 shows that the values for total phosphorus vary in the same direction as do those for total nitrogen. The differences, however, are not so great in degree. The A_0 and A_1 horizons of most soils have a higher total phosphorus content than any of the other horizons while the A_2 usually has the lowest phosphorus content. A recalculation of the data to determine the average phosphorus content of the surface foot shows that the black soils in this area have an average of 0.08 per cent whereas the grey wooded soils have an average of about 0.04 per cent. This is slightly lower than similar averages for black and grey wooded soils typical of other areas.

Investigations conducted at the University of Alberta reveal that in many parts of central Alberta grey wooded soils appear to be deficient in sulphur. Analyses of some of the parent materials of such soils show them to have a sulphur content of about 0.02 per cent. Similar analyses of some representative profiles reported in Table 9 indicate a higher sulphur content in the lower horizons of

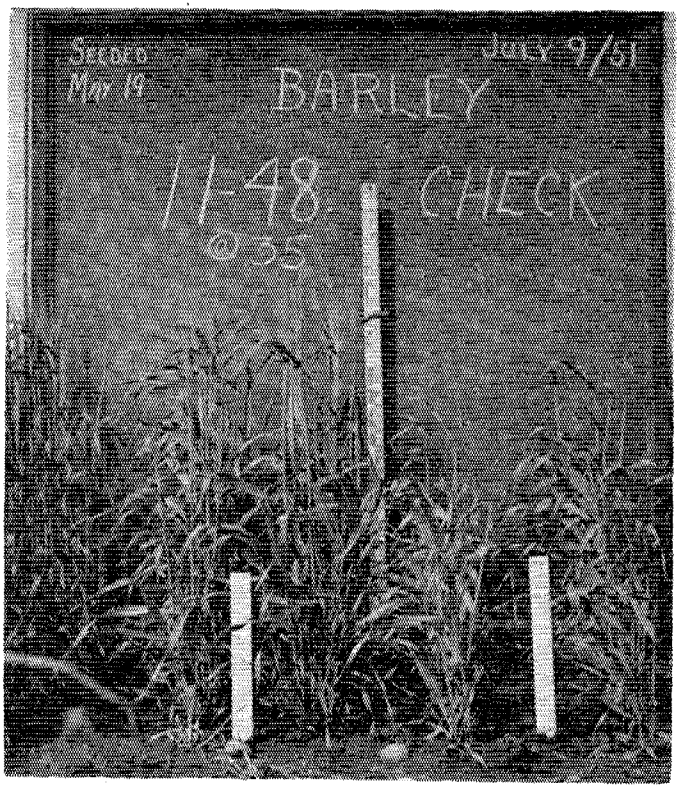


Figure 33—Plot tests by the Beaverlodge Experimental station show that increased yields can be expected from applications of commercial fertilizer. In this test the yield for the unfertilized crop was 65.8 bus. while that of the fertilized crop was 88.9 bus. per acre.

Photo courtesy C. H. Anderson, Can. Exp. Station, Beaverlodge.

Figure 34—Fertilizer trial on oats near High Prairie by the Dept. of Soils, University of Alberta, shows a marked response to applications of ammonium phosphate at recommended rates. The lighter colored fertilized strips ripened earlier and out-yielded the darker colored unfertilized strips by about 20 bushels per acre.

Photo courtesy C. F. Bentley, Dept. of Soils, Univ. of Alta.

all profiles except those of the Enilda and Goose series. Various field trials indicate that sulphur may not be deficient on the heavy textured soils in this area. On some of the lighter textured soils like those of the Davis and Culp series and perhaps those of the Braeburn series further trials appear desirable. Most of the solonetzic soils have accumulations of gypsum (calcium sulphate) in their parent materials.

Potassium is rarely a deficient plant nutrient in Alberta soils. As a consequence a very limited number of analyses have been made to determine the potassium content of various soils. An analysis of a profile typical of the Nampa series showed a potassium content varying from 1.24 percent in the A_2 horizon to 1.73 percent in the C horizon. The other horizons had intermediate amounts and the variation in the amount of total potassium by horizons is much less than that of any other nutrient element.

Ordinarily the calcium and magnesium content tends to be low in the upper horizons and much higher in some of the lower horizons of the soil profile. This is due to the fact that, being slightly soluble, these elements tend to be moved down by the percolating rain water. However, varying proportions of these elements are returned to the surface by plant roots. For example, the A_0 horizons consisting of semi-decompased plant remains often contain over 1 percent calcium. In the succeeding horizons the amount is much smaller in all but the lower B and C horizons. Most of the soil profiles reported in Table 9 have 1 to 2 percent calcium in the B_{ca} or lime horizons. However, in the Davis soil profile the amount of calcium in the B_{ca} horizons exceeds 6 percent. Most of the Davis, Judah and Culp soil profiles have a calcium content of between 5 and 6 percent in the B_{ca} and C horizons. The relatively high calcium content of the lower horizons of Kavanagh soils is largely due to the frequent occurrence of calcium salts, of which calcium sulphate is most common.

The analyses given in Table 9 refer to the total amounts of the various elements present in the soil. However, to be immediately useful to the growing plant there must be an adequate supply of those elements in an easily soluble form which the plant can take up in the soil solution. Thus, although the total amount may be fairly large, there may not be sufficient in the available form to meet the needs of the growing plants. Maintaining an adequate supply of organic matter is one of the best ways of providing an ample supply of available plant nutrients.

The pH (acidity or alkalinity) of the soil horizons of each profile is given in the last column of Table 9. It is also given for most of the profiles described in a preceding section of this report. The pH values of the surface horizons range from slightly acid to slightly alkaline. A pH value of 7.0 is neutral (neither acid nor alkaline). Values below 7.0 on the pH scale are increasingly acid while values above 7.0 are increasingly alkaline. Thus a moderately acid soil has a pH value of about 5.0 while a very acid soil has a pH value of about 4.0. A strongly alkaline soil has a pH value of 9.0 or over. The most acid horizons of the profiles reported in Table 9 are the A_2 and upper B horizons of the grey wooded and degraded black soils and the peat accumulation of Kenzie soils. The most alkaline horizons are usually those having a lime accumulation and those having salt accumulations. Strong alkaline reactions are typical of the lower horizons of Kavanagh soils.

Generally, applications of lime have not been considered necessary for successful crop production in this area. However, the low calcium content and the acid reactions in some horizons of Esher, Saddle, Nampa, Kathleen and Braeburn soils would suggest that additions of lime might prove beneficial.

In the High Prairie and McLennan sheets there are a few small areas that contain an excess of salts sufficient to retard plant growth. They occur as small patches at the base of some of the

long slopes associated with areas of Kavanagh and Valleyview soils in the vicinities of Prairie Echo and Salt Prairie. There are from 2 to 5 percent total salts in the uppermost horizons of these areas. The principal salts present are calcium sulphate and sodium sulphate. No other salt encrusted areas were observed at the time of survey and alkali does not appear to be a soil problem elsewhere in the surveyed area.

TABLE 9—Chemical Analysis of Some Representative Soil Profiles

Depth in inches	Horizon	Nitrogen	Phosphorus	Sulphur	Calcium	Magnesium	pH
			Percent				
Braeburn Series—Grey Wooded silt loam, 13-80-21 W5.							
0- 2	A_0 & A_1	0.860	0.080	0.072	1.24	0.41	6.9
2- 6	A_2	0.055	0.022	0.013	0.21	0.35	6.2
6- 8	$A_3(B_1)$	0.055	0.017	0.014	0.22	0.48	5.2
8-18	B_2	0.067	0.020	0.013	0.22	0.68	5.0
18-34	B_3	0.067	0.038	0.031	0.27	0.58	6.9
34-40	Bca	0.070		0.050	1.17	0.91	7.9
Saddle Series—Degraded Black (solodic) silt loam, 13-77-16 W5.							
0- 2	A_0	1.855	0.130		2.02	0.22	6.6
2- 6	A_1	0.324	0.069		0.28	0.22	5.8
6- 7	A_2	0.041	0.031		0.04	0.18	5.1
7-11	$A_3(B_1)$	0.081	0.038		0.12	0.45	4.4
11-21	B_{21}	0.076	0.037		0.24	0.56	4.2
21-32	B_{22}	0.076	0.055		0.26	0.55	4.9
32-38	Bca	0.071			0.68	0.71	6.8
Donnelly Series—Grey Wooded (solodic to solodized solonetz) silt loam, 14-76-17 W5.							
0- 3	A_0 & A_1	0.501	0.107	0.077	0.94	0.40	6.3
3- 8	A_2	0.064	0.044	0.009	0.46	0.32	6.4
8-16	B_{21}	0.069	0.032	0.021	0.58	0.74	6.2
16-28	B_{22}	0.076	0.033	0.037	0.62	0.76	6.6
28-31	Bca	0.078	0.064	0.062	1.12	0.76	7.7
31-35	C	0.080	0.065	0.067	1.36		7.7
Esher Series—Degraded Black (solodic to solodized solonetz) silt loam, 33-77-16 W5.							
0- 2	A_0	1.48	0.131		1.42	0.54	6.9
2- 5	A_1	0.267	0.077		0.42	0.62	5.2
5- 8	$A_3(B_1)$	0.147	0.032		0.26	0.71	4.3
8-13	B_{21}	0.133	0.044		0.24	0.75	4.3
13-23	B_{22}	0.108	0.061		0.24	0.75	4.2
23-31	B_3	0.117	0.079		0.38	0.84	6.6
31-36	Bca	0.129	0.081		0.88	0.84	7.6
36-48	C	0.113	0.077		2.00	0.88	7.4
Nampa Series—Grey Wooded (solodic to solodized solonetz) silt loam, 8-74-19 W5.							
0- 1	A_0	0.692	0.110	0.071	1.17	0.71	7.0
1- 2	A_1	0.296	0.068	0.083	0.72	0.68	6.2
2- 5	A_{21}	0.160	0.048	0.028	0.41	0.60	5.0
5- 8	A_{22}	0.092	0.038	0.036	0.37	0.61	4.6
8- 9	B_1	0.118	0.040	0.021	0.35	0.89	4.6
9-15	B_{21}	0.138	0.048	0.040	0.49	1.17	4.4
15-26	B_{22}	0.118	0.061		0.58	1.21	6.5
26-30	Bca	0.106	0.082		1.95	1.34	7.0

TABLE 9—Continued

Depth in inches	Horizon	Nitrogen	Phosphorus	Sulphur	Calcium	Magnesium	pH
		Percent					
Kathleen Series—Grey Wooded silt loam, 20-75-18 W5.							
0- 1	A_0	1.125	0.109	0.082	1.44	0.62	6.9
1- 3	A_1	0.208	0.057	0.014	0.48	0.56	4.9
3- 5	A_2	0.082	0.039	0.007	0.41	0.51	4.5
5- 9	$A_3(B_1)$	0.082	0.036	0.010	0.33	0.63	4.4
9-17	B_{21}	0.096	0.045	0.017	0.35	1.11	4.5
17-23	B_{22}	0.086	0.058	0.030	0.36	1.07	5.3
23-29	B_3	0.102	0.075	0.040	0.89	1.23	7.3
29-36	Dca	0.108	0.085	0.023	1.27	1.42	7.8
Goose Series—Meadow (somewhat poorly drained) silt loam, 1-70-20 W5.							
0- 3	A_0	0.745	0.168	0.063	1.50	0.90	6.8
3- 6	A_1	0.505	0.131	0.058	1.15	0.96	5.6
6- 9	B_{1g}	0.330	0.095	0.030	0.95	1.00	5.5
9-19	B_{2g}	0.182	0.067	0.028	0.94	1.09	5.8
19-29	G	0.058	0.067	0.014	0.89	0.93	6.5
29-37	C_g	0.060	0.063	0.028	0.98	0.96	7.5
37-47	C	0.076	0.067	0.020	0.94	1.19	7.8
Snipe Series—Depression Podsol, often peaty (poorly drained) loam, 5-72-19 W5.							
0- 5	A_{00}	0.873	0.071	0.330	2.02	0.22	5.9
5- 6	A_1	0.389	0.073	0.070	0.56	0.37	5.4
6-10	A_2	0.052	0.044	0.025	0.40	0.27	5.2
10-13	B_1	0.076	0.043	0.040	0.60	0.58	4.9
13-22	B_{2g}	0.068	0.047	0.044	0.62	0.74	5.3
22-32	B_{3g}	0.068	0.062	0.056	0.60	0.73	6.9
32-37	Bca	0.057	0.078	0.048	1.22	0.61	7.3
37-47	C	0.057	0.069	0.052	1.34	0.38	7.5
Davis Series—Grey Wooded silt loam, 11-78-23 W5.							
0- 2	A_0	0.470	0.050	0.008	0.65	0.28	7.0
2- 6	A_2	0.070	0.017	0.008	0.19	0.29	6.4
6-12	B_1	0.082	0.019	0.015	0.13	0.62	5.6
12-20	B_2	0.067	0.035	0.033	0.19	0.76	6.0
20-32	Bca	0.058		0.050	6.46	1.21	8.6
32-40	C	0.055		0.041	5.21	1.24	8.6
Culp Series—Grey Wooded sandy loam, 21-76-17 W5.							
0- 3	A_0 & A_1	0.710	0.151	0.059	1.64	0.35	6.5
3-11	A_2	0.048	0.065	0.059	0.56	0.36	6.4
11-14	$A_3(B_1)$	0.038	0.057	0.025	0.57	0.37	6.3
14-17	B_{21}	0.068	0.070	0.020	0.63	0.60	6.4
17-21	B_{22}	0.026	0.042	0.015	0.54	0.30	6.4
21-25	B_{31}	0.032	0.043	0.024	0.60	0.38	6.4
25-30	B_{32}	0.022	0.040		0.53	0.26	6.6
Heart Series—Podsolized Grey Wooded sand, 17-76-17 W5.							
½- 4	A_{2P}	0.032	0.011		0.44	0.12	5.8
4-12	B_P	0.018	0.031		0.42	0.10	5.4
12-18	C_P	0.018	0.029		0.45	0.19	5.6
18-26	$A_3(B_1)$	0.004	0.023		0.64	0.33	5.7
26-36	B_2	0.012	0.026		0.44	0.17	5.4

TABLE 9—Continued

Depth in inches	Horizon	Nitrogen	Phosphorus	Sulphur	Calcium	Magnesium	pH
			Percent				
High Prairie Series—Dark colored (moderately well drained) silt loam, 13-74-17 W5.							
0- 4	A_1	1.199	0.097	0.133	1.37	0.45	7.0
4- 8	B_{11}	0.479	0.087	0.051	0.75	0.45	6.3
8-12	B_{12}	0.461	0.057	0.031	0.72	0.41	6.1
12-14	C_{11}	0.087	0.055	0.067	0.59	0.35	6.1
14-19	C_{12}	0.087	0.053	0.030	0.66	0.36	6.0
19-24	C_{13g}	0.137	0.056	0.044	0.76	0.64	6.3
High Prairie Series—Dark colored (moderately well drained) clay loam, 31-74-16 W5.							
0- 4	A_1	0.546	0.147		0.96	0.60	6.3
4-18	B_1	0.169	0.078		0.66	0.63	5.8
18-22	C_{11}	0.184	0.067		0.86	0.74	6.6
22-23	C_{12}	0.307	0.079		1.46	0.55	7.3
23-30	C_{13}	0.055	0.067		0.80	0.30	7.7
30-37	C_{14g}	0.049	0.067		1.20	0.77	7.8
37-48	C_{15g}	0.030	0.060		1.32	0.45	7.7
Enilda Series—Poorly drained, often peaty silty clay loam, 36-74-16 W5.							
0- 4	A	1.77	0.120	0.210	3.22	0.61	7.1
4- 7	B_g	0.40	0.052	0.082	1.10	0.57	6.5
7-10	C_{11g}	0.143	0.048	0.033	0.98	0.88	6.7
10-11	C_{12g}	0.351	0.066	0.075	1.36	0.93	6.4
11-16	C_{13g}	0.173	0.051	0.064	1.06	0.99	6.3
16-24	C_{14g}	0.069	0.047	0.043	0.92	0.57	6.9
24-30	C_{15g}	0.074	0.052	0.051	1.32	0.72	6.9
30-39	C_{16g}	0.067	0.051	0.025	1.14	0.84	6.9
Codesa Series—Grey Wooded (weakly structured) sandy loam, 5-73-19 W5.							
0- 3	A_0 & A_1	1.34	0.126	0.127	2.44	0.49	5.5
3- 7	A_2	0.046	0.030	0.006	0.89	0.45	4.8
7-12	B_{11}	0.042	0.035	0.011	1.47	0.64	4.7
12-17	B_{12}	0.018	0.025	0.010	1.89	0.65	4.7
17-23	D_{11}	0.040	0.038	0.016	1.61	1.06	4.4
23-31	D_{12}	0.042	0.032	0.005	1.37	0.89	4.6
31-37	D_{13}	0.052	0.043	0.034	1.91	1.08	7.3
37-42	Dca	0.048	0.050	0.043	1.17	1.13	7.4
Valleyview Series—Black (solodized solonetz) loam, 24-76-16 W5.							
0- 4	A_1	0.820	0.156	0.077	0.79	0.54	5.8
4- 7	A_{21}	0.194	0.085	0.032	0.44	0.47	5.8
7- 8	A_{22}	0.098	0.053	0.018	0.46	0.42	6.1
8- 9	B_{21}	0.154	0.067	0.031	0.41	0.85	6.4
9-15	B_{22}	0.176	0.065	0.077	0.44	0.82	7.0
15-27	B_3	0.154	0.061	0.063	0.44	1.02	7.9
27-35	Bca	0.078	0.073	1.11	1.63	1.20	8.0
35-47	C	0.082	0.073	1.08	2.37	1.14	8.1

TABLE 9—Continued

Depth in inches	Horizon	Nitrogen	Phosphorus	Sulphur	Calcium	Magnesium	pH
			Percent				
Kavanagh Series—Black (solonetz) loam, 23-76-16 W5.							
0-½	A_0	0.714	0.090		0.90	0.53	6.5
½- 2	A_1	0.874	0.101		1.14	0.64	6.7
2-10	B_2	0.115	0.073		0.58	0.48	8.1
10-12	Bca	0.090	0.030		4.52	0.60	9.2
12-14	C_{11}	0.032	0.042		3.32	0.45	9.4
14-16	C_{12}	0.060	0.032		2.96	0.70	9.1
16-23	C_{13}	0.048	0.043		3.18	0.65	9.3
23-34	C_{14}	0.124	0.045		1.54	0.74	8.9
Eaglesham Series—Sedge peat soil, 21-79-21 W5.							
0-16	1	1.031	0.094		1.53	0.25	5.8
16-18	2	0.796	0.080		0.98	0.75	6.8
18-20	3	0.354	0.071		0.79	0.82	7.3
20-28	4(G)	0.119	0.048		0.98	0.74	7.8
28-36	5(ca)	0.113			2.48	1.03	7.9
Kenzie Series—Moss peat soil, 29-75-18 W5.							
0- 8	1	0.708	0.049		0.82	0.18	4.7
8-13	2	0.507	0.040		1.12	0.10	4.3
13-19	3	1.117	0.038		1.82	0.14	4.8
19-28	4(G_{11})	0.025	0.031		0.32	0.31	6.8
28-34	5(G_{12})	0.078	0.045		0.66	0.74	7.0
34-40	6(D_g)	0.090	0.075		0.62	0.61	7.2

Using fusion methods, analyses were made to determine the relative proportions of silica and sesquioxides in the various horizons of some representative soil profiles. Such analyses are of interest in studying the processes of profile development since they indicate the type and degree of leaching involved in soil formation.

An acid type of leaching has prevailed in the formation of most of the soils listed in Table 10. Basic compounds such as the oxides of iron, aluminum, calcium and magnesium are moved from the A to the B horizons. The more readily soluble calcium and magnesium compounds are likely to move to lower horizons in the profile than are aluminum and iron. (For calcium and magnesium analyses of these or similar profiles refer to Table 9.) In more extreme leaching, and especially in lighter textured soils, much of the calcium and magnesium may be removed from the solum and be carried away in the ground waters. Such a removal is accompanied by an increase in the acidity of the soil due to the lack of sufficient neutralizing bases of which calcium and magnesium are of greatest importance. The sesquioxides (iron and aluminum oxides) on the other hand are less easily removed and commonly accumulate and remain in the B horizon.

Characteristic of an acid leaching, therefore, is a reduction of basic constituents in the A horizon accompanied by an apparent increase in the amount of silica. The reverse occurs in the B

horizon where iron and aluminum oxides may accumulate and the apparent amount of silica is decreased in proportion. Thus the molecular ratio of SiO_2 to R_2O_3 (silica oxide to iron and aluminum oxides) indicates the comparative degree of leaching of iron and alumina. This ratio has been calculated for each horizon and is given in the last column of Table 10. The relocation and accumulation of nitrogen, phosphorus, calcium and magnesium can be ascertained from the data recorded in Table 9.

TABLE 10.—Silica and Sesquioxide Analyses of Representative Soil Profiles

Depth in inches	Horizon	pH	Percent			SiO_2
			SiO_2	Fe_2O_3	Al_2O_3	R_2O_3
Braeburn Series—Grey Wooded (solodic) loam, 17-72-16 W5.						
0- 2	A_0 & A_1	7.2	40.24	1.33	4.73	12.24
2- 5	A_2	6.1	81.46	2.16	9.21	13.06
5-11	B_1	5.2	70.63	4.44	14.10	7.08
11-21	B_{21}	4.2	73.51	4.42	13.24	7.77
21-37	B_{22}	4.8	71.46	4.67	14.47	6.95
37-44	B_3	5.2	73.47	4.34	13.24	7.78
Donnelly Series—Grey Wooded (solodized solonetz) silt loam, 6-74-25 W5.						
2- 4	A_{21}	5.3	76.92	2.88	10.90	10.25
4- 7	A_{22}	5.0	81.32	2.44	10.18	11.76
7- 8	B_1	4.6	75.02	3.52	13.10	8.30
8-16	B_{21}	4.0	63.14	5.72	18.20	4.90
16-20	B_{22}	4.6	63.60	5.80	18.66	4.83
20-26	B_{31}	5.0	67.56	5.37	16.15	5.87
26-32	B_{32}	6.1	70.12	5.00	14.80	6.62
32-38	Cca	7.2	70.54	4.64	14.30	6.94
Nampa Series—Grey Wooded (solodized solonetz) silt loam, 28-74-18 W5.						
0- 2	A_0 & A_1	5.6	50.59	3.56	11.53	6.22
2- 6	A_2	4.6	74.22	3.96	12.59	8.33
6-10	$A_3(B_1)$	4.7	73.61	4.33	13.29	7.78
10-28	B_2	4.5	62.63	6.27	18.70	4.73
28-40	Bca	7.3	60.12	6.02	18.54	4.56
40-50	C	7.4	57.66	5.83	18.94	4.32
Kathleen Series—Grey Wooded silt loam, 20-75-18 W5.						
0- 1	A_0	6.4	50.95	2.31	8.08	9.04
1- 3	A_1	4.9	75.03	3.12	11.39	9.52
3- 6	A_2	4.5	79.18	2.71	10.42	7.12
6- 9	B_1	4.4	76.30	3.96	11.73	9.08
9-17	B_{21}	4.5	63.96	6.54	18.04	4.89
17-23	B_{22}	5.3	65.58	6.10	16.96	5.34
23-29	B_3	7.3	63.71	5.95	17.24	5.14
29-36	Dca	7.8	60.60	5.91	18.28	4.67
Heart Series—Podsolized Grey Wooded sand, 17-76-17 W5.						
½- 4	A_{2P}	5.8	93.19	0.51	3.26	45.2
4-12	B_P	5.4	92.76	1.10	4.07	32.92
12-18	C_P	5.6	91.79	1.12	4.42	30.32
18-26	$A_3(B_1)$	5.7	92.34	1.01	4.48	30.61
26-36	B_2	5.4	92.02	1.12	4.12	37.92

TABLE 10.—Silica and Sesquioxide Analyses of Representative Soil Profiles —Continued

Depth in inches	Horizon	pH	Percent			SiO_2
			SiO_2	Fe_2O_3	Al_2O_3	R_2O_3
Valleyview Series—Black (solodized solonetz) loam, 23-70-22 W5.						
0- 1	A_0	6.1	57.87	3.51	11.93	6.93
1- 4	A_1	5.0	61.70	4.36	15.36	5.72
4- 7	A_2	5.3	78.81	2.91	9.40	11.88
7- 9	B_{21}	5.4	71.20	4.13	12.49	7.99
9-19	B_{22}	6.2	63.09	5.25	16.09	5.51
19-27	Bca	8.1	61.98	3.14	19.58	4.87
27-35	B_{SO^4}	7.6	61.90	5.41	17.66	5.10
35-40	C	7.6	61.44	5.57	17.41	4.97
Goose Series—Meadow (somewhat poorly drained) silt loam, 1-70-20 W5.						
0- 3	A_0 & A_{11}	6.8	53.52	4.81	16.83	4.56
3- 6	A_{12}	5.6	54.37	6.29	17.43	4.30
6- 9	B_{1g}	5.5	58.00	7.02	18.20	4.19
9-19	B_{2g}	5.8	59.47	6.48	19.36	4.30
19-29	G	6.5	69.22	4.96	15.64	6.25
29-37	C_g	7.5	66.80	5.34	16.95	5.57
37-44	C	7.8	60.36	6.56	19.74	4.28

In the grey wooded soils of Table 10 there appears to be definite evidence of leaching. This may not be as great as that of other podsolic soils, but there is an appreciable concentration of SiO_2 in the A_2 horizons and an accumulation of iron and aluminum in the B horizons.

The acidity of the various horizons of these soils does not appear to be related directly to leaching as expressed in terms of SiO_2 and R_2O_3 accumulation. In many of the soils analyzed in this area the upper B horizons are generally the most acid horizons of the profile. Frequently this is more apparent in some of the degraded black soils than it is in grey wooded soils.

In the black solodized solonetz profile typical of the Valleyview series (Table 10) there is an accumulation of SiO_2 in the A_2 horizon and an accumulation particularly of aluminum in the lower part of the B horizon. In the somewhat poorly drained profile typical of the Goose series, there appears to have been little movement of either the SiO_2 or the R_2O_3. The G horizon of this profile becomes quite hard on drying, and it would appear that organic substances may be the chief cementing agents.

APPENDIX

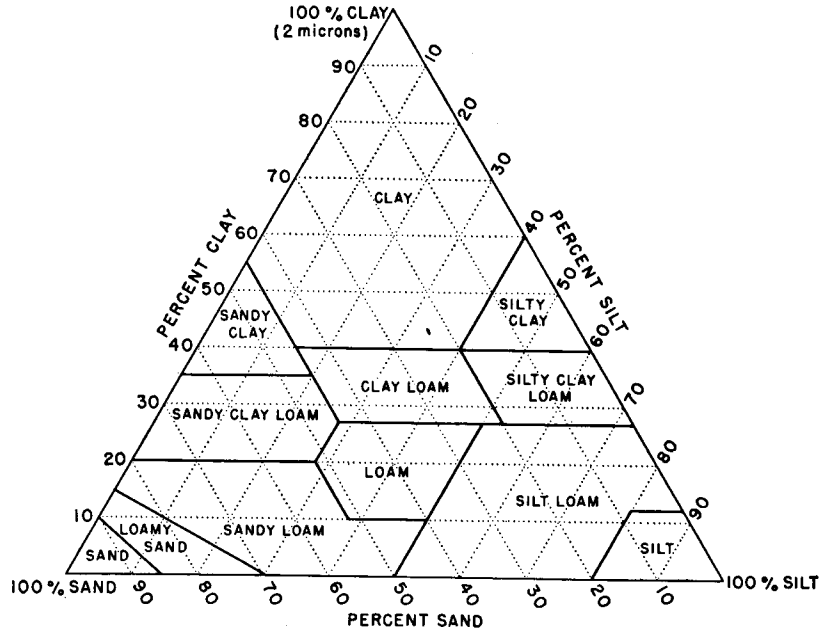
Throughout this report and in field classification frequent use is made of relative terms to describe features of significance in the mapped area. Definitions of some of these terms and the field designations used in this area are as follows:

TABLE 11.—Soil Separates (Particle Sizes) on which Textural Classes are Based

Separates	*Diameter in Millimetres*
Very Coarse Sand (V.C.S.)	2.0 -1.0
Coarse Sand (C.S.)	1.0 -0.5
Medium Sand (S.)	0.5 -0.25
Fine Sand (F.S.)	0.25-0.10
Very Fine Sand (V.F.S.)	0.10-0.05
Silt (Si.)	0.05-0.002
Clay (C.)	less than 0.002

Figure 35—Chart Showing Proportions of Soil Separates in Various Soil Textural Classes

From U.S. Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering Guide for Textural Classification—March, 1948.



A further separation of sands is made according to the prevalence of different sized sand fractions. Medium and coarse sands may contain over 25 percent coarse sand but not over 50 percent fine sands. Fine and very fine sands must contain over 50 percent of the respective fine sand fractions.

TABLE 12.—Classes of Stony Land.

S_0—*Stone free.*
S_1—*Occasional stones*—no serious handicap to cultivation.
S_2—*Moderately stony*—requiring removal, occasional stone piles in the field.
S_3—*Very stony*—serious handicap to cultivation, frequent stone piles in the field.
S_4—*Excessively stony*—too stony to permit cultivation.

TABLE 13.—The Classification of Tree Cover

T_0—*Open land*—trees no handicap to cultivation.
T_1—*Light tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 4 acres per hour.
T_2—*Medium tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 2 acres per hour.
T_3—*Heavy tree cover*—can be cleared at a rate of about 1 acre per hour.
T_4—*Excessively heavy tree cover*—preferably left for timber.
Further designations, relating to the prevailing types of trees, are often included in this field classification.

TABLE 14.—The Classification of Calcareous Soil Materials

Cc_1—*Slightly Calcareous*—materials usually contain less than the equivalent of 1 percent calcium. Weak effervescence to dilute hydrochloric acid.
Cc_2—*Moderately Calcareous*—materials that contain the equivalent of from 1 to about 5 percent calcium. Moderate effervescence to dilute hydrochloric acid.
Cc_3—*Very Calcareous*—materials that contain the equivalent of from 5 to about 10 percent calcium. Strong effervescence to dilute hydrochloric acid.
Cc_4—*Extremely Calcareous*—materials that contain the equivalent of over 10 percent calcium. Violent effervescence to dilute hydrochloric acid.

Classification of Soil Structure

Single masses of soil consisting of many individual soil particles are called aggregates. Soil aggregates vary in shape and size, and these variations are recognized in classifying the structure of soil profiles. Often one type of aggregate occurs within another. For example, the columnar structure of solonetz soils will break down into smaller aggregates. The *macrostructure* is used to designate the large columnar aggregates and *mesostructure* for the smaller blocky or nuciform aggregates. Still finer subdivisions of structure are referred to as *microstructure*. The following structures are recognized in describing the soils in the field and in this report:

Blocky—Block-like aggregates with sharp angular corners.
Nuciform—Nut-like aggregates with more or less clearly defined edges and faces that are sub-rectangular.
Granular—More or less rounded soil aggregates with an absence of smooth faces and edges, relatively non-porous.
Platy—Thin horizontal plates or aggregates in which the horizontal axis is longer than the vertical.
Columnar—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well defined regular edges and surfaces. The tops of the columns are usually rounded. Commonly found in the B horizon of solonetzic soils.
Prismatic—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well defined regular edges and surfaces. The tops of the aggregates are usually flat.
Massive—Large cohesive masses of soil, almost amorphous or structureless, with irregular cleavage faces.
Vesicular—A soil structure that is characterized by small round or oval cavities or vesicles. *Crumb* structure is the term applied to porous granular aggregates.

Depending on the degree of distinctness the various grades of structure may be indicated as weak, moderate or strong. Descriptive terms commonly used to denote size of structural aggregates

are very fine, fine, medium, coarse or very coarse. Such terms as friable, hard, firm, very firm, etc., refer to the durability of the aggregates to displacement or gentle crushing.

TABLE 15.—Classification of Drainage.

Excessively Drained—little retention of moisture by the soil—usually droughty.

Well Drained—Removal of water is not too rapid.

Imperfectly or Somewhat Poorly Drained—drainage slow—often due to an impervious layer and a fairly high water table.

Poorly Drained—Removal of water very slow—soil often remains wet for considerable periods.

Very Poorly Drained—Removal of water is so slow that the water table is at or near the surface.

The foregoing terms are relative and refer in a general way to the natural drainage characteristics of a soil. 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 characteristics and described as rapid, moderate, slow, very slow or none.

GLOSSARY*

Aeolian deposition—Wind laid material.

Aggregate (soil)—A single mass or cluster of soil consisting of many soil particles held together, such as a prism, granule or crumb, etc.

Alluvium—Water transported, recently deposited material on which the soil forming process have not acted long enough to produce distinct soil horizons.

Available plant nutrients—Plant nutrients in soluble form, readily available to the plant roots.

Calcareous material—Material containing a relatively high percentage of calcium carbonate. Will effervesce visibly when treated with hydrochloric acid.

Claypan—A dense and heavy soil horizon underlying the upper part of the soil; hard when dry and stiff when wet.

Cleavage—The capacity of a soil on shrinkage to separate along certain planes more readily than on others.

Concretions—Local concentrations of certain chemical compounds such as calcium carbonate or compounds of iron, that form hard grains or nodules of mixed compositions and of various sizes, shapes and coloring.

Consistence—The relative mutual attraction of the particles in the whole soil mass or their resistance to separation or deformation. Described by such terms as loose, compact, mellow, friable, plastic, sticky, soft, firm, hard and cemented.

Degradation—Change of one soil type to a more leached one.

Drift—Material of any sort deposited in one place after having been moved from another. *Glacial drift* includes all glacial deposits whether unstratified or stratified.

*This is not a complete glossary, but is primarily to define some of the terms commonly used in this report.

Erosion—The wearing away of the land surface by running water, wind or other geological 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.

(a) *Sheet*—Removal of a more or less uniform layer of material from the land surface.

(b) *Rill*—A type of accelerated erosion that produces small channels which can be obliterated by tillage.

(c) *Gully*—Erosion-produced channels that are larger and deeper than rills and cannot be obliterated by tillage. Ordinarily they carry water only during and immediately following rains or following the melting of snows.

Flocculate—To aggregate individual particles into small groups or granules: used especially with reference to clay and colloidal behaviour. The reverse of flocculate is deflocculate, commonly referred to as puddling.

Flood Plain—The nearly flat surface subject to overflow along stream courses.

Friable—Easily crushed in the fingers, non-plastic.

Glei Soil—A soil whose solum is either wholly or partly modified by a fluctuating water table. 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, characterized by a grey often mottled appearance which, on drying, shows numerous rusty brown iron stains or streaks, is called the G horizon. It is generally very sticky when wet and hard when dry. Those horizons in which the gleying is less intense are often designated as Bg or Cg horizons.

Green manure crop—Any crop that is plowed under for the purpose of improving the soil, especially by the addition of organic matter.

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 building processes.

Humus—The well decomposed, more or less stable part of the organic matter of the soil.

Impervious materials—Materials which resist the passage of drainage water and plant roots.

Lacustrine materials—Materials deposited by or settled out of lake waters.

Lithosol—A soil having no clearly expressed soil characteristics and consisting of an imperfectly weathered mass of rock fragments.

Mature soil—A soil with well developed characteristics produced by the natural processes of soil formation and in equilibrium with its environment.

Muck—Fairly well decomposed organic soil material relatively high in mineral content, dark in color and accumulated under conditions of imperfect drainage.

Nutrients (Plant)—The elements taken in by the plant, essential to its growth, and used by it in the elaboration of its food and tissue. These include nitrogen, phosphorus, calcium, magnesium, potassium, sulphur, iron, manganese, copper, boron and perhaps others obtained from the soil; and carbon, hydrogen and oxygen obtained largely from the air and water.

Organic soil—A general term used in reference to any soil whose solum is made up of predominantly organic material.

Peat—Unconsolidated soil material consisting largely of undecomposed to partially decomposed organic matter accumulated under conditions of excessive moisture.

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.

Podsolization—A general term referring to that process by which soils are depleted of bases, become acid and develop leached A horizons. Specifically the term refers to the process by which podsol soils are formed and in which the iron and alumina are removed from the upper part of the profile more rapidly than is the silica. This results in the development of a light colored surface horizon and an accumulation of iron, alumina and organic matter in the B horizon.

Profile—A vertical section of the soil through all its horizons and extending into the parent material.

Relief—The elevations or inequalities of a land surface when considered collectively. Minor surface configurations, such as slight knolls, ridges or shallow depressions are referred to as micro-relief.

Solonetzic soils—Soils developed on somewhat saline parent material and characterized by a compact B horizon.

Solodization—A soil forming process that is somewhat similar to podsolization in that the soil becomes acid in the surface horizons and develops a leached A_2 horizon. Through improved drainage and an accompanying decrease in the salt content of solonetz soils they develop a leached A_2 horizon accompanied by a general breakdown of the hard B horizon that ultimately results in the development of a solod soil. The process of change of solonetz to solod is called "solodization". Whereas solonetz and solod soils are of uncommon occurrence, there are a great many soils, having intermediate profile characteristics that are referred to as solodized-solonetz soils.

Solum—The upper part of the soil profile, which is above the parent material and in which the processes of soil formation are taking place. It includes the A and B horizons.

Stratified—Composed of or arranged in strata or layers. The term is applied to parent materials. Those layers that are produced in soils by the processes of soil formation, are called soil horizons, while those inherited from the parent material are called *strata*. Thin horizontal layers are often referred to as *laminae*, strata up to about 12 inches in thickness as *bands*, and those over 12 inches are referred to in this report as *beds*.

Terrace—A flat or undulating plain bordering a river or a lake. Many streams are bordered by a series of terraces at different levels indicating flood plains at successive periods. Although many older terraces have become more or less hilly through dissection by streams or wind action, they are still regarded as terraces.

Till—A heterogenous mixture of stones, sand, silt and clay transported by glaciers and deposited during the melting and subsequent recession of the ice front.

Till plain—A level or undulating land surface covered by glacial till.

Water table—The upper limit of the part of the soil or underlying material wholly saturated with water.

Weathering—The physical and chemical disintegration and decomposition of rocks and minerals.

Zonal soils—Any one of the great soil groups having well developed soil characteristics that reflect the influence of climate and living organisms, chiefly vegetation. In the surveyed area these groups include the grey wooded, degraded black and black soils.

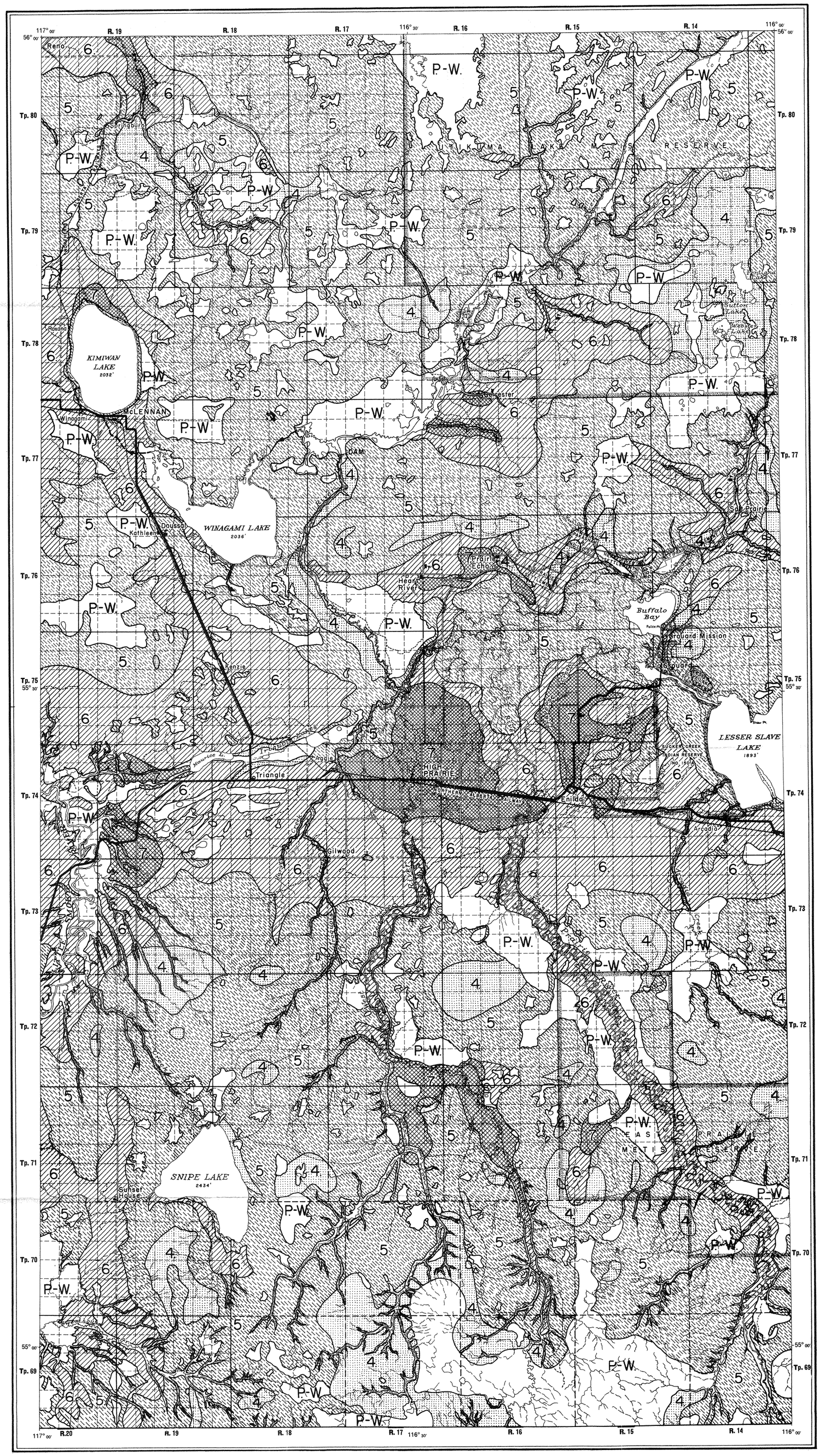
SOIL RATING MAP OF THE HIGH PRAIRIE AND McLENNAN SHEETS

PROVINCE OF ALBERTA

WEST OF FIFTH MERIDIAN

Scale 4 Miles to 1 inch

2 1 0 2 4 6 8 10 MILES



Prepared by the Soil Survey, Research Council of Alberta, in co-operation with the Experimental Farms Service, Canada Department of Agriculture and the Department of Soils, University of Alberta.

Rating based on Soil and other Physical Features as determined by the Alberta Soil Survey, 1948, 1949 and 1950. This Map to be used in connection with Soil Map and Report.

LEGEND

Pasture and Woodland ..... P.-W.

Poor to Fair Arable 4

Fair to Fairly Good Arable 5

Fairly Good to Good Arable 6

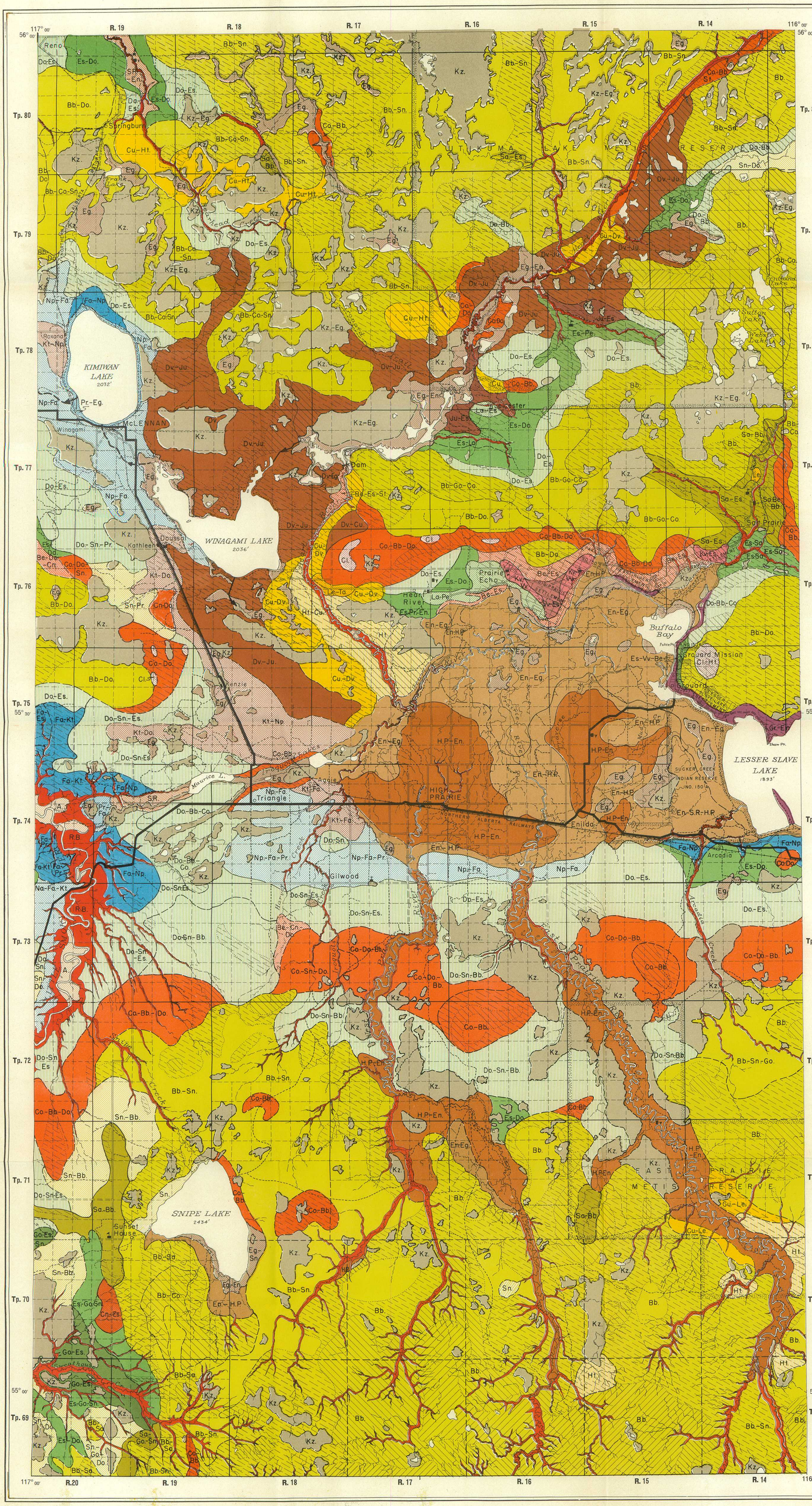
Good to Very Good Arable 7

SOIL MAP OF THE HIGH PRAIRIE AND McLENNAN SHEETS

PROVINCE OF ALBERTA

WEST OF FIFTH MERIDIAN

Scale 3 Miles to 1 inch



LEGEND

SOIL SERIES

Soils developed on glacial till:

Till yellowish brown to greyish brown, slightly calcareous, somewhat sandy clay loam to loam

Braeburn—Grey Wooded loam to heavy loam ..... Bb.

Saddle—Degraded Black (solodic) loam to heavy loam ..... Sa.

Till grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam to clay. (Lacustro-till.)

Donnelly—Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam ..... Do.

Esher—Degraded Black (solodic to solodized solonetz) heavy loam to clay loam ..... Es.

Landry—Black (solodic to solodized solonetz) silty loam to clay loam ..... La.

Snipe—Depression Podsol, often peaty (poorly drained) loam ..... Sn.

Goose—Meadow (somewhat poorly drained) silt loam to silty clay loam ..... Go.

Soils developed on lacustrine deposited materials:

Slightly to moderately calcareous, somewhat saline, unctuous, grey to dark grey clay.

Nampa—Grey Wooded (solodic to solodized solonetz) heavy loam to clay loam ..... Np.

Falher—Degraded Black (solodized solonetz) silty loam to clay loam ..... Fa.

Prestville—Thin Peat (poorly drained) silt loam to clay loam ..... Pr.

Moderately calcareous, brown, friable, silty clay loam to silty clay.

Kathleen—Grey Wooded silt loam to silty clay loam ..... Kt.

Judah—Degraded Black silt loam to silty clay loam ..... Ju.

Soils developed on alluvial and aeolian deposited materials:

Very calcareous, variable, silty parent material.

Davis—Grey Wooded loam to silt loam ..... Dv.

Tangent—Degraded Black loam to silt loam ..... Ta.

Moderately calcareous, variable, sandy parent material.

Culp—Grey Wooded loamy sand to sandy loam ..... Cu.

Leith—Degraded Black loamy sand to sandy loam ..... Le.

Slightly calcareous, fairly loose sand parent material.

Heart—Grey Wooded and Podsolized Grey Wooded sand to loamy sand ..... Ht.

Slightly calcareous, comparatively recent river and flood plain deposited materials.

Spirit River—Black (weakly structured) sandy loam to silt loam ..... S.R.

High Prairie—Dark colored, (moderately well drained) sandy loam to clay loam ..... H.P.

Enilda—Poorly drained, often peaty, sandy loam to clay loam ..... En.

Alluvium—Undifferentiated river flat and river bench deposits ..... A.

Relatively thin, slightly calcareous, light to medium textured deposits that overlie other heavier textured deposits.

Fairly uniform sandy or silty material overlying till or lacustrine deposits.

Peoria—Degraded Black to Black (weakly structured) sandy loam to silt loam ..... Pe.

Variable, sandy to silty often gravelly material usually overlying till deposits.

Codesa—Grey Wooded (weakly structured) sandy loam to loam ..... Co.

Belloy—Degraded Black to Black (weakly structured) sandy loam to silt loam ..... Be.

Codner—Meadow (somewhat poorly drained) sandy loam to silt loam ..... Cn.

Soils developed on coarse outwash and shoreline materials:

Clouston—Grey Wooded (weakly structured) gravelly or stony loamy sand to sandy loam ..... Cl.

Grouard—Degraded Black to Black (weakly structured) gravelly or stony loamy sand to sandy loam ..... Gr.

Soils developed on residual and modified residual materials:

Somewhat saline, sandy shales.

Kavanagh—Degraded Black to Black (solonetz) loam to heavy loam ..... Kv.

Valleyview—Degraded Black to Black (solodized solonetz to solonetz) loam to heavy loam ..... Vv.

Organic Soils:

Eaglesham—Peat fine and mainly of sedge origin ..... Eg.

Kenzie—Peat coarse and mainly of moss origin (Muskeg) ..... Kz.

TOPOGRAPHY CLASSES

Percent slope:

0.0 — 0.5
0.5 — 1.5 ..... Level and Undulating
2 — 5 ..... Gently Rolling
6 — 9
10 — 15 ..... Rolling
16 — 30 ..... Hilly

Rough, broken land adjacent to drainage courses ..... R.B.

OTHER FEATURES

Stony phase ..... St.

Soil boundaries (determined)

Soil boundaries (conjectured)

Topography boundaries

REFERENCE

Roads—gravelled highway

—local road, well travelled

—local road, not well travelled

—wagon road or trail

Railway

Township boundary (surveyed)

Township boundary (unsurveyed)

Section line

Intermittent stream

Canal

Proposed canal

Town (or built up area)

Church

School

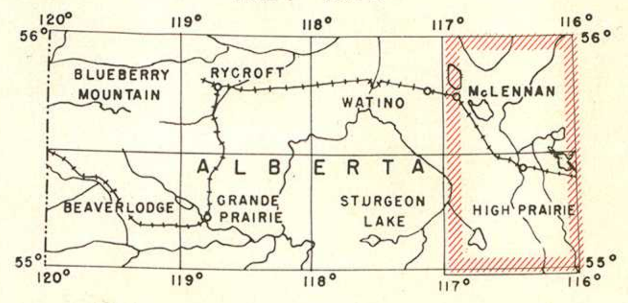
Post office at town or village

Indian and Metis Reserve boundaries

DIAGRAM OF TOWNSHIP

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

KEY MAP



Soil information by the Alberta Soil Survey
(Research Council of Alberta, Canada Department of Agriculture and the University of Alberta)
Map to be used in conjunction with Soil Survey Report No. 17.

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