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Report No. 56

Soil Survey
of the
Rycroft and Watino Sheets

BY

WM. ODYNSKY

AND

J. D. NEWTON

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ALBERTA SOIL SURVEY ADVISORY COMMITTEE

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ACKNOWLEDGMENT

The soil survey of the Rycroft and Watino Sheets was conducted as a joint project by the Research Council of Alberta, the Dominion Department of Agriculture and the University of Alberta.

The field work was carried out by Messrs. R. S. Baptie, A. L. Brown*, E. J. Evans, J. Fraser, H. N. Hart, A. Harboway, W. C. Hinman, B. Hughes, C. J. McAndrews, Wm. Poohkay, H. O. Ritchie and A. Wynnyk under the direction of Mr. Wm. Odynsky. The chemical and physical analyses were made by Messrs. W. C. Hinman, J. N. Leat and T. W. Peters. Mr. S. J. Groot prepared the final copies of the soil and soil rating maps.

The authors wish to acknowledge their appreciation of the assistance received from the late Dr. F. A. Wyatt, Dept. of Soils, Dr. J. A. Allan, Dept. of Geology, Dr. E. H. Moss, Dept. of Botany and Mr. M. B. Crockford, Research Council of Alberta, University of Alberta, and Dr. A. Leahey and Mr. W. E. Bowser of the Dominion Experimental Farms Service.

Acknowledgment is recorded of agricultural and other information obtained from Provincial and Dominion publications which have been freely used in this report. Extensive use has been made of the preliminary soil survey reports of parts of this area.

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

INTRODUCTION

The first reports on the soils of the Peace River area of Alberta were the Research Council of Alberta Reports No. 23 and 31 titled, "Preliminary Soil Survey Adjacent to the Peace River, Alberta West of Dunvegan" and "Preliminary Soil Survey of the Peace River — High Prairie — Sturgeon Lake Area." They were published in 1930 and 1935 and were based on the information obtained by exploratory soil surveys conducted in the years 1928 to 1931.

Further soil survey work was discontinued in this part of the province until 1944. At that time officials of the Veteran's Land Act were anxious to explore the settlement possibilities in the area northwest of Fairview, and the Dominion Experimental Farms Service provided them with a soil survey party to determine the suitability of the soils in the area under consideration. Since then, soil survey work has been continued in the northwestern part of Alberta as a joint project of the Research Council of Alberta, the Dominion Department of Agriculture and the University of Alberta.

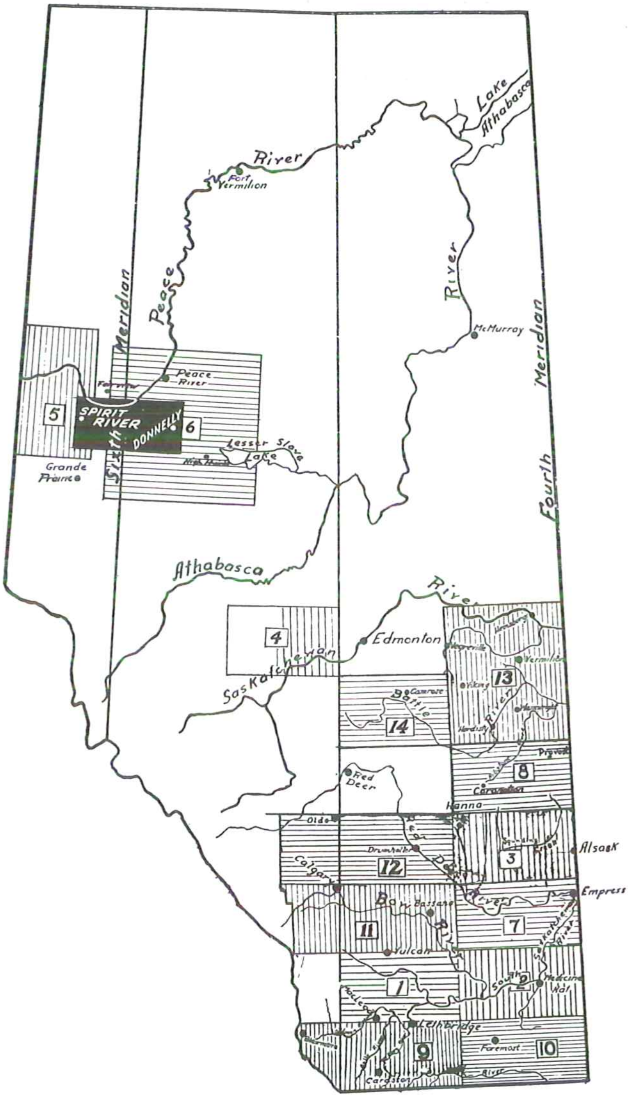
This report is based on the information obtained from soil surveys conducted in the Rycroft and Watino sheets during the summers of 1945, 1946 and 1947. It provides an inventory of the soil resources in the mapped area. The properties of the surface and subsoil of the various soil series are described. The first part of each description deals with the characteristics by which the soil may be recognized, while the second part discusses the soil in relation to agriculture. The report also gives a general description of the mapped area and deals with the topography, drainage, climate, vegetation and other factors which have a bearing on soil development, settlement and crop production. A glossary is included in this report to acquaint the reader with some of the terms frequently used in describing the various soils found in this area.

The soil map, printed on the scale of three miles to the inch, is an integral part of this report. It shows the location and extent of the different soil series and indicates the most important physical features of the area such as topography, streams, roads, railroads and towns. Two other maps accompany this report; one shows the distribution of the cultivated, abandoned and virgin lands 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.

The soil map and the soil rating map should not be used as the sole basis for estimating the value of the land. 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 soil encountered on any particular parcel within the surveyed area.

Soil surveys in Alberta were organized and guided from their inception until 1947 by the late Dr. F. A. Wyatt. Those of us privileged to carry on can only hope that this and succeeding reports will continue to contribute to a better understanding of our soils and their problems, and that they may serve as a useful guide in the development of sound land utilization policies in Alberta.

PLATE I



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 Lakes 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, (IN BLACK) Rycroft and Watino sheets.

Note: Reports for areas 1 to 6 inclusive are out of print, but may be obtained on loan from the University Extension Library, University of Alberta, Edmonton.

Soil Survey of the Rycroft and Watino Sheets

GENERAL DESCRIPTION OF THE AREA

LOCATION AND EXTENT

The Rycroft and Watino sheets are in the Peace River region of Alberta. They include part of the former Smoky River and Dunvegan sheets and cover approximately 2,760 square miles or 1,765,000 acres.

The general location of the surveyed area is indicated on the sketch map in Plate 1. Its exact boundaries are: on the east, west longitude 117°00′; on the west, west longitude 119°00′; on the south, north latitude 55°30′; and on the north, north latitude 56°00′. It includes all or parts of townships 75 to 81 in ranges 20 to 26 west of the fifth meridian and all or parts of townships 75 to 81 in ranges 1 to 7 west of the sixth meridian. Donnelly is near the eastern edge and Spirit River is near the western edge of the mapped area. Peace River is about 16 miles north and Fairview is about 5 miles north of the northern boundary while Sexsmith is about 10 miles south and Grande Prairie is about 22 miles south of the southern boundary.

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.

The till plain remnants are found neighboring Donnelly, Codesa and Spirit River and they form the Birch and Saddle hills. The highest of these is in the vicinity of Braeburn at an elevation of about 3,150 feet above sea level. The horizontal axis of these remnants lies in an east-west direction. The slopes to the lower lying basin are generally long and fairly uniform but, while those on the south sides rarely exceed 5 percent, some of those on the north side often exceed 10 percent—particularly in the Birch and Saddle hills.

The basin varies in elevation from 1,800 feet to about 2,100 feet above sea level and slopes very gently to the main drainage courses. The lower elevations occur adjacent to the drainage courses. These lower areas are usually characterized by a humpy, variable topography and by materials of alluvial origin. The upper or remaining part of the laking basin has an undulating to depressional topography and extends from the lower slopes of the till plain areas to elevations rarely exceeding 2,100 feet. The main part of the laking basin occurs in the vicinities of Falher, Wanham, Rycroft and Peoria.

The most striking relief features of this area are the deep and wide channels of the Peace and Smoky rivers and their tributaries. The trenches of these rivers vary from one to four miles in width and at Watino and Dunvegan they attain a depth of about 600 feet below the neighboring upland. Many of the tributary streams have cut trenches that are 200 feet to 300 feet deep and over a mile wide. (See Fig. 2 Plate III). Such trenches are often found relatively short distances from the headwaters of these streams.

DRAINAGE

The entire mapped area lies in the drainage basin of the Peace river. This is the largest river in Alberta and it is navigable to river barges for much of its distance. It enters the surveyed area in township 80 range 6 west of the sixth meridian and leaves it in township 80 range 25 west of the fifth meridian. The Smoky river is its largest tributary and joins it about 15 miles north of the mapped area near the town of Peace River. The river bed of the Peace river is in many places about a half mile wide while that of the Smoky river is rarely over a quarter of a mile wide. The Little Smoky joins the Smoky river near Watino. It is the main tributary of the Smoky river and is the only other permanent stream in the mapped area. The remaining tributary streams, shown on the accompanying soil map, are seasonal in character and are often nearly dry during the later summer months.

There are no large fresh water lakes in this area. Lac Magloire north of Falher, and Kakut lake northwest of Heart Valley are both shallow and seasonal in character. They recede during the summer months and in some seasons may be practically dry. (See Plate VIII, Fig. 3)

Depressional, poorly drained areas are very common throughout the surveyed area. Water accumulates in such areas in the spring but by midsummer most of them are fairly dry. Frequently these ill-drained areas have an accumulation of sedge peat that rarely exceeds a depth of 24 inches. The largest of these sedge peat areas are to be found in the area north of Girouxville, south of Culp, and both north and south of Eaglesham.

Poorly drained areas having an accumulation of moss peat and commonly referred to as "muskegs" are of infrequent occurrence in the Rycroft and Watino sheets.

TRANSPORTATION

The main line of the Northern Alberta Railway traverses the central portion of the mapped area and then proceeds south from Rycroft, cutting across the western portion of the area en route to Grande Prairie and Dawson Creek, B.C. The present outlet for the produce of this area is over the Northern Alberta Railway through Edmonton. The shipping distance from Donnelly to Edmonton is 275 miles while that from Spirit River is 362 miles.

The Peace River highway passes through the east side of the surveyed area by way of Donnelly. This highway is gravelled and extends through Fairview. From Fairview the highway to

Grande Prairie is nearly all gravelled and passes through the west side of the area just east of Rycroft. The highway from Donnelly to Dawson Creek, B.C. passes through the centre of the area. As yet, it is gravelled only from Donnelly to Girouxville and from Rycroft to Spirit River. The settled portions of the area are generally well supplied with market roads.

The main river courses can only be crossed by ferry. There are three such crossings in this area: at Dunvegan, Watino, and in section 25, township 75, range 22, west of the fifth meridian. Steel bridges are found only over some of the seasonal stream courses in the western portion of this area.

SETTLEMENT AND AGRICULTURAL DEVELOPMENT

From records supplied by M. H. Long, Dept. of History, University of Alberta, it would appear that Fort Dunvegan was established by A. N. McLeod as a North West trading post in 1805. It served as the main headquarters for the fur traders and missionaries in the northwestern part of Alberta and remained in use until May, 1918. In 1866 Father Tessier established a Catholic mission at Fort Dunvegan and in 1883 Father Grouard built the log buildings and church that still remain at Dunvegan. The Anglican mission was established here in 1883 and the first farming was carried on adjacent to these missions. John Gough Brick's interest and skill in agriculture did much to encourage the development and settlement of this area.

In the Report of the Peace River Region published by the Geological Survey of Canada in 1904, Macoun states that between 1882 and 1887 farming on a small scale was attempted at Waterhole at first by the settlers and afterwards by the Hudson's Bay Company but the efforts were not very successful and were discontinued for some time after 1887. At the time of his visit in 1903 the only settlement of any consequence in the Rycroft and Watino sheets was in the vicinity of Spirit River. About 20 homesteads had been located, mostly along Spirit river and about 200 acres were under cultivation.

The first settlers in this area came in by way of the Athabasca or Grouard trail and the Edson trail. Prior to 1910 the main line of traffic from Edmonton was to Athabasca and then up the Athabasca and Lesser Slave rivers and across Lesser Slave lake to Grouard. Steam boats were used on the Athabasca river and on Lesser Slave lake while scows were used on the Lesser Slave river. Traffic from Grouard to the mapped area was by wagon roads and trails. The main wagon road from Grouard to Peace River passed by the north east corner of the surveyed area.

During the years 1910 to 1912 a trail was cut from Edson to Grande Prairie and made use of extensively by the early settlers, particularly of the western part of the surveyed area. A land office was opened in Grande Prairie in 1911 to facilitate handling the first large influx of settlers.

The major portion of the settlement in this area has taken place since the building of the railroad. Steel was laid into McLennan in March 1915, and extended to Spirit River within a year. During the first few years after this, the increase in settlement was spectacular, particularly in the more open country adjacent to Spirit River, Rycroft, Dunvegan, Wanham, Peoria and Falher. There has been a progressive, though not as rapid, increase in settlement ever since and the movement now is to areas more difficult of access and in which the tree cover is often fairly heavy.

According to the Census of Canada, the population of the entire Peace River region was approximately 3,550 in 1911. By 1912 however the population of the mapped area itself was 3,575. In 1931 this area had a population of approximately 8,750 and by 1941 the population in the Rycroft and Watino sheets had increased to 10,310. In 1946 the population of the incorporated villages in this area was as follows: Falher 279, Rycroft 272, Spirit River 363.

Table 1 gives, in summary, the number of farms, the occupied and the improved acreage in the surveyed area at intervals of time from 1916 to 1941. The data, compiled from the Dominion Census returns, show a very marked increase in the number of farms between the years 1926 and 1931.

TABLE 1.—Number of Farms, Acres Occupied and Acres Improved in the Rycroft and Watino Sheets, 1916-1941.

Year	Number of Farms	Acres Occupied	Acres per Farm	Acres Improved	Percentage of Land Improved
1916	470	106,369	226	17,196	16
1921	978	213,395	218	53,412	25
1926	788	245,618	312	84,913	35
1931	2,433	578,570	238	203,320	35
1936	2,210	582,455	264	243,885	42
1941	2,210	684,827	310	317,624	46

Prior to 1926 most of the settlement was in areas immediately neighboring Spirit River, Rycroft, Dunvegan and Falher. Since then, there has been a marked increase in settlement in the outlying areas. A comparison of the data in column 2 and column 4, of Table 1 would seem to suggest a recurrent cycle of expansion and consolidation. The increase in number of farms was greatest in 1921 and 1931. In 1926 and 1941 however, while the number of farms decreased by about 200, the size of the farm holdings increased appreciably. This might suggest a consolidation of holdings by those farmers remaining in the area. The percentage of improved land increased from 16 percent in 1916 to 46 percent in 1941. The distribution of the improved land in this area at the time of survey is shown on the cultivation map in Plate VI.

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. There has been a steady and very appreciable increase in the acreage devoted to hay crops. Alfalfa and clovers are primarily grown for seed production. Census data for the year 1946 were not available at the time of writing this report. However it is estimated that approximately 7 million pounds of forage seed were shipped out of the Rycroft and Watino area in 1948. Approximately 80 percent of this consisted of clover and alfalfa seed.

TABLE 2.—Total Acreage Cropped and Acreage by Principal Crops in the Rycroft and Watino Sheets 1916-1941.

Year	Total Field Crops ac.	Wheat ac.	Barley ac.	Oats ac.	Rye ac.	Flax ac.	Hay* ac.
1916	13,236	4,292	836	7,702	36	39	127
1921	41,652	9,361	2,655	26,283	265	73	951
1926	61,908	28,070	1,653	26,798	320	1	1,513
1931	148,720	81,419	2,472	59,465	538	—	1,859
1936	155,665	80,200	7,733	55,887	542	55	5,402
1941	202,477	108,705	13,181	61,893	465	3,222	11,471

*Hay includes clovers, alfalfa and all cultivated grasses.

The census returns also show that, while the number of livestock increased as more farms were established, this increase was not proportionate to the rate of land improvement. In 1916 there were 1,947 head of cattle and 2,723 hogs in this area, and by 1936 the numbers had increased to 17,029 for cattle and 12,123 for hogs. However by 1941 the number of cattle had declined to 11,078 while the hog population had practically doubled (24,333). The 1948 shipments however would seem to indicate a very marked drop in hog population.

On the basis of the crop reports for census divisions 15 and 16, the following estimates were made of the average yields for this area: wheat 21 bushels per acre, oats 37 bushels per acre, and barley 25 bushels per acre. These estimates include yields produced on many soil types and under many different types of farm practice. Some of the better soils should give higher yields and many individual farmers have exceeded these averages by a considerable margin.

CLIMATE

Meteorological data compiled from the Dominion Meteorological Records are given in Tables 3 to 6 for two stations in the surveyed area and three stations in adjacent areas. The two stations in the area are located at Rycroft and Dunvegan. In both cases the records may not be indicative of the long term average of the Rycroft and Watino sheets. The record for Rycroft is not long enough to be representative, while that of Dunvegan has been taken on the river flat at an elevation about 700 feet lower than that of the surrounding upland plain. The station at Beaverlodge is located some 50 air miles southwest of Rycroft, the station at Fairview is about 15 miles northeast of Dunvegan and the station at

High Prairie is about 40 miles southeast of Donnelly. The records for Beaverlodge are the most complete and of the longest duration.

Table 3 gives the average monthly, seasonal and annual precipitation at the five recording stations. In this table the year is divided into three sections, namely, the previous fall, winter, and growing season. This is done because it is believed that the moisture of the previous fall and the growing season is closely related to the crop growth obtained, whereas that of the winter months is relatively ineffective insofar as growing crops are concerned, since most of it runs off or evaporates during the spring thaw.

TABLE 3.—Average Precipitation in Inches. Monthly and Seasonal Distribution for Points in or near the Rycroft and Watino Sheets.

	Beaverlodge	Dunvegan	Fairview	High Prairie	Rycroft
Elevation	2,484 ft.	1,305 ft.	2,160 ft.	1,968 ft.	1,983 ft.
Years	1914-40	1883-1940	1932-40	1927-40	1931-36
August	1.73	1.18	2.12	1.96	1.92
September	1.68	1.65	2.00	1.79	2.36
October	1.10	0.85	1.24	1.34	1.29
Previous Fall	4.51	3.68	5.26	5.09	5.57
November	1.18	0.78	1.45	1.15	1.88
December	1.25	1.11	1.34	1.06	1.47
January	1.39	1.14	1.65	1.10	1.77
February	0.82	1.00	1.00	0.63	1.14
March	1.18	0.76	1.08	1.02	1.44
Winter	5.82	4.79	6.52	4.96	7.70
April	0.76	0.60	1.03	1.01	1.37
May	1.59	0.91	1.55	1.70	1.70
June	2.08	2.08	2.45	2.93	3.09
July	2.15	1.95	2.76	3.14	2.73
Growing Season	6.58	5.54	7.79	8.78	8.89
Total	16.91	14.01	19.67	18.83	22.16
% of Total Occurring in Fall and Growing Season	66%	66%	67%	74%	65%

The data in Table 3 indicate an appreciable difference in precipitation between Beaverlodge and Rycroft. However, it must be borne in mind that averages based on records of less than about 25 years duration may not be truly representative of the long time average. Nevertheless, a comparison of the records of Beaverlodge, Fairview and Rycroft shows the following: 65 percent of the average annual precipitation at Beaverlodge, 67 percent at Fairview and 65 percent at Rycroft came in the fall and growing season. Thus it would appear that, while the average annual precipitation in the surveyed area compares favorably with that of such points as Edmonton and Lacombe, the percentage of the total that occurs in the fall and growing season is much less since Edmonton and Lacombe get nearly 80 percent of their precipitation during that time.

At all the stations reported in Table 3, June and July are the months of greatest rainfall. The total for the two-months averages about four to five inches. This is usually sufficient to produce at least a fair crop, provided sufficient moisture has been conserved to carry the crop into June. Moisture can be a limiting factor in crop production in this area, and more attention will have to be paid to conservation measures. Stacey* draws attention to the fact that, at the Experimental Station at Beaverlodge during a 29 year period, the April to August precipitation fell below 7 inches in 8 years and was over 10 inches in only 6 of those 29 years. By comparison, Lacombe has about the same annual precipitation as Beaverlodge, but it gets less snow and 3 inches more of summer precipitation. That extra summer precipitation comes at a very opportune time with the result that moisture is not as limiting a factor to successful crop production at Lacombe as it is at Beaverlodge.

In addition, it would appear that evaporation is slightly higher at Beaverlodge than it is at Lacombe. Stacey* reports that the May to September evaporation at Beaverlodge in a 21 year average is 16.93 inches, whereas that of Lacombe is 15.39 inches. By comparison the evaporation at Lethbridge is reported as 24.60 inches and that at Manyberries 33.17 inches for about the same period.

The average annual snowfall in the mapped area is about 70 inches. The averages of the stations reported in Table 4 vary from a low of 47.1 inches at Dunvegan to a high of 85.8 inches at Rycroft. The longest and probably most representative average would appear to be that of Beaverlodge at 72.9 inches. As will be observed, snow has been recorded at some points in every month except July. The average winter snowfall varies from 42.3 to 70.5 inches. Much of this snow is lost in the spring run-off, particularly on cleared and sloping land, and is relatively ineffective insofar as the growing crops are concerned.

TABLE 4.—Snowfall in Inches. Monthly and Seasonal Distribution for Points in or near the Rycroft and Watino Sheets

Average	Beaverlodge 27 years	Dunvegan 21 years	Fairview 9 years	High Prairie 14 years	Rycroft 6 years
August	0.0	0.0	0.0	0.1	0.0
September	2.9	0.4	4.7	1.4	5.5
October	5.1	2.3	7.5	4.6	6.0
Previous Fall	—— 8.0	—— 2.7	——12.2	—— 6.1	——11.5
November	9.9	6.6	13.0	8.5	15.0
December	11.9	9.4	12.4	9.3	14.3
January	13.7	9.9	16.4	9.7	18.3
February	9.0	8.4	9.8	5.7	10.5
March	11.4	8.0	11.1	9.4	12.4
Winter	——55.9	——42.3	——62.7	——42.6	——70.5
April	5.7	2.0	8.5	4.7	8.8
May	2.3	0.1	0.4	0.5	0.5
June	1.0	0.0	0.2	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0
Growing Season	—— 9.0	—— 2.1	—— 9.1	—— 5.2	—— 9.3
Total	72.9	47.1	84.0	53.9	85.8

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 varies from 32.0°F at Rycroft to 34.4°F and 34.3°F

*Climatic Factors Affecting Crop Production. Sci. Agr. 26: 79:82. 1946.

at High Prairie and Beaverlodge respectively. This variation may be due at least in part to the difference in recording periods. Here, again, Beaverlodge had the longest continuous record and its average of 34.3°F should be fairly representative of the surveyed area. In comparison the yearly mean at Edmonton is 37°F, at Calgary it is 38.9°F and at Lethbridge 41°F. Over most of the surveyed area the mean growing season temperature is about 50°F, while the mean winter temperature is about 12°F.

TABLE 5.—Monthly, Seasonal and Annual Mean Temperatures (Degrees F.) for Points in or near the Rycroft and Watino Sheets

	Average	Beaverlodge 27 years	Dunvegan 21 years	Fairview 9 years	High Prairie 14 years	Rycroft 6 years
August		56.5	58.2	58.2	58.1	57.0
September		48.0	48.2	48.8	48.6	48.5
October		37.0	37.8	37.9	38.2	37.0
Previous Fall		—47.2	—48.1	—48.3	—48.3	—47.5
November		20.5	20.1	20.0	21.6	18.0
December		10.1	4.4	6.8	7.9	4.0
January		7.0	4.7	2.0	5.4	-5.5
February		13.0	3.2	5.4	8.4	4.0
March		21.0	20.4	19.8	20.8	20.0
Winter		—14.3	—10.6	—10.8	—12.8	— 8.1
April		36.9	39.2	37.2	37.8	37.5
May		49.5	50.4	50.6	50.8	48.5
June		55.0	57.5	54.9	55.3	55.5
July		57.0	61.0	60.3	60.4	59.0
Growing Season		—49.6	—52.0	—50.7	—51.1	—50.0
Total		34.3	33.8	33.5	34.4	32.0

Insofar as crop production is concerned, the length of growing season is very important in determining the type of crops that can be grown successfully. 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. However, in general, the length of the frost-free period is 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. Certain low-lying areas often have fall frosts considerably earlier than nearby higher land. Similarly, a dense tree cover that impedes natural air drainage seems to increase the hazards of frost. Table 6 gives the growing season and frost-free period as reported for the stations in or near the surveyed area. The data indicate that it would be reasonable to assume that the average growing season in the surveyed area is about 110 days, while the frost-free period is about 90 days. A thirty-two year average at Edmonton gives a frost-free period of 95 days and it would appear that frost is not much more serious a factor in limiting crop production in the surveyed area than it is at Edmonton.

Out of a possible annual total of approximately 4,500 hours of sunshine, Calgary receives 2,300 hours, Edmonton 2,200 hours, Beaverlodge 2,100 hours and Fort Vermilion about 2,000 hours.

Such a trend seems reasonable and Fairview should be expected to have about 2,100 hours. However, for reasons that are not apparent, the 10 year average at Fairview is only about 1,700 hours. Nevertheless, in view of the much longer record at Beaverlodge, it would appear that the surveyed area would have about 2,100 hours of sunshine per year.

TABLE 6.—Growing Season and Frost Free Period for Points in or near the Rycroft and Watino Sheets

	Years Averaged	Growing Season (days above 29° F)	Frost Free Period (days above 32° F)
Beaverlodge	19	131	96
Dunvegan	13	107	78
Fairview	9	133	108
High Prairie	10	100	81
Rycroft	6	108	83

Wind data for any of the Peace River region are very meagre. Records of wind mileage are available for the years 1932 to 1939 at Fairview and for the years 1936 to 1939 at the Beaverlodge Experimental Station. These records show that at Fairview the total average annual wind mileage is 61,217 miles. About 65 percent of the winds come from a west and southwest direction and May is the windiest month of the year. Winds of gale proportions occur on the average of about twice per year. It is also locally reported that hot dry winds of the Chinook variety occasionally occur in this district. Beaverlodge on the other hand, has a total average annual wind mileage of 79,643 miles with winds of gale proportions occurring about 18 times per year. The wind velocity averages about 8.3 miles per hour and varies from an average of about 7 miles in the winter months to a peak average of 10.5 miles in May at a time when spring seeded crops are most vulnerable. By way of comparison the Lacombe Experimental Station has a total average annual wind mileage of only 43,000 miles and April is the windiest month. Calgary averages about 79,000 miles and the Lethbridge Experimental Station about 104,000 miles per year. Winds in the surveyed area should compare fairly closely with those recorded at Fairview.

VEGETATION

Generally the natural vegetation consists of a mixed tree cover in which aspen poplar is predominant. Balsam poplar, birch, willow, alder, spruce and pine occur either in mixtures or as the dominant cover of local areas. Much of the native cover in this area has been destroyed as the result of both land improvement and unrestricted burning. Prior to the severe fires of the last few years there was sufficient timber in scattered patches throughout this area to supply local demand. Now merchantable stands of spruce and pine occur only as small patches in some of the less severely fire-killed portions of the Birch and Saddle hills and in some of the more remote areas bordering the Peace and Smoky rivers.

In addition to the wooded areas, however, there are fairly extensive parkland areas that consist of woodland bluffs, low shrub cover and varying amounts of open grassland. Such parkland conditions seem to have prevailed in much of the area around Spirit River, Rycroft, Wanham, Heart Valley, Dunvegan and Falher.

The existence of these and other parkland areas within the wooded Peace River region has been a source of major interest for a long time. They were the sites of the berry picking activities of the Cree and Beaver Indians and were commented on by Dawson in the Geological Survey Report of 1879-1880. He believed that they were produced and maintained by fires and that, before the country was inhabited by Indians, they were tree covered like the rest of the area. Preliminary investigations by E. H. Moss, Dept. of Botany, University of Alberta, indicate that the native vegetation of these northern parklands is similar in many respects to that of the foothills and some of the other parklands of Alberta, but that it lacks some of the leading grass species of the latter areas. Further studies will be required to determine the species native to the northern parklands and their relationship to the soils in these areas.

The soil profile that develops in any one place is the result of the influence of a number of factors, one of which is the native vegetative cover. Thus under heavy woods, soils develop the bleached appearance characteristic of grey wooded soils whereas under a grass vegetation a dark soil with a dark surface horizon develops. That is, there is a much greater accumulation of humus under grass than under woods. Degraded black soils are usually found in the transitional belts between the true grassland and woodland areas. It would appear that these soils have been under the influence of tree cover for a much shorter period of time than have the grey wooded soils since they have not had time to lose entirely the black surface horizon that developed under an earlier grass cover.

The occurrence of minor plant associations is very common throughout the wooded area. Such associations are the result of local conditions of climate, soil, topography and drainage. They often serve as good indicators of some of those conditions. For example, areas of sand are generally covered with jackpine, bearberry and blueberry. Salt grass, gumweed and wild barley seem to thrive in saline areas. Willow, scrub birch, black spruce, tamarack, labrador tea, sedges and mosses are moisture-loving and usually occupy low-lying areas that have a restricted drainage. The presence of some of these plants and the relative abundance of others varies with the amount of moisture present. Poorly drained soils having a variable accumulation of sedge peat are of very common occurrence in the surveyed area. Many other examples of such associations or soil-plant relationships will be familiar to those who work with the soils in these areas.

The existence of parkland areas within the wooded region of northern Alberta might be an added example of such an association or relationship. The soils in these parklands are generally dark colored and suggest a long continued dominance of grass cover. They have developed on a heavy somewhat saline parent material and are distinguished by a clay pan that is relatively near the surface. Such a clay pan might tend to be unfavorable to the development of a good tree growth and it is suggested that, as a result, trees never did become well established in such areas. Further studies will be required to determine to what extent such a soil condition might inhibit the growth of trees in these and other similar areas.

GEOLOGY AND PARENT MATERIAL

The uppermost geological deposits constitute the parent materials from which the present day soils are developed. They influence the physical and chemical characteristics of the soil and its fertility. Consequently, a consideration of their origin and a knowledge of their nature is essential in the study of soils.

The surface deposits and surface features of the mapped area are the result of erosion and deposition during 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. The extent and distribution of the various geologic formations in the Rycroft and Watino sheets is shown on the Geological Map in Plate IX and a detailed description of these formations can be found in report number 21 of the Research Council of Alberta titled "Geology and Water Resources in parts of the Peace River and Grande Prairie Districts, Alta." The following excerpts from that report will indicate some of the characteristics of the dominant formations in the surveyed area:

"The lower shale member (of the Smoky River formation) has the greatest aerial distribution at the surface. It occupies broad areas along both sides of the Peace and Smoky valleys, underlying many of the settled districts, and extends down to river level along the Smoky river south and west of Watino. The member consists of thin bedded, dark to black shales with occasional ironstone and pyrite nodules . . . The Bad Heart member consists of a thin lithological unit separating the upper and lower shale members. It consists of medium to coarse grained porous sandstone which is dark red in color . . . The upper shale member is the uppermost marine shale member of the Cretaceous succession in this part of Alberta."

"The Smoky River shales weather readily and where they occur along steep valleys, slides and slumps prevail . . . Decomposition of the pyrite content of these slumped shales gives rise to vapors which condense at the surface, leaving crystalline salts as incrustations which are common along the Smoky river near the mouth of the Little Smoky . . . . Much of the crystalline material appears to be related to the alums and contains a relatively high percentage of magnesium. The water analyses from shale horizons show a high sulfate content and gypsum crystals occur very commonly on exposure of the shales."

"The uppermost formation in this area is the Wapiti . . . It underlies such uplands as the Saddle and Birch hills and these uplands usually present a steeper slope to the north than to the south since the Wapiti beds dip to the south. 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."

During the Pleistocene epoch this region was overridden by an ice sheet advancing from the Keewatin ice centre in the vicinity of the Hudson Bay. In passing over the area, this ice sheet mixed the materials accumulated from the underling 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 portion 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 a much older till.

Three distinct and different glacial deposits were observed in the surveyed area. The lowest of these is exposed in places along the Ksituan creek and at the base of the Saddle hills near Woking. It consists of a dark yellowish brown compacted sandy clay till that is fairly stony. The stones appear to be predominantly granitic and sometimes there is an accumulation of them in the lower portion of the deposit bordering the underlying bedrock. While this till does not appear to form the parent material of any of the soils in this area, it seems to underly some of the eastern and western portions of the area very closely and may be responsible for some of the soil characteristics in these areas.

The second glacial deposit consists of a greyish brown to brown sandy clay till that is somewhat stony, has numerous coal flecks and may be at least partly derived from the Smoky River and Wapiti formations. This till underlies many of the subsequent deposits in the surveyed area and is exposed most extensively in the Birch and Saddle hills. It forms the parent material of the Braeburn and Saddle soils. Outwash deposits of boulders, sand and gravel occur as islands or ridges associated with this deposit, particularly in the eastern part of the area both north and south of Donnelly. Near the crown of the Saddle hills however, in section 7, township 75, range 5, west of the sixth meridian, there is a gravelly deposit in which the stones are predominantly quartzites and which contains an 18 inch layer of what appears to be bentonite. This deposit is not characteristic of the glacial or more recent deposits in this area, but appears to resemble the Tertiary deposits that cap the Cypress hills in the southeastern part of Alberta.

The third glacial deposit, frequently lying immediately above the preceding ones, consists of a well sorted, stratified till or modified lacustrine material. It is a dark greyish brown clay that has few stones, numerous gypsum crystals and appears to be derived 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 during the retreat of an ice front. It forms the parent material of the Donnelly, Esher and Landry soils, and occurs on the lower slopes of the till plain remnants at elevations that are often several hundred feet higher than those of the lacustrine basin.

In the laking basin below the 2,100 foot contour the soils' parent materials may be of post-glacial origin. The lacustrine grey to dark grey heavy clays are found in the upper part of this basin at elevations from about 1,900 to 2,100 feet. They are stone free, waxy heavy clays that appear to be derived from the Smoky River shale. Except for the fact that these clays are stone free and somewhat darker colored, they differ very little from the previously described clays. However the occurrence of ill-defined beaches would seem to suggest that this lacustrine deposit was laid down much more recently and may be the result of a reworking of the former parent material. The Rycroft, Falher, Nampa and Prestville soils are developed on this dark, somewhat saline lacustrine parent material.

At elevations usually below the 1,900 foot contour and particularly in the areas bordering the major stream courses the parent materials are brownish colored and appear to be of alluvial origin. In some cases these silty and sandy materials appear to have been reworked by wind. The Judah, Davis, Culp and other related soils are formed on this type of parent material.

In addition there are other types of parent material that are important in relatively small local areas. These are the gravelly outwash materials found in association with some of the areas of greyish brown till, 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 has continued since glacial time and is continuing at the present time. Perhaps the most striking result of post-glacial erosion in this area is the deep dissection of the broad, nearly flat, areas formed as the result of glacial laking. This dissection has been deepest along the valleys of the major streams where, in addition to cutting through the comparatively soft deposits, the streams have deepened their channels into the underlying bedrock formations. Landslides and slumps have followed in the wake of this dissection to produce relatively wide rough areas bordering the stream courses. The eroded materials were carried down the stream courses and partly redeposited in favored locations bordering the stream channels. Such a sorting and redeposition may have been responsible for the parent materials of the brownish colored sandy and silty soils that are found adjacent to the Peace and Smoky rivers. Much more recent examples of this type of redeposition are to be found on the river flats and terraces, the largest of which occur at Watino.

There is apparently a great variation in the total depth of the surface deposits remaining in this area. Well-log reports would seem to indicate a depth exceeding several hundred feet in the vicinities of Falher and Rycroft. However, in the slight ridges just south of Codesa, Wanham and Spirit River, bedrock may be seen at or near the surface. Similarly it would appear that bedrock is very close to the surface in the vicinities of Kakut lake, Heart Valley and Bad Heart.

The depths of the different types of surface deposits are also extremely variable. The greyish brown till deposit is probably deepest on the Birch and Saddle hills. In some places recent road cuts indicate a depth of till that is in excess of 25 feet. The stratified till or modified lacustrine material appears to be fairly shallow. Near Esher and Donnelly it rarely exceeds a depth of 10 feet, while in many of the gently sloping areas the underlying greyish brown till may be found close to or exposed at the surface. The dark colored lacustrine clay deposit rarely exceeds depths of about 15 feet in the vicinities of Falher and Rycroft. However just east of Donnelly the underlying till is often found within 24 inches of the surface. The brownish colored silty and sandy deposits, adjacent to the Peace and Smoky rivers, are underlain at variable depths either by till or by dark grey heavy clay. In some places the dark clay is very close to the surface and forms the parent material of those soils formed in the lower positions of these areas.

AGRICULTURAL PROBLEMS

Land Development: Tree cover is the major impediment to land development in this area. Until fairly recently it has been necessary for the settlers to resort to slow laborious hand methods and burning to remove the tree cover. By this means the average settler was seldom able to develop more than about five acres per year. Furthermore, the fires all too often got out of control and destroyed much valuable cover and timber.

With the introduction of adaptable power equipment, methods are being developed to bring about a rapid, efficient and inexpensive improvement of bush lands. Clearing by crawler tractor equipment is becoming the full time occupation of many operators within this area. Since power equipment has made the clearing of large tracts of bush land relatively easy there is a growing tendency toward the indiscriminate removal of tree cover. Such removal has little more to commend it than uncontrolled burning. Fairly wide strips of undisturbed cover should be left adjacent to lake beds, along the banks of stream courses, bordering the road allowances and at least up the middle of each section so that the westerly winds cannot have a clear sweep of the area. Wherever possible additional woodlots should be left to serve as future sources of firewood or as watersheds for farm reservoirs. Due regard is being given to these considerations in clearing the area set aside by the Alberta Government for the settlement of veterans. That area lies between Wanham and Tangent and is principally north of the railroad. (See Plate VI and Plate IV, Fig. 2 and Fig. 3).

The costs of clearing, piling and breaking vary with the size and density of the tree cover, the size of the equipment and the efficiency of the operator. The custom charges in 1948 averaged about 16 dollars per hour for clearing and piling and about 9 dollars per acre for breaking. Fairly open 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 heavy tree cover the rate of clearing may not exceed 1 acre per hour. In connection with most custom work, the settler himself assumes the task of burning the slashed tree cover and preparing the land for crop after breaking.

Water Supply: Throughout much of this area the difficulties experienced in obtaining a suitable water supply have long been a matter of grave concern. Dr. R. L. Rutherford's study as reported in Research Council Report No. 21 was made in order to obtain data on the possible underground water resources in this and adjacent areas. Although he found that the probability of obtaining well water was good in the vicinities of the Birch and Saddle Hills and in the Peoria district, many of the wells have gone dry in the last few years. This has probably been due to the removal of tree cover by fires in the Birch and Saddle hills. Elsewhere in the area he found that the probability of obtaining water from shallow wells was very remote, and that the water resources of the area could only be determined by drilling test holes to depths often exceeding 1,000 feet.

Drilling deep wells in any area is a hazardous undertaking unless there is reason to hope for an artesian water supply. Pending further exploration, there seems to be no such assurance in this area even though there is a flowing well in the Whitemud district south of the Little Smoky river. As a result most of the settlers have had to resort to the construction of dams or dugouts to provide themselves with a water supply. (See Plate IV, Fig. 1). When they are of an adequate size and properly looked after, these dugouts and dams seem to be satisfactory sources of water supply.

Throughout this area the amount of spring run-off is generally adequate to fill up the dugouts providing that some care has been taken in selecting suitable sites. Engineering advice and assistance such as that provided by the P.F.R.A. in southern Alberta, would be of great help in properly locating these dugouts.

Farmers within this area, complying with the requirements as set out by the Alberta Department of Agriculture, may be assisted in the construction of dugouts by means of a subsidy. The requirements, plans of dugouts and filter trenches are discussed in that department's publication, "Peace River District Farm Water Supply Assistance Policy."

Soil Conservation: One of the major agricultural problems is that of conserving our soil resources. 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 distribution of soils. However in this area the depth and width of the many coulees would seem to indicate that normal erosion has been unusually severe due, probably, to a lack of adequate vegetative protection. This should serve as a warning, for if man disturbs the balance of nature by cultivating the land, he exposes the soil to the abrasive action of wind and water and thereby materially increases the likelihood of soil displacement. Unless adequate measures are taken to guard against abnormal, highly acclerated soil erosion, it frequently becomes the most potent single factor contributing to the deterioration of productive land.

In the surveyed area most of the native cover has been destroyed by fire. In fact in many of the settled parts of the area firewood has become a scarce commodity. As a result there is nothing left to check the sudden melting and run-off of snow in the spring nor the sweep of the prevailing westerly winds. Without the regulating effect of tree cover many of the streams and lakes flood in the spring and become practically dry by mid-summer. Every effort should be made to protect or re-establish tree cover in areas recommended to be withheld from settlement. In addition all farmed land should have adequate windbreaks. These should be re-established in the settled areas and conserved in the newer areas that are being developed.

In Alberta, soils developed under a woodland vegetation are generally low in plant fibre, humus and nitrogen. It is not possible to maintain an adequate supply of fibre and humus in these soils by growing cereal crops year after year on the same ground. In the wake of the decline of fibre and humus follow surface run-off, erosion, poor tilth, inadequate supplies of plant food and poor crops. Grasses will add fibre while legumes will also add nitrogen to the soil and provide the best source of supply for humus.

Organic matter consists of plant and animal residues whereas humus is produced as the result of the decay of these residues.

During the summer months this decay is quite rapid and most of the products of decay are lost into the air. Only a very small proportion of the organic matter is left in the soil in the more permanent form known as humus. 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. More humus is produced from materials rich in nitrogen than from those with a low content of nitrogen. That is, more humus will be produced from the rotting of one ton of legume residue than from one ton of wheat straw. However, since plowing and cultivation speeds up the loss of organic matter, a continuous systematic return of all available residue is necessary to maintain an adequate supply of humus in the soil.

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 or eliminate soil losses due to water erosion. Organic matter acts much like a sponge in soaking up water, and maintaining a good supply of organic matter will do much towards making the best use of all available moisture. Similarly, soils that are well supplied with fibre and have good crumb structure are less likely to drift. As indicated in a previous section of this report the wind velocities in this area tend to be high particularly in the early spring and late fall months when the cropped areas have very little protective cover. As a result, soil drifting is becoming increasingly serious in many parts of the surveyed area and steps must be taken to curtail further serious losses.

Experimental work to determine the best methods of maintaining or improving the fertility of the soils, and constant attention to conservation measures are of paramount importance in developing a permanent and profitable agriculture in this area. In a following part of this report, dealing with descriptions of various soils mapped in the Rycroft and Watino sheets, attention will be drawn to considerations that are believed pertinent to the development of good farm management practices on the soils of this area.

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 more finely divided condition. Percolating rains carry down the soluble and finely divided materials and redeposit them at lower depths. Concurrent with this there is a return of plant foods 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 in the surface, giving it a dark color. This humus decays and liberates plant foods that may be carried down by the percolating rain 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.

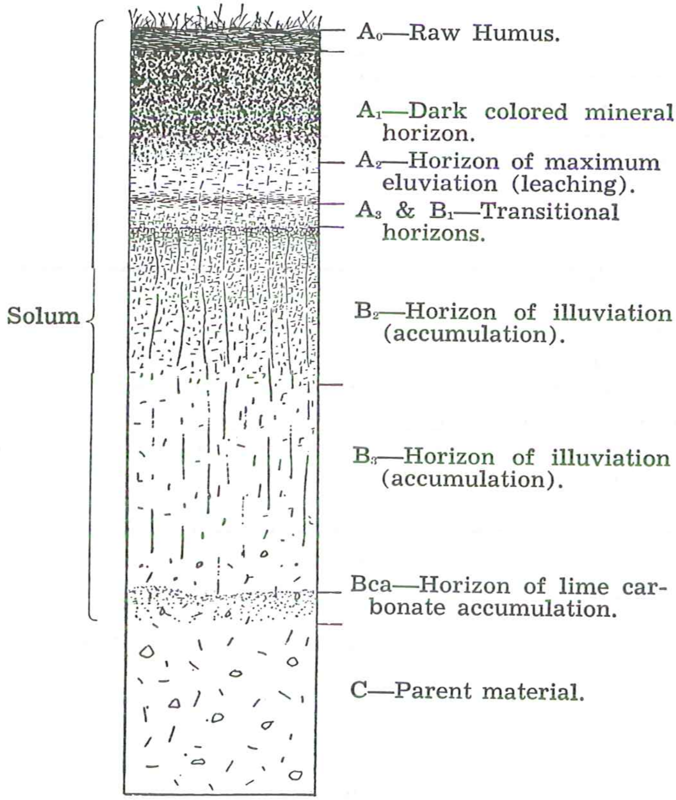
The characteristics that a soil acquires, as the result of the interaction of the various soil forming factors, are reflected in the development of more or less distinct layers or horizons. A cross section of these horizons from the surface to the relatively unaltered parent material is known as a soil profile. 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. Since one or more of these factors may change from place to place, a great number of different soil profiles is developed.

A schematic picture of a soil profile, together with the names of the various horizons is given in Plate II. The A horizons are the portions 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 horizons are the portions 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 which lies in contact with the soil above.

If the profile is underlaid by geological material which is different from that in which the solum has formed, it is designated as the D horizon. These horizons may be further subdivided into A_1, A_2, A_3, B_1, B_2, B_3, etc. depending on differences in the degree of removal and the type of accumulation.

In the Rycroft and Watino sheets the soils have developed under climatic conditions that are favorable to the growth of a woodland vegetation. The accumulated forest litter decomposes slowly and accumulates on the surface. The decomposition pro-

PLATE II



Note:—The above is a schematic drawing of a soil profile. (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.

action and cause the soluble bases such as lime, potash, magnesia and, to a lesser extent, iron and alumina to be leached from the upper horizons. Under the humid conditions prevailing in wooded areas there is a leaching of the mineral and organic constituents and much of the A horizon develops a light-colored ash-like appearance. This appearance is typical of grey-wooded soils. The horizon of maximum leaching (A$_2$) is generally not as well developed nor as deep in the grey wooded soils of this area as it is in some of those found in other parts of Alberta. This may be due to the generally heavy parent material prevailing in this area. Furthermore, those soils developed on the brown silty and sandy materials adjacent to the Peace and Smoky rivers have a very distinct brown color in their surface horizons not unlike that of some of the soils described in eastern Canada.

In addition to those soils developed under a woodland vegetation there are rather extensive areas of darker colored soils resembling those developed under a grass vegetation. Under grass, the decomposition products are commonly basic in reaction, the soil climate is often less humid and there is less tendency for the organic and mineral constituents to be leached out of the surface horizons. These dark colored soils occur in relatively large areas and as small patches intimately associated with grey wooded soils. The reasons for their occurrence in areas that are predominantly wooded are not entirely apparent. As already mentioned, the nature of the parent material or repeated removal of tree cover by fires may be responsible for what appears to be a long continued absence of tree cover. Further study will be required to assess the relative importance of these factors in the development of the northern parkland areas.

Drainage is also an important factor affecting the development of soils in the surveyed area. Under conditions of poor drainage the high water table limits the penetration of air through the soil and restricts the occurrence of living organisms in the soil. Because of these restrictions much of the organic matter accumulates at the surface in a raw state. The subsoil becomes discolored and may show rusty, black or bluish mottling. Such soils, characterized by an accumulation of sedge peat, are of very common occurrence in this area.

The degree of maturity attained by soils varies with the length of time during which they have supported plant growth. The oldest soils in this area are those that have developed on the glacial deposits. Those of intermediate age occur on the higher river terraces while the youngest are developed on the more recent materials deposited on the river flats.

All of these factors help to determine the type of profile that is formed. Each profile has its own specific characteristics and offers its own agricultural problems and potentialities. The following summary shows the relation of some of the soil-forming factors to the principal profile types found in the Rycroft and Watino sheets.

A. Vegetation and Relief

1. Well drained to moderately well drained topographic positions

(a) *Grey Wooded Soils*: Developed under a mixed deciduous and evergreen woodland vegetation and consist of profiles that are characterized by a thin or absent 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. This group of soils may be subdivided on the basis of the color and development of the A and B horizons.

(b) *Degraded Black Soils*: Developed in areas in which the woodland vegetation has not been as dense nor as well established as in the grey wooded areas. The profile has a dark grey to brown A_1 horizon that is well developed and usually several inches thick. The underlying A_2 horizon is light grey to greyish brown in color and rarely exceeds a thickness of six inches in this area. The B horizon is generally of a nuciform structure and lime carbonate is usually present in the lower part of this horizon. Differences in color and development of the horizons are used as a basis of separating profile types.

(c) *Black Soils*: Developed on non-saline parent materials in areas characterized by a long continued absence of tree cover. The profile has a very dark brown to black A horizon and depending on the nature of the parent material, a prismatic or granular structure in the B horizon. The lower portion of the B horizon has a lime carbonate accumulation. Such soils are of infrequent occurrence in this area.

2. Moderately well drained to poorly drained topographic positions

(a) *Depression Podsol*: Usually found on the ill-drained depressions and characterized by a profile in which there is a thick, grey A_2 horizon and a heavy "sticky" B horizon. Rusty streaks are often found throughout the profile.

(b) *Organic Soils*: These soils have an accumulation of organic material (peat) overlying a mottled and often rusty streaked mineral subsoil. Their profiles are identified by the depth and nature of the peat accumulation. Thin peat soils usually have less than 12 inches of peat and are frequently subdivided on the basis of differences in the underlying mineral subsoil. Thick peat soils are 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 as *sedge peat* or *moss peat soils.*

B. Nature of Parent Material

Parent material exerts a very marked effect on the type of profile that is developed in any region. It usually modifies and sometimes dominates other soil forming factors. The "off-types" referred to in the discussion of grey wooded and degraded black soils are often the result of parent material differences. The following profile types are believed the result of the predominating influence of a saline to somewhat saline parent material.

(a) *Solonetz*: Profile usually found on saline parent material in areas of somewhat impeded drainage. It may occur as the dominant profile of fairly large areas or in association with other degraded black or black soils. The profile has 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. Lime carbonate and salts are usually present in the lower part of the B horizon.

(b) *Solodized Solonetz*: Similar to the previous profile except that the upper part of the B horizon is not as hard and there is usually a moderately well developed, grey A_2 horizon. The lower B horizons are often much more friable than the upper and lime carbonate and salt accumulations are common in the lower part of the solum. This profile may have a grey, grey-black or black surface and is of extensive occurrence in this area.

(c) *Solod*: Profile usually found in the moderately well drained topographic position. It may or may not be related to the two previously described profiles. The parent material is somewhat saline and the profile appears to be a remnant of a solodized solonetz profile. It generally has a fairly thick A horizon of which the grey, platy A_2 horizon is usually well developed. There is often a yellowish brown A_3 or B_1 horizon that consists of blocky to nuciform aggregates while the darker colored B_2 horizon is friable and has a small blocky to nuciform structure. It occurs in the grey wooded, degraded black and black soil areas.

SOIL CLASSIFICATION AND MAPPING

Soil classification is concerned with the identification and description of soil profiles together with the determination of their genetic relationships. Soil mapping, on the other hand, involves the determination of the area and extent of those soils characterized by similar profiles. Subsequent groupings can be made to show similarities relating to parent material, drainage, topography, land use, etc.

In any one zone, parent material and position are generally the most important factors affecting the development of soils. Soils formed on similar parent material have certain common inherited characteristics. They usually form a specific landscape pattern in which positional differences largely determine the kind of profile that has developed on that parent material. Groups of soils developed on similar parent material are called "soil catenas", whereas the individual soils which make up that catena are called "soil series." The various soil series are the result of a variety of local environmental factors that affect drainage, temperature, moisture relationships, vegetation, etc., and give rise to differences in color, depth and structure of the profile. The number of soil series that are shown on the soil map is governed largely by the detail of mapping.

Further separations, based on the texture of the surface soil or A horizon are called "soil classes." The class name of the soil texture, such as loam or clay, is often added to the series name to give the complete name of that soil. However, soils developed on similar parent material usually have a narrow range of texture and further separations into soil classes are often unnecessary.

External characteristics and variations that have importance from the standpoint of land use are known as "phases". They involve such features as gravel, stoniness, topography, etc., and are often indicated by the use of descriptive terms following the series name.

Soil series are given convenient geographic names taken from the localities in which they are found. These include the names of rivers, lakes, towns and districts.

The soils of the Rycroft and Watino sheets were classified and grouped according to the scheme outlined in Table 7. The dominant profiles developed on each type of parent material were given soil series names. While the range in texture is indicated for each soil series, further separation into soil classes was not made in this area. Much additional study is required to determine the relationship of some of the processes of soil formation and to differentiate between some of the parent materials in this area. For example, the differences between the modified lacustrine and lacustrine parent material may not be sufficiently significant to merit the separation. Similarly it is very difficult to assess the relative importance of the solodic and the podsolic soil forming processes in this area. Both result in the development of a leached A_2 horizon. It is assumed that a greying of the upper part of the A_1 horizon is indicative of podsolic degradation while a greying of only the lower part of the A_1 horizon indicates solodic degradation. In the classification adopted (Table 7), solod and solodized solonetz profiles are subdivided according to the color and development of their A_1 horizons. In this respect they resemble other black, degraded black and grey wooded soils and they are classified accordingly. Furthermore, it is assumed that the clay-pan characteristics of these soils are the result of the solodic process and not the result of normal soil development on a heavy parent material. Thus, as knowledge of the soils in this area increases, it is quite probable that numerous adjustments may have to be made in this classification scheme.

Five topography phases were mapped in the surveyed area and supplementary notes were made on the direction and degree of slope. Since the completion of field work a new topography classification has been recommended by the National Soil Survey Committee. In that recommendation slopes are classified as Simple or Complex depending on their uniformity. The first category consists of smooth slopes which are subdivided into 7 types ranging from level to very steeply sloping, while the second category consists of irregular slopes that are subdivided in a similar manner.

Each of the 7 types is assigned a range in percentage of slope. While the supplementary field notes give this information for many of the areas outlined on the soil map, most of the mapped area was not done in sufficient detail to permit the use of this new system of classification. However, the 7 recommended slope groups and their relation to the descriptive terms used in this report are given in Table 7. The overlapping indicates the range of slopes found in the topography phases outlined on the soil map.

Approximately 46 percent of the entire mapped area is classed as level to undulating. It consists of predominantly smooth slopes rarely exceeding 1 percent. Much of the area has a "wavy" appearance and consists of long smooth slopes broken at infrequent intervals by minor irregularities whose slopes do not exceed 2 percent.

The gently rolling areas are generally more irregular and frequently 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 the area in and adjoining the Birch and Saddle hills. Gently rolling land covers about 26 percent of the total area.

Rolling land covers approximately 15 percent of the total area. If other conditions are favorable, rolling land is considered as arable. Much of the area indicated as rolling consists of low choppy humps whose slopes are between 8 and 15 percent. Such variably choppy topography is common in many of the areas neighboring the Peace and Smoky rivers. Included in this class are those portions of areas whose long uniform slopes have a gradient of between 6 and 15 percent.

Hilly land makes up only 1 percent of the mapped area. It occurs in some of the northern portions of the Birch and Saddle hills and consists of the steepest slopes of those hills. Both uniform and irregular slopes exceed 15 percent and such areas are considered as non-arable.

Eroded land makes up about 12 percent of the mapped area. It consists of the rough land, with variable slopes, that borders and forms the valley banks of stream courses.

The soil map is colored on the basis of similar parent material and the soil series developed on that material are indicated in different shades of that color. Areas consisting of more than one soil series receive the color of the dominant series. Organic soils are indicated both by color and by the use of symbols. Color is used to designate only those organic soil areas that were outlined and separated. The many small areas whose boundaries were not determined are indicated by symbols to suggest the relative distribution of organic soils in the area. A hatchured legend is used to designate the topography phases while the eroded land is indicated by a solid color.

Rarely does one soil series occur to the practical exclusion of all other soil series. Soils having different profile types occur in very close association throughout most of this 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. Rycroft, Falher and Nampa 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 practicable or possible on the scale of mapping used in this survey. Thus, most of the soil areas outlined on the soil map consist of mixtures of two or more soil series. The first named is predominant particularly with reference to the color of the surface horizons. In naming the soil areas, only the dominant soil series are indicated and no consideration is given to those that make up less than about 25 percent of the mapped areas.

Table 7—Classification of Soils in the Rycroft and Watino Sheets

A. Soils developed on glacial till:

(a) Braeburn—grey wooded, loam to heavy loam.
(b) Saddle—degraded black, solod, loam to heavy loam.

B. Soils developed on stratified till or modified lacustrine material:

(a) Donnelly—grey wooded, solodized, heavy loam to clay loam.
(b) Esher—degraded black, solod to solodized solonetz, heavy loam to clay loam.
(c) Landry—black, solod to solodized solonetz, silt loam to clay loam.

C. Soils developed on lacustrine deposited material:

(a) Nampa—grey wooded, solodized, heavy loam to clay loam.
(b) Falher—degraded black, solodized solonetz, silty loam to clay loam.
(c) Rycroft—black, solodized solonetz, silt loam to clay loam.
(d) Prestville—thin peat.

D. Soils developed on alluvial-lacustrine deposited material:

(a) Judah—degraded black or brown forest, granular, silt loam to clay loam.
(b) Bronco—black, granular, silt loam to silty clay loam.
(c) Wanham—depression podsol.

E. Soils developed on alluvial and aeolian deposited materials:

1. Calcareous, variable silty parent material that has occasional sandy strata.
   (a) Davis—grey wooded, loam to silt loam.
   (b) Tangent—degraded black loam or brown forest silty loam to silty clay loam.
2. Calcareous, variable sandy parent material that has occasional sandy clay strata.
   (a) Culp—grey wooded, loamy sand to sandy loam.
   (b) Leith—degraded black, loamy sand to sandy loam.
3. Sand—not differentiated as to profile type or series.

F. Soils developed on alluvial deposited materials:

(a) Spirit River—black, weakly structured, sandy loam to silt loam.
(b) Alluvium—undifferentiated recent river deposits.

G. Soils developed on coarse outwash materials:

(a) Clouston—grey wooded, gravelly or stony, loamy sand to sandy loam.

H. Soils developed on relatively thin alluvial deposits that overlie other heavier textured deposits:

1. Fairly uniform sandy or silty material overlying stratified till or lacustrine deposits.
   (a) Peoria—degraded black to black sandy loam to silt loam.
2. Variable sandy to silty shore line material that may contain gravel lenses and stones, overlying till or stratified till.
   (a) Codesa—grey wooded sandy loam to loam.
   (b) Belloy—degraded black to black sandy loam to silt loam.

I. Soils developed on relatively undisturbed residual materials:

1. Reddish brown sandstone:
   (a) Rahab—reddish brown, lithosol.
2. Saline, sandy shale:
   (a) Kavanagh—degraded black to black, solonetz, loam to heavy loam.

J. Organic soils:

(a) Eaglesham—sedge peat soils.
(b) Kenzie—moss peat soils

Topography Phases

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

SOIL SURVEY METHODS

The soil survey of the Rycroft and Watino Sheets was 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 the traverse interval and the route was very irregular and the information thus obtained was of an exploratory nature.

Test holes were dug at frequent intervals in order to determine the texture, color, depth and structure of the various horizons. Wherever possible, cutbanks, dugouts and other excavations were examined to determine the characteristics of the parent materials. Additional notes were made on the nature and density of cover, stones, drainage, the approximate acreage under cultivation and the topography and direction of slope. The soil boundaries were determined from the information gained at the test holes and from observations of the physical features of the land. After the boundaries of the various soil areas had been established, samples representative of the larger areas were collected and brought to the laboratory for analysis.

During the survey of this area, aerial photographs were made available through the courtesy of the Dominion Experimental Farms Service. These photos have been used extensively not only in checking completed areas but also as a very helpful aid in surveying new areas. Eroded land, tree cover, cultivated areas and areas of peat soils were outlined from the photographs and then checked at the time of survey.

In a survey carried out in this manner and recorded finally on a map of the scale of three miles to the inch, small areas cannot always be accurately established. In the accessible portions further inspection should be made in determining the soil types on individual quarter sections. In the more remote parts, that were done by saddle horse, the soil boundaries are conjectured and the areas should be re-examined as soon as conditions warrant. The conjectured soil boundaries are differentiated on the soil map by broken lines and should not be confused with those that are fairly well established.

DESCRIPTION OF SOILS

A. Soils Developed on Glacial Till

The upper till in the Rycroft and Watino Sheets consists of greyish brown to brown, fairly uniform material that appears to be derived largely from the Wapiti and Smoky River formations. It has some stones, occasional coal flecks, and its texture is dominantly a clay loam. It occurs in the "upland" portions of the mapped area and consists of the erosional remnants of what may have been a former till plain. On the east side of the mapped area the till deposits occur at elevations that are from 50 to 200 feet higher than the surrounding basin, while in the Saddle hills, near Braeburn, they are about 1,200 feet higher. Except for some portions of the Birch and Saddle hills, the slopes from these upland areas are generally long and uniform and rarely exceed a gradient of 8 percent. At the lower elevations this till deposit underlies the brownish grey modified lacustrine material. The depth to the till, in these lower areas, is very variable and in some places it is exposed at the surface. This patchy occurrence of till is quite common and the soils, in such areas, are developed on mixed parent materials.

The dominant soils formed on this till deposit are those of the Braeburn and Saddle series. However, associated with them are soils formed in the depressional areas and sedge or moss peat soils. In addition soils of the Donnelly and Esher series are often found in close association with those of the Braeburn and Saddle series. The following is a description of the dominant soil series formed on the glacial till in this area:

(a) Braeburn Series: (Grey wooded loam to heavy loam)

Soils of the Braeburn series predominate on about 228,000 acres of the mapped area. They occur at the higher elevations of the eastern and southwestern portions of the area, and appear to have developed under a fairly heavy tree cover consisting chiefly of aspen poplar and spruce with some pine, birch and occasional balsam. Fire has destroyed this cover in all but some sheltered portions of the Birch and Saddle hills. While most of the Braeburn soil areas have an undulating to gently rolling topography, some of the slopes from the crowns are quite steep and variable. These are indicated on the accompanying soil map.

Braeburn soils are fairly well drained, grey wooded soils that 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 found at depths of 36 to 48 inches below the surface. Stones are found throughout the profile but, although significant, they do not usually occur in sufficient numbers to be an undue obstruction to cultivation. The stones are chiefly granites and quartzites and vary in size from small pebbles to large boulders. The following is a generalized description of a Braeburn soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 1½	Dark greyish brown to very dark brown decomposed and semi-decomposed leaf litter. pH 6.6 to 7.0
A_1	1½ - 2	Greyish brown loam with little well defined 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. It is friable and has a fairly well developed platy structure. pH 5.8 to 6.2
A_3	6 - 8	Yellowish brown silt loam. It is fairly loose and often has a well developed vesicular nuciform structure. pH 5.2 to 5.8
B_2	8 - 14	Dark yellowish brown clay loam to clay—weakly columnar, nuciform. pH 5.0 to 5.3
B_3	14 - 34	Dark yellowish brown to greyish brown loam to clay loam that has occasional streaks or pockets of sandy loam or silty clay loam. It is fairly loose and has a nuciform structure. The aggregates are smaller than in the B_2 horizon and frequently contain imbedded coal flecks. pH 5.8 to 7.0
Bca	34 - 40	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	40 -	Greyish brown to yellowish brown clay loam till. pH 7.8 to 8.2

Stones of varying size are present in all horizons. On cultivation the surface soil is a greyish brown to yellowish brown color and tends to bake and crust on exposure.

Agricultural Use: Exclusive of the steepest and roughest phases, Braeburn soils are generally fair to fairly good arable soils. Only a very small proportion of them is being farmed at the present time. This may be due to the fact that until fairly recently the Braeburn soil areas have had a fairly heavy tree cover. However, even with much of that cover destroyed by fire, it would seem desirable to withhold from settlement the crowns and upper slopes of such portions of the Braeburn areas as the Birch and Saddle hills. If these areas were protected and reforested they would eventually supply good timber and aid in replenishing the dwindling ground water supply of the neighboring areas.

Braeburn soils are relatively low in natural fertility. As a result of the leaching process, by which these soils have formed, many of the soluble plant foods have been removed from the upper horizons and redeposited in the lower horizons. Consequently the B horizons are generally better supplied with mineral plant food elements than are the A horizons. Furthermore, the organic material developed under a woodland vegetation is not as fibrous nor as stable as that developed under grass cover.

The addition of organic matter and the return of deficient plant food elements are therefore the prime requirements associated with the successful cropping of Braeburn soils. Crop rotations that include grasses and legumes will help fulfill these requirements. In addition, present information indicates that occasional supplementary applications of commercial fertilizers are proving beneficial. More field trials are needed to determine the fertility requirements of Braeburn soils. However, they are adequately drained soils and their subsoils are generally fairly well supplied with most of the required plant food elements. Consequently they should respond very favorably to good management practices.

(b) Saddle Series: (Degraded black loam to heavy loam)

Soils of the Saddle series predominate in about 12,000 acres of the mapped area. They occur on some of the lower slopes and on some of the isolated remnants of the till plain. On the lower slopes they frequently occur in association with Esher and other soils but they are not often predominant in such areas. They are also found in association with Braeburn soils in some of the more sparsely wooded portions of the area.

Saddle soils are fairly well drained, degraded black soils that have a well developed dark colored A_1 horizon, a yellowish brown A_2 horizon that is rarely more than 6 inches thick, and a yellowish to greyish brown B horizon that is often fairly compact in the upper 6 inches. Stones are found throughout the profile but rarely occur in sufficient numbers to be an undue impediment to cultivation.

The following is a description of a Saddle soil profile. It is a solodic profile.

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown to black leaf litter. pH 7.0
A_{11}	1 - 5	Dark brown to black loam, weakly prismatic, crushes easily to small crumbs. pH 6.0
A_{12}	5 - 7	Greyish brown loam, weakly prismatic. pH 5.5
A_2	7 - 10	Yellowish brown very fine sandy loam, platy in the upper 2 inches to vesicular nuciform in the lower 1 inch. pH 5.3
$A_3(B_1)$	10 - 12	Yellowish brown clay loam, vesicular, nuciform. Aggregates occur in clusters and may be tops of old columns. pH 4.5
B_2	12 - 18	Dark yellowish brown clay to clay loam, weakly columnar, nuciform to blocky, firm. pH 4.8
B_3	18 - 30	Dark yellowish brown to brown clay loam, weakly prismatic nuciform to blocky, friable. pH 6.5
Bca	30 - 36	Brown to greyish brown clay loam, small nuciform to blocky, friable, medium lime content. pH 7.8
C	36 -	Greyish brown clay loam till. pH 7.8

On cultivation the surface soil is greyish brown to dark greyish brown in color.

Agricultural Use: Saddle soils have a higher native fertility and as a result are more desirable for agricultural purposes. However, every precaution should be taken to see that their native productivity is maintained. These soils are adapted to a mixed farming agriculture and the common practice of cereal-fallow rotation should not be continued.

B. Soils Developed on Stratified Till or Modified Lacustrine Material

This material consists of a dark greyish brown, fairly uniform clay deposit that appears to be derived largely from the Smoky River formation. Further study is required to determine its mode of deposition and its relation to the till and lacustrine deposits in this area. It is very similar to the lacustrine deposited material except that it is somewhat browner, less compact and has a few stones. The parent material is stratified and frequently the yellowish brown, sandy clay to clay loam strata are quite stony. The stones are usually small and predominantly granitic. Variable depths of this deposit overlie the lower slopes of the till plain remnants at elevations ranging from 2,100 feet to about 2,400 feet in the eastern part and up to about 2,600 feet in the western part of the mapped area. In addition, similar, highly sorted and often stratified deposits are found in many of the small, low-lying basins that occur in the previously described till areas. The soils formed on this parent material may merge gradually with those formed on till or lacustrine materials 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 three dominant soil series formed on this stratifeid till or modified lacustrine material:

(a) Donnelly Series: (Grey wooded heavy loam to clay loam)

Soils of this series predominate in about 98,000 acres of the mapped area. No estimate is made of the extent of their occurrence in the many areas in which they are not predominant. They occur adjacent to or in association with the till areas in the eastern and western portions of the mapped area, and are found on level to undulating and depressional topography. The native cover appears to have consisted of aspen poplar in which there were variable proportions of black poplar, spruce, willow, alder, birch and various shrubs. Much of this cover is removed as the result of agricultural development or destroyed by fires.

Donnelly soils are imperfectly or somewhat poorly drained soils. They have a grey, solodized profile in which there is a thin or absent A_1 horizon, a grey A_2 horizon seldom exceeding a thickness of about 4 inches and a grey to greyish brown nuciform AB or B_1 horizon. The remainder of the solum consists of a dark yellowish brown to dark greyish brown clay that is fairly compact, nuciform to small blocky, and in which small stones are of common occurrence. The lower part of the B horizon is often much darker colored than the upper part and this color change may be quite abrupt. Accumulations of lime and salts are found at depths of 24 to 36 inches. The parent material is variable in color and may be predominantly brown or predominantly grey depending on the thickness and distribution of the yellowish brown and dark grey strata. The following is a description of a Donnelly soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown leaf litter. pH 6.7
A_1	1 - 2	Dark greyish brown to dark grey heavy loam to clay loam with little well defined structure. May be absent. pH 6.6
A_2	2 - 4	Light yellowish brown very fine sandy loam, medium to coarse platy, easily crushing into small irregular fragments. pH 5.9
$A_3(B_1)$	4 - 7	Light yellowish brown loam to clay loam, medium nuciform, vesicular, friable. pH 5.3

Horizon	Depth in inches	Description
B_2	7 - 13	Dark yellowish brown clay, weakly columnar, fine nuciform to blocky, firm to very firm. pH 5.1
B_3	13 - 19	Dark yellowish brown to dark brown clay, fine to medium blocky, firm. pH 5.1
B_4	19 - 25	Greyish brown to dark grey clay, fine to medium blocky, firm. pH 7.2
Bca	25 - 33	Greyish brown to dark grey clay with occasional yellowish brown sandy clay loam strata. Moderate lime. pH 8.0
Bso_4	33 - 39	As above with accumulation of salts. pH 7.8
C	39 -	Grey clay with occasional thin strata of yellowish brown sandy clay loam. pH 7.8

A few small stones are usually present in all horizons. On cultivation the surface soil is brownish grey in color and tends to bake and crust on exposure.

Agricultural Use: Donnelly soils are fairly good to good arable soils. However, their surface horizons tend to be low in organic matter and mineral plant foods while their subsurface horizons tend to have a restricting influence on the penetration of water and of plant roots. Crop rotations that include deep rooted crops such as legumes will help to open up the subsoil and thereby improve the natural drainage and 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 favorable response to applications of manure and to applications of phosphate fertilizers.

(b) Esher Series: (Degraded black heavy loam to clay loam)

Soils of this series predominate in about 65,000 acres of the mapped area. They are found in the eastern and western portions of the area mainly in association with or adjoining Donnelly and Falher soils. Their native tree cover appears to have been considerably more open than that of the Donnelly soils. Esher soils have undulating to gently rolling topography in which the slopes are usually smooth and seldom exceed a gradient of 5 percent. They are moderately to imperfectly drained soils and are found in positions that are better drained than those in which Donnelly soils are found.

Esher soils are degraded black soils that have a solod to solodized solonetz type of profile. They usually have a well developed A_1 horizon that is greyish brown to dark brown in color, a light brownish grey platy A_2 horizon and a nuciform A_3 horizon. The B horizon is often very compact although it tends to break fairly readily into fine blocky to nuciform aggregates. Distinct horizontal cleavage lines are common in the lower B and C horizons. Occasional stones are found throughout the profile. Accumulations of lime and salts are usually found at depths of 24 to 36 inches. The following is a generalized description of an Esher soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown to black decomposed and semi-decomposed leaf litter. pH 7.0 to 7.6
A_1	1 - 4	Dark brown to brown silt loam to clay loam, weakly prismatic, breaking readily to weakly nuciform aggregates. The color of this horizon is often greyish, and quite variable but the depth rarely exceeds 6 inches. pH 5.9 to 6.3
A_2	4 - 7	Light yellowish brown silty loam, platy in the upper 2 inches to vesicular nuciform in the lower 1 inch. There is often a deeper and more distinct A_3 horizon. pH 6.0 to 6.2
B_2	7 - 11	Dark yellowish brown clay—often silty. Medium columnar breaking into fine nuciform aggregates. Cleavage faces stained a dark brown. pH 5.0 to 6.0
B_3	11 - 17	Dark yellowish brown to dark brown clay, compact, weakly nuciform to massive. pH 5.5 to 6.5
B_4	17 - 24	Greyish brown to dark grey clay, compact, weakly nuciform to massive. pH 7.0 to 7.5
B_5	24 - 36	Greyish brown to dark grey clay with occasional bands of yellowish brown clay loam. Friable, small nuciform. pH 7.5 to 8.0
Bca	36 - 48	Greyish brown to dark grey clay loam to clay. Medium lime content. pH 7.9 to 8.1
C	48 -	Greyish brown to yellowish brown clay loam to clay. Frequently mixed with bands of dark grey clay. Lime and salt pockets common. pH 8.0 to 8.3

On cultivation, the surface soil is greyish brown to dark greyish brown in color.

Agricultural Use: Esher soils have a higher native fertility than the Donnelly soils and most of the areas in which they predominate are now under cultivation. They are good arable soils but their fibre content is generally fairly low and their B horizon is often very compact. While these soils have been cropped successfully for a number of years, yields are decreasing and losses due to wind and water erosion are increasing on many of these soils. Crop rotations that include grasses and legumes will help to curtail these losses, replenish the organic matter and mineral plant food supply, and improve the drainage and structure of these soils.

(c) Landry Series: (Black silt loam to clay loam)

Landry soils are found mainly in the west central and northwestern portions and predominate in about 25,000 acres of the mapped area. They appear to have developed in the better drained, more open parkland portions of the area. They have an undulating topography that consists of long smooth slopes whose gradient seldom exceeds 5 percent.

In many respects a Landry soil profile is very similar to that of an Esher soil. However, 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. Like the Esher soils they have a solod to solodized solonetz type of profile in which there are occasional small stones. Frequently their parent material appears to be a mixture of both yellowish brown till-like material and dark grey clay, with the latter predominating. The following is a generalized description of a Landry soil profile:

Horizon	Depth in Inches	Description
A_1	0 - 6	Very dark brown to black, silt loam to clay loam, crushes easily to small crumbs. pH 6.8
A_2	6 - 8	Dark greyish brown grading to yellowish brown silty loam, fine to medium platy, very friable. pH 6.2
$A_3(B_1)$	8 - 10	Yellowish brown clay loam, vesicular, nuciform, fairly firm, often occurs in loose clusters. pH 6.2
B_2	10 - 18	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	18 - 26	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
Bca	26 - 36	Dark grey clay in which yellowish brown sandy clay loam strata are of common occurrence. These may also occur in the lower part of the preceding horizon. Moderate concentrations of lime are usually found in these lighter colored strata and salt inclusions are common in the lower part of this horizon. pH 8.0
C	36 -	Dark grey and yellowish brown stratified clay to clay loam. pH 7.8

Agricultural Use: Landry soils are among the most productive soils in the mapped area. They have a fairly high natural fertility and are good to very good arable soils. However, every precaution should be taken to see that their relatively high natural fertility is maintained.

Unfortunately it would appear that the best soils in this area are the last to receive conservation attention. The grain summerfallow system of farming is practised almost exclusively on such soils. Landry soils are well adapted to a mixed farming agriculture and if their natural fertility is to be maintained the grain-fallow rotation should be discontinued.

C. Soils Developed on Lacustrine Deposited Material

This parent material appears to be derived from materials that are mainly of Smoky River origin. It is a grey to dark grey clay that is quite compact and has a waxy or glazed appearance. Occasional thin strata of yellowish brown silty loam to silty clay loam occur in some parts of this deposit. While this material is often very similar to the modified lacustrine material it is usually more compact, darker in color and stone-free. It is found at elevations of from 1,950 feet to 2,100 feet and may be separated from the modified lacustrine deposits by areas in which there is a relatively shallow overlying deposit of sandy or gravelly material.

The soils developed on this lacustrine 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 vegetation consisting of grasses, shrubs, willows and poplar. The growth of the latter appears to have been retarded and it has been suggested that the development of a solonetzic profile may have been partly responsible for inhibiting tree growth in such areas.

These soils are imperfectly to poorly drained and have a level to undulating and depressional topography. In addition it would appear that micro relief is an important factor determining the color of the profile that is formed on this parent material. For example, 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. This is particularly apparent in the Falher area. The grey 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 where drainage deficiencies are less apparent.

Following is a description of the four main soil series formed on this lacustrine deposited parent material:

(a) Nampa Series: (Grey wooded heavy loam to clay loam)

There are only a few areas, comprising a total of about 30,000 acres, in which Nampa soils are predominant. In addition, however, minor proportions of most of the Falher and Rycroft soil areas and many of the Judah and Davis soil areas consist of Nampa soils. No attempt is made to determine their relative distribution in such areas.

Nampa soils are poorly drained and are found in level and depressional areas. Their profile is quite similar to that of Donnelly soils except that the B horizon tends to be more compact and usually not as brown in color. The brown coloring is evident

PLATE III

Fig. 1.—Tree cover fairly typical of a considerable proportion of the virgin land in the Rycroft and Watino sheets. Much of it has been fire-killed.

Fig. 2.—Eroded land near the junction of Kakut creek with the Bad Heart river. Deep wide coulees are characteristic of the drainage courses in this area. Destruction of protective tree cover along the banks results in increased soil erosion, and offers no check to the spring run-off from rapidly melting snow. The smaller streams in this area flood in the spring and are practically dry by midsummer.

Fig. 3.—Sedge bogs of varying size are of common occurrence throughout the mapped area. Hay is made on some of them. The soils in these areas have an accumulation of sedge peat that rarely exceeds a depth of 24 inches.

PLATE IV

Fig. 1.—The lack of a suitable well-water supply is a major problem in most of the area. Farm reservoirs, such as this, are satisfactory provided they are of adequate size and suitably located.

Fig. 2.—Land improvement by the use of crawler tractor equipment is becoming a general practice in the wooded areas. Fire-killed cover can be successfully cleared in the winter if the snow is not too deep.

Fig. 3.—A disc-type breaking plow developed by Mr. O. B. Lassiter and used on the Alberta Land Clearing Project. Recent improvements in construction and design have enhanced the value of this type of plow for breaking land in this area.

PLATE V

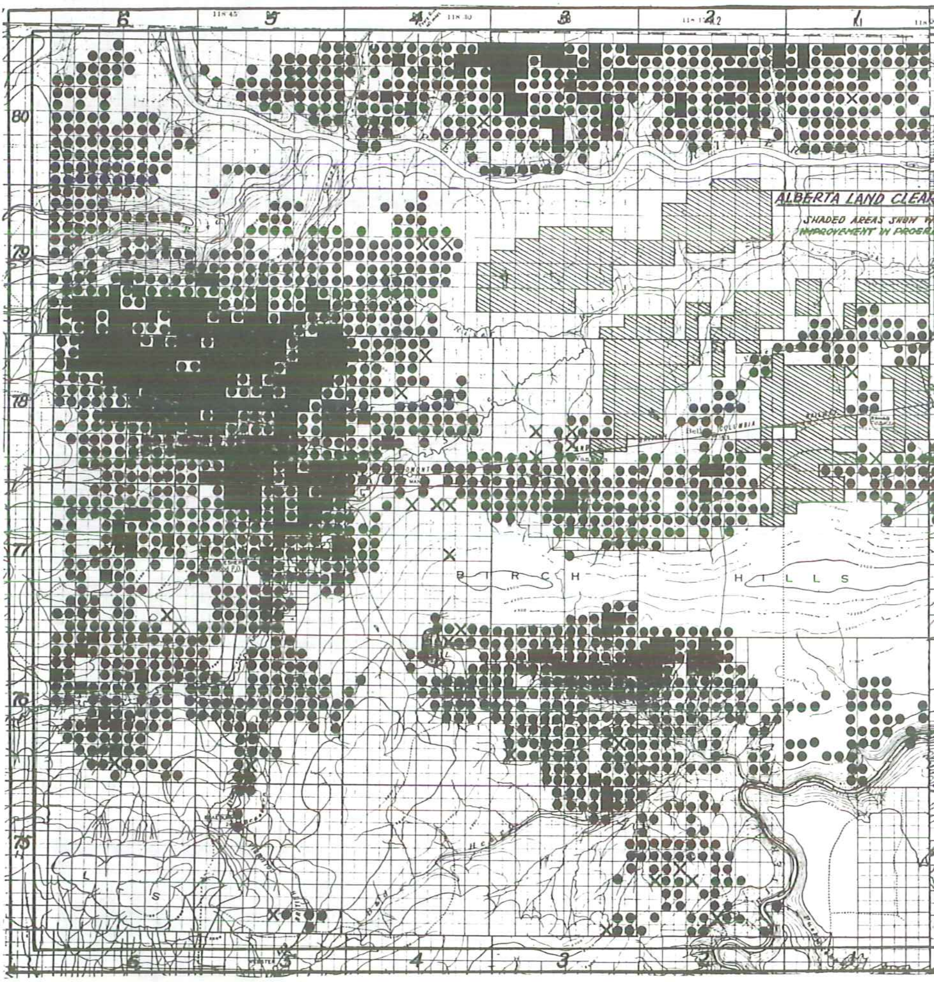
Fig. 1—A deep road cut showing a profile fairly typical of the Judah series. A brownish colored fairly deep A_1 horizon, a yellowish brown A_3 horizon and a silt and clay laminated C horizon are characteristic of Judah soils.

Fig. 2—A deep road cut showing a profile fairly typical of the Davis series. Note the depth of the leached A_2 horizon, the darker colored B horizon and the light colored silty C horizon. Davis soils should be "built up" by the frequent inclusion of grasses and legumes in the crop rotation supplemented with applications of mineral fertilizers.

Fig. 3—A profile typical of the Falher series. Note the depth and development of the A and B horizons. There is a well developed dark brown to greyish brown A_1 horizon, a relatively thin platy A_2 horizon and usually a thicker, greyish colored, nuciform A_3 horizon. The depth to the columnar, compact, and heavy textured B horizon is quite variable and the color of the B horizon is often darker than that of the A_1 horizon. This is a solodized solonetz profile.

P

Present Cultivated, Abandoned and Vi

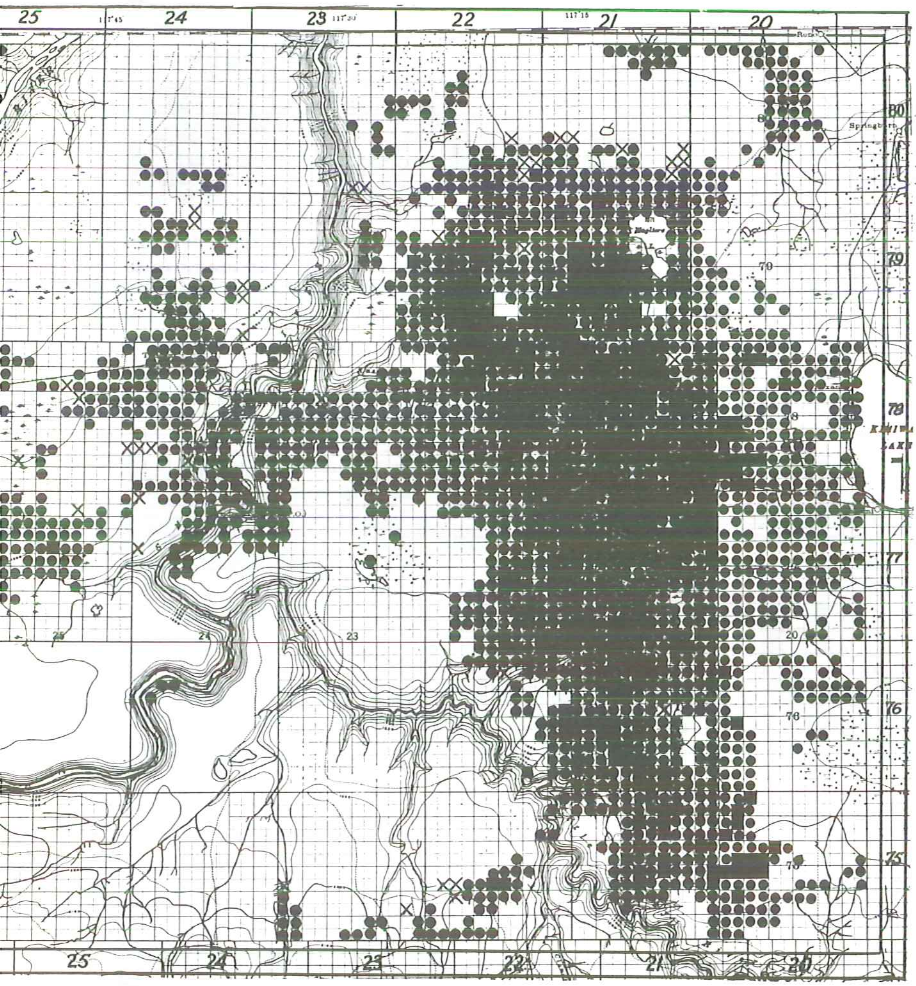


From information compiled by the Soil Survey during 1945, 1946, and 1947.

Completely Cultivated (120-160 acres) ....

Partially Cultivated (10-120 acres) ....

nds of the Rycroft and Watino Sheets



andoned Cultivation (10-160 acres) .... ☒

gin Lands (Idle and Pasture) .... ☐

PLATE VII

(Photo courtesy of C. H. Anderson, Dom. Exp. Station, Beaverlodge, Alta.)

Fig. 1.—A two year old stand of alfalfa and brome on grey wooded soils similar to those of the Donnelly series. Grasses and legumes should be included in the crop rotations not only in the grey wooded but on all soils in this area.

Fig. 2.—Good grain crops are harvested throughout the area and are the dominant crops grown in the area. However, the common practice of growing grain exclusively should be discontinued. Note the long fairly uniform slopes and occasional stones typical of the Esher and Belloy soil series.

Fig. 3.—A one year old stand of creeping red fescue in an area of mixed Rycroft and Broncho soils. Rycroft soils are found in the lower lying level to undulating basins while Bronco soils are found on the slopes and crowns of the knolls or humps in such areas.

Fig. 1.—Water erosion, that was the result of the spring run-off in 1948, in the Rycroft-Bronco mixed area northeast of Prestville. Maintaining the organic matter and farming across the slope will help prevent this loss.

Fig. 2.—Gully erosion on Tangent soil southwest of Eaglesham. This is again the result of the spring run-off of 1948. The slope is from one to two percent and the soil has a friable silty subsoil in which gullies can form rapidly. Unless steps are taken to build up the fibre and organic matter, increased losses from soil erosion can be expected in this area.

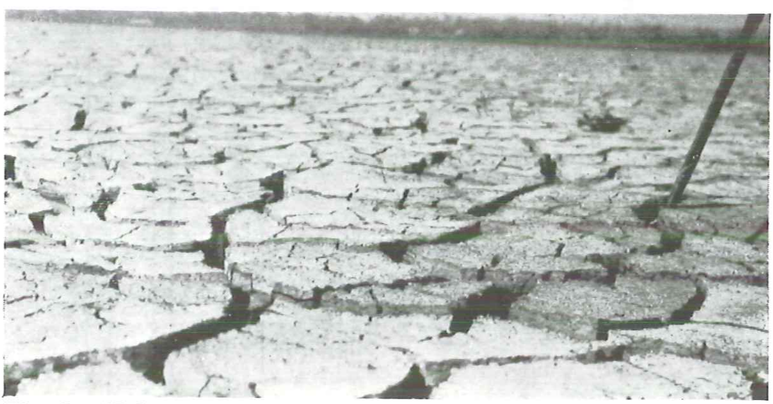
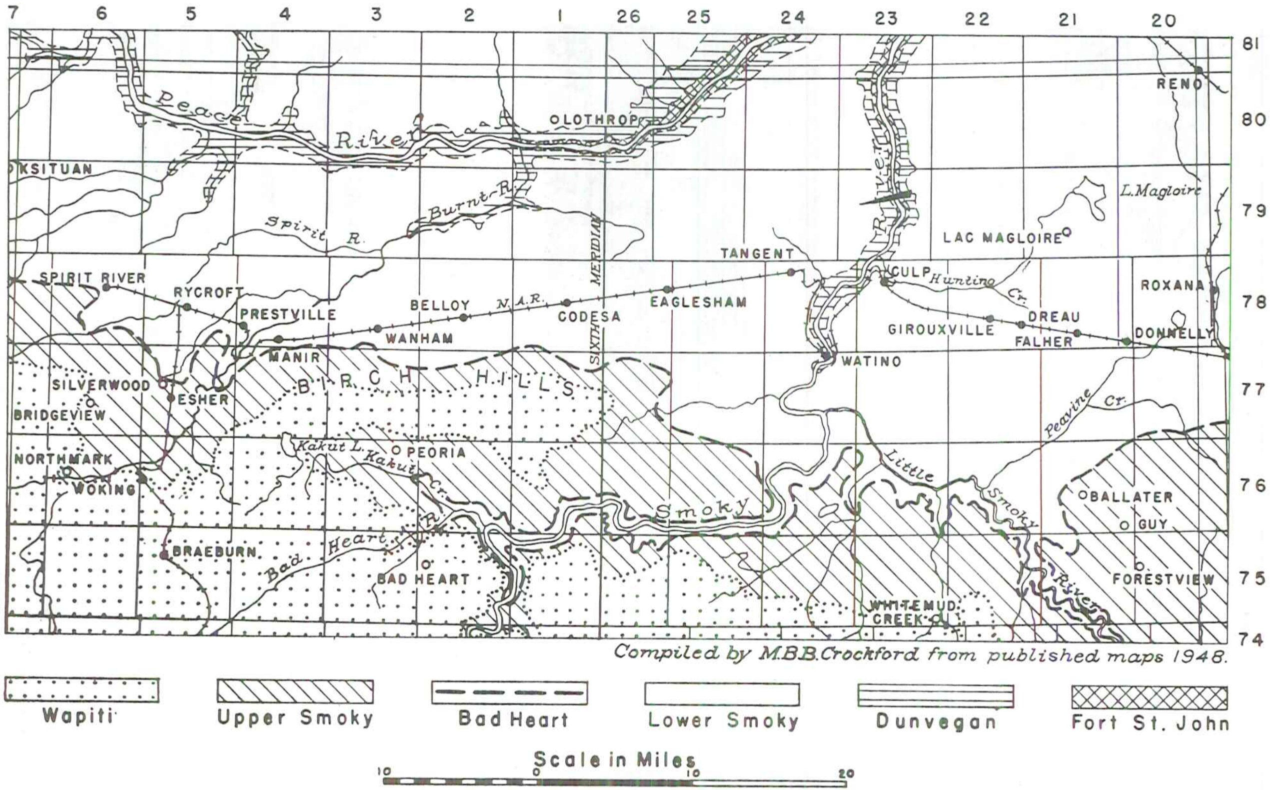


Fig. 3.—Kakut lake in August 1945. Indiscriminate removal of tree cover has resulted in variable and generally diminishing supplies of water in most of the lakes and stream courses of the Rycroft and Watino sheets.

PLATE IX

Geology of the Rycroft and Watino Sheets



Supplied by courtesy of Geological Survey, Research Council of Alberta in the upper part of the B horizon and merges gradually into the grey to dark grey colors characteristic of the parent material. The following is a description of a Nampa soil profile. It is a solodized profile in which the color of the A horizons resembles that of other grey wooded soils.

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown leaf litter. pH 5.8
A_1	1 - 2	Greyish brown heavy loam to clay loam, nuciform, friable—often absent. pH 5.5
A_2	2 - 4	Light brownish grey very fine sandy loam to silt loam, medium to coarse platy, friable, often iron stained. pH 5.2
$A_3(B_1)$	4 - 8	Light brownish grey to light yellowish brown silt loam to silty clay loam, vesicular, nuciform, fairly firm. Aggregates often occur in clusters and may be tops of old columns. pH 5.0
B_2	8 - 15	Dark greyish brown to dark yellowish brown, clay to silty clay, weakly columnar, medium nuciform to blocky, very firm. pH 5.2
B_3	15 - 22	Dark greyish brown to dark grey clay, coarse nuciform to blocky, very firm. pH 7.6
B_4	22 - 26	Dark grey clay, fine to medium blocky, firm. pH 7.5
Bca	26 - 30	Dark grey to very dark grey clay to silty clay loam, fine to medium blocky, friable. Lime in pockets or in the thin silty strata when these are present. pH 7.6
Bso_4	30 - 34	As above but with gypsum accumulation. pH 8.0

This profile has very few to no stones. The cultivated top soil is usually greyish brown to light brownish grey in color.

Agricultural Use: Nampa soils are fairly good arable soils. They 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. Its retarding effect on root penetration is particularly apparent when the soil is rather dry. Deep breaking, followed by the periodic inclusion of deep rooted legumes in the crop rotation will help to open up and materially improve the structure and natural drainage of these soils. Experimental information dealing with cultural practices on these and other solodized solonetz soils is very badly needed.

(b) Falher Series: (Degraded black silty loam to clay loam)

Falher soils predominate in about 201,000 acres of the mapped area. They rarely occur to the exclusion of either Nampa or Rycroft soils. However the dominance of the respective series varies appreciably and the soil areas, appearing on the soil map, are outlined on the basis of that dominance. While Falher soils are imperfectly or somewhat poorly drained they occupy better drained positions than those of Nampa soils. They are found in fairly open or sparsely wooded areas with level to undulating topography.

Falher soils have a dark brown to greyish brown A_1 horizon that is usually about 4 inches thick. The depth to the B horizon is generally quite variable but the break between the A and B horizons is very abrupt and very distinct. (See Plate V, Fig. 3.) They are degraded black soils and they usually have a well developed solodized solonetz type of profile in which there are very few to no stones. The following is a generalized description of a profile typical of the Falher series:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown leaf litter. pH 7.5 to 7.7
A_1	1 - 5	Dark brown to dark greyish brown silt loam to clay loam, granular, loose. pH 6.2 to 6.7
A_2	5 - 7	Yellowish brown to light yellowish brown very fine sandy loam to silt loam, platy, friable. pH 5.2 to 5.5
$A_3(B_1)$	7 - 10	Greyish brown silt loam to silty clay loam, vesicular, nuciform, fairly firm. Aggregates sometimes have a dark brown staining on the under sides. pH 5.3 to 5.8
B_2	10 - 17	Dark greyish brown to dark grey clay. Massive, very firm and has a waxy or glazed appearance when dry. pH 7.0 to 7.5.
B_3	16 - 22	Dark greyish brown to dark grey clay. Massive, vrey firm and has a waxy or glazed appearance when dry. pH 7.0 to 7.5
B_4	22 - 28	Dark grey to very dark grey clay, massive, firm. pH 7.4 to 7.8
Bca	28 - 36	Dark grey clay with occasional silty laminae. Lime low to medium—spotty. pH 7.9 to 8.1
Bso_4	36 -	As above with gypsum accumulation. pH 8.0 to 8.2

Agricultural Use: Falher soils are good soils but they require careful management. Their loose surface soil is vulnerable to both wind and water erosion. The fibre content is not high and needs building up. In addition the tight subsoil absorbs water slowly, so that during heavy rains the surface may become wet enough to flow. This condition is becoming increasingly apparent in some of the older settled areas neighboring Falher, Girouxville and Prestville. (See Plate VIII, Fig. 1.)

As in the Nampa soils, this tight subsoil offers physical obstruction to root penetration. The incorporation of organic matter and the growing of deep rooted legumes will help to improve the structure 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 these soils.

(c) Rycroft Series: (Black silt loam to clay loam)

Rycroft soils predominate in about 52,000 acres of the mapped area. They are found in association with Falher and Nampa soils and, in the western portion, with Bronco soils. While their internal drainage is slow, they occupy the better drained positions of areas that have a slightly wavy, level to undulating topography. However, when associated with Bronco soils (north of Rycroft), they are found on the lower slopes of the knolls and in the level to undulating areas between the knolls.

Rycroft soils are stone-free and have a darker colored solum than Landry soils. They are very similar to Falher soils except that they have a deeper A_1 horizon that is very dark brown to black in color. The following is a generalized description of a profile typical of the Rycroft series. It is a black soil having a solodized solonetz type of profile.

Horizon	Depth in Inches	Description
A_1	0 - 6	Very dark brown to black silt loam to silty clay loam, weakly prismatic, crushes readily to small granular structure. pH 6.8 to 7.0
A_2	6 - 7	Greyish brown to yellowish brown silt loam, platy, friable. This horizon is often absent. pH 6.2 to 6.4
$A_3(B_1)$	7 - 9	Yellowish brown clay loam to silty clay loam, vesicular, nuciform, fairly firm—often occurring in loose clusters. pH 6.3 to 6.6
B_2	9 - 18	Very dark greyish brown clay, columnar to massive, very firm, medium blocky meso-structure. pH 6.7 to 6.9
B_3	18 - 24	Dark grey to very dark grey clay, massive, very firm. Has a waxy or glazed appearance when dry. pH 7.7 to 8.0
Bca	24 - 36	As above with occasional yellowish brown silty laminae. Lime low to medium—spotty. pH 8.0 to 8.4
Bso_4	36 -	As above with gypsum accumulation. pH 7.9 to 8.1

Agricultural Use: Rycroft soils are very good soils but their successful management involves the same considerations that were referred to in the discussion of Falher soils. For the most part a grain-summerfallow system has been followed on these soils since they were brought under cultivation twenty to thirty years ago. Many fields drift badly each fall and spring and water erosion is becoming a serious problem. Furthermore, yields have dropped appreciably—in many cases by as much as 50 percent. Rycroft soils are adaptable to a fairly wide range of crops and responsive to good mixed farming practices.

(d) Prestville Series: (Thin peat)

There are three areas, making up about 8,200 acres, in which Prestville soils predominate. They are found south of Donnelly, north of Eaglesham and near Prestville. However, these soils are also found in other areas particularly in association with Falher, Nampa and Judah soils. No estimate is made of the extent of their occurrence in those areas in which they do not appear to be predominant. Similar soils are also found on other parent materials in the mapped area but have not been outlined or assigned a series name.

Prestville soils are poorly drained soils found under sedge cover in some of the depressional areas. They have a surface accumulation of sedge peat that rarely exceeds a depth of 12 inches. Unlike the organic soils described in a subsequent section of this report, these thin peat soils usually have fairly well developed mineral horizons overlying the glei horizon. The following is a description of a profile typical of the Prestville series:

Horizon	Depth in Inches	Description
A_{00}	0 - 7	Brown to dark brown sedge peat. pH 5.8
A_0	7 - 10	Dark brown semi-decomposed sedge peat. pH 6.8
A_1	10 - 12	Very dark brown to black loam to clay loam with very little definite structure. pH 7.2
B_1	12 - 13	Dark greyish brown clay loam, fairly firm. pH 7.4
G	13 - 26	Grey to dark grey clay with considerable iron staining. pH 7.8 There are usually two subhorizons in this glei horizon. They are as follows:
G.1	13 - 19	Dark grey clay, firm and fairly high in iron. Breaks into blocky fragments.
G.2	19 - 26	Grey clay, which on drying tends to have a loose granular to shot-like structure.
Ca	26 -	Grey to dark grey clay with lime concretions. pH 7.9 to 8.1

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. Moreover, in areas that have been burned over, a considerable portion of the uppermost peat accumulation is often burned off. However, after draining, they are cold soils that are not immediately suitable for grain crops. The general practice, in the mapped area, is to raise oats for greenfeed for the first two years after breaking. With increased aeration and natural drainage grain crops can be grown successfully. After they have been cropped for a number of years, Prestville soils are very difficult to distinguish from Falher soils.

D. Soils Developed on Alluvial-Lacustrine Deposited Material

This material is found at elevations that are somewhat lower than those of the lacustrine deposits. It adjoins the latter and occurs adjacent to the main drainage courses on what appear to be the uppermost river terraces. It consists of stratified silty clay that is brown to greyish brown in color. The strata are generally thin and often contain yellowish brown layers of silt or very fine sand. The underlying lacustrine or modified lacustrine materials are found at variable depths and in some parts of the area are exposed at the surface.

While these brown silty clay areas usually have an undulating to gently rolling topography they are often characterized by a humpy and dune-like topography in which the slopes are very irregular, quite variable and sometimes exceed 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 silty clay deposits have been reworked and redeposited by wind.

The soils formed on this material have a distinctive brown colored solum whose structure is granular to nuciform and quite friable. They often occur in association with Rycroft, Falher and Nampa soils and 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 alluvial-lacustrine parent material:

(a) Judah Series: (Degraded black or brown forest silt loam to silty clay loam)

Judah soils predominate in about 230,000 acres, largely in the central and northern portions of the mapped area. They are well drained soils and their topography is undulating to gently rolling and rolling. The native cover is a woodland vegetation in which aspen poplar is predominant.

Judah soils can be recognized by the brown colored surface horizon and by a brown fairly heavy textured, usually stone-free subsoil. The structure of the solum is fairly loose and the structural aggregates lack the cohesion typical of Falher soils. Furthermore, there is often a gradual greying of the lower part of the A horizon rather than any distinct A_2 horizon. With respect to their color and structure they are unlike other degraded black soils in this area and more closely resemble brown forest soils. The following is a generalized description of a Judah soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown decomposed and semi-decomposed leaf litter. pH 7.3 to 7.6
A_1	1 - 4	Dark brown to brown silt loam to silty clay loam, fine granular to crumb, friable. pH 6.9 to 7.2
A_3	4 - 6	Yellowish brown very fine sandy loam to silt loam, fine granular to crumb, friable. pH 6.5 to 6.8
B_1	6 - 12	Brown to dark yellowish brown silty clay loam to silty clay, granular to nuciform, friable. pH 5.8 to 6.2
B_2	12 - 18	Similar to above but somewhat more compact. pH 5.6 to 6.2
B_3	18 - 24	Dark yellowish brown silty clay loam to silty clay, nuciform, friable. Occassionally has light yellowish brown silty and very fine sandy laminae. pH 7.0 to 7.4
Bca	24 - 36	Brown to yellowish brown silty clay, nuciform, friable, frequently laminated, usually fairly high in lime. pH 8.1 to 8.3
C	36 -	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

Agricultural Use: Depending on topography, Judah soils are fairly good to good arable soils. However, they are generally low in plant fibre and organic matter. In addition, water erosion—particularly gully erosion, is becoming increasingly troublesome in many of these soils. Fibre and organic matter must be built up to increase the adhesion of the soil aggregates. Grasses should be included along with legumes in the crop rotations. The introduction of grass fibre, green manure and occasional applications of fertilizer appear to be the basic requirements for a successful management of Judah soils.

(b) Bronco Series: (Black silt loam to silty clay loam)

In the western portion of the area, near Rycroft, there are about 12,000 acres in which Bronco soils predominate. In addition, they are of minor but nevertheless significant occurrence in some areas where Rycroft or Falher soils predominate. They have a "humpy" gently rolling to rolling topography in which the slopes are usually short and fairly steep. Bronco soils are found on the upper well drained portions of the humps whereas Rycroft, Falher or Nampa soils are often found on the lower slopes and in the undulating area between the knolls.

Bronco soil profiles have a fairly thick, very dark brown to black A horizon underlain by a dark yellowish brown to brown, granular B horizon. They are well drained, stone-free soils developed on a parent material that, in some cases, appears to have been reworked and redeposited by wind. Following is a generalized description of a profile typical of the Bronco series:

Horizon	Depth in Inches	Description
A_1	0 - 3	Black silt loam, slightly prismatic, weak crumb structure. pH 7.0 to 7.3
A_3	3 - 8	Very dark grey to very dark greyish brown silty loam to silty clay loam, weakly prismatic, fine granular, friable. pH 6.4 to 6.8
B_1	8 - 13	Dark yellowish brown silt loam to silty clay loam, fine granular to nuciform, weakly prismatic, friable. pH 6.2 to 6.5
B_2	13 - 20	Dark yellowish brown to brown silt loam to silty clay loam. More compact and coarser nuciform than B_1. pH 6.3 to 6.6
B_3	20 - 24	Dark yellowish brown to dark greyish brown silty clay loam to silty clay, fine nuciform, friable. pH 6.7 to 7.0
Bca	24 -	As above with moderate lime. pH 7.8 to 8.1

Agricultural Use: Bronco soils are very good agricultural soils and are adapted to a fairly wide range of crops. They are relatively rich soils on which good tilth can be maintained fairly easily. However, they are vulnerable to water erosion. Therefore, in addition to maintaining their fertility every effort must be made to maintain their fibre and organic matter content. The periodic inclusion of grass and legume crops and the reduction of summerfallow are essential considerations in the proper management of these soils.

(c) Wanham Series: (Depression podsol)

There are two areas near Wanham, comprising a total of about 15,000 acres, in which Wanham soils are predominant. In addition, however, they are found along with Nampa and organic soils in other poorly drained depressional portions of the Judah and Davis soil areas. The extent of their occurrence in such areas is very difficult to determine and appears to be governed by the depth and distribution of the brown silty clay parent material. Since this is often thin or absent in the depressional portions of these areas, there is usually an erratic distribution of both Wanham and Nampa soils.

The solum of a typical Wanham soil profile is light yellowish brown to greyish brown in color. Occasional rusty streaks or stains are common in both the surface and sub-surface horizons. However, the subsoil lacks the compactness and the dark color typical of Nampa soils. Following is a description of a profile typical of the Wanham series:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown sedge and leaf debris. pH 7.5
A_1	1 - 3	Very dark brown to black, silty muck. pH 7.0
A_{21}	3 - 7	Light grey to grey very fine sandy loam, coarse platy, friable. pH 6.6
A_{22}	7 - 11	Light brownish grey very fine sandy loam, platy, with occasional iron stains and concretions. pH 5.2.
A_3	11 - 15	Light yellowish brown silt loam, vesicular, small nuciform, friable. pH 4.9
B_1	15 - 24	Grey silty clay, granular to nuciform with some iron staining, friable. pH 5.5
B_2	24 - 30	Grey to greyish brown clay, coarse nuciform, firm. pH 6.8
Bca	30 -	Grey and yellowish brown mottled silty clay. Has occasional iron streaks and is often laminated with very fine sand or silt. Moderate lime. pH 8.1

Agricultural Use: Soils of the Wanham series are cold soils that are not immediately adapted to grain crop production. Improved drainage, aeration and the incorporation of organic matter are essential to successful crop production. Grasses, clovers and coarse grains are grown successfully and appear to respond favorably to periodic applications of fertilizer.

E. Soils Developed on Alluvial and Aeolian Deposited Materials

These deposits are part of the uppermost terrace deposits associated with the Peace and Smoky rivers. They generally occur closer to the valleys of those drainage courses than do the more uniform silty clay deposits. They are stratified but the strata are generally thicker and 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.

A wide variety of soils is formed on this type of parent material. Most of them, however, may be grouped according to the dominant textural characteristics of their parent material. These groups are as follows:

1. Calcareous, Variable Silty Parent Material that has Occasional Sandy Strata

This material is yellowish brown in color, fairly high in lime and stratified. The strata are rarely less than 6 inches thick and vary considerably. For the most part, however, silt and silty clay strata predominate. The following are the dominant soils formed on this material:

(a) Davis Series: (Grey wooded loam to silt loam)

Soils of this series predominate in about 175,000 acres of the mapped area and often occur in association with Judah soils. They are well drained soils with a humpy, gently rolling to rolling topography. The knolls are low but often steep-sided. The native cover is a woodland vegetation consisting of aspen poplar, spruce, shrubs and coarse grasses. Sedges, and sometimes mosses are found in many of the poorly drained depressional areas associated with this series.

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 generalized description of a typical Davis soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 1	Dark brown organic debris. pH 7.2
A_1	1 - 2	Brown loam to silt loam, often absent. pH 7.0
A_2	2 - 5	Light brown to very pale brown very fine sandy loam to silt loam, platy, very friable. pH 6.4 to 6.8
A_3	5 - 8	Pale brown silt loam to silty clay loam, vesicular, nuciform, friable. pH 6.2 to 6.6
B_1	8 - 20	Yellowish brown silt loam to silty clay loam, weakly columnar, nuciform, friable. pH 5.4 to 5.8
B_2	20 - 26	Brown to strong brown silty clay. Somewhat more compact than the B_1 horizon. pH 5.6 to 6.0
Bca	26 - 30	Light brownish grey silty clay and light yellowish brown silt and very fine sand strata that often exceed 12 inches in thickness. Fairly high to high lime. pH 8.0 to 8.6
C	30 - 50	Light yellowish brown very fine sand to silt loam in upper 8 inches. Remainder very fine sand to silt with occasional thin bands of silty clay.

Agricultural Use: Davis soils are fair to fairly good arable soils. They are loose, medium textured soils that are vulnerable to both wind and water erosion. In addition, they are generally fairly low in organic matter and in mineral plant foods.

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 crested wheat, creeping red fescue, slender wheat and brome can be grown successfully. Alfalfa, sweet clover and altaswede are very desirable soil improving crops and legume seed production has met with marked success in many of the Davis soil areas.

Since these soils tend to have a low reserve of mineral plant foods they may respond to fertilizer amendments. Present experimental evidence indicates a very marked response to phosphate fertilizers, and a lesser, but nevertheless significant, response to nitrogen fertilizers.

(b) Tangent Series: (Degraded black or brown forest silty loam to silty clay loam)

Tangent soils predominate in about 20.000 acres of the mapped area. They are found in association with Falher, Judah, Davis and Leith soils in locations that are characterized by a prevailing south slope, and by a sparser tree cover than that of Davis soils.

They have a well developed, dark colored A_1 horizon. Otherwise their profile is much the same as that of Davis soils. The prevailing brown color of the solum is unlike that of other degraded black soils and it is suggested that it might resemble that of brown forest soils. Following is a generalized description of a profile fairly typical of the Tangent series:

Horizon	Depth in Inches	Description
A_1	0 - 3	Very dark brown to brown very 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	3 - 5	Pale to very pale brown very fine sandy loam, weakly platy. pH 7.4 to 7.6
A_3	5 - 8	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 - 16	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
Bca	16 - 30	Grey to light brownish grey very fine sand to silt loam. Fairly high in lime—often marly. pH 8.6
C	30 - 50	As above and occasionally finely laminated or cross-bedded.

Agricultural Use: Tangent soils are fairly good to good arable soils but they 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. Otherwise soil erosion can become a serious problem. (See Plate VIII, Fig. 2.)

2. Calcareous, Variable Sandy Parent Material that has Occasional Sandy Clay Strata

This yellowish brown, stratified material is somewhat similar to that of the preceding group but 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 2 inches.

The soil profile that is developed on this sandy parent material usually has a fairly compact B horizon at depths of about 12 to 18 inches below the surface. This horizon serves to distinguish these soils from those developed on the undifferentiated sand deposits. The following are the dominant soils formed on this variable sandy parent material:

(a) Culp Series: (Grey wooded loamy sand to sandy loam)

Culp soils predominate in about 68,000 acres of the mapped area. They are stone-free, well to excessively well drained soils found on gently rolling to rolling, somewhat humpy topography. They often occur in close association with Davis soils or with sands. The native cover is a woodland vegetation that consists of aspen poplar, some spruce and pine, shrubs and the coarser grasses. Sedges are of common occurrence in the poorly drained depressional parts of these areas.

Culp soils are grey wooded soils that have a brownish colored sandy profile in which there is a fairly well developed, compact B horizon. The following is a description of a typical Culp soil profile:

Horizon	Depth in Inches	Description
A_0 & A_1	0 - 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	2 - 8	Light brownish grey to light yellowish brown loamy sand, loose. pH 7.3
A_3	8 - 14	Light yellowish brown to yellowish brown loamy sand, darker and firmer than the A_2 horizon. pH 7.0
B_2	14 - 20	Yellowish brown to brown sandy clay loam to sandy loam, blocky, firm. pH 6.4
B_3	20 - 26	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_4	26 - 32	Yellowish brown sand with occasional clay loam laminae. pH 8.0
Bca	32 - 40	Similar to preceding horizon but with moderate lime particularly in the heavier textured laminae. pH 8.3
	40 - 48	Similar to above but higher in lime. pH 8.4

Agricultural Use: Culp soils are fair arable soils. They require and appear to respond to good management practices. They are sufficiently sandy to be vulnerable to wind erosion and to have a low water-holding capacity, yet they have sufficient fine particles, particularly in the B horizon, to make them fairly desirable soils. However, organic matter and fibre must be maintained at a fairly high level in order to cut down losses due to soil erosion. In addition, they appear to respond to fertilizer amendments.

Some of the Culp soil areas have a choppy topography and an appreciable proportion of poorly drained sedge peat bogs. The latter are small, of very patchy occurrence and tend to cut up the areas and make them difficult to farm. Such areas are found south of Tangent and south of Culp. They should be withheld from cultivation or seeded permanently to grass.

(b) Leith Series: (Degraded black loamy sand to sandy loam)

Soils of the Leith series predominate in about 10,000 acres of the mapped area. They occur in association with Tangent and Culp soils and are found in areas that have a prevailing south slope on which the native tree cover is not very dense. The topography is undulating to rolling and much of it has a dune-like appearance.

Leith soils are well drained to excessively well drained degraded black soils. They are brownish colored, sandy soils that have a well developed, dark colored A_1 horizon and a fairly well developed, compact B horizon. Following is a description of a typical Leith soil profile:

Horizon	Depth in Inches	Description
A_0	0 - 2	Dark brown organic debris. pH 7.0
A_1	2 - 8	Brown to dark brown fine sandy loam, weakly blocky. pH 7.6
A_2	8 - 16	Pale brown to yellowish brown loamy sand, loose. pH 7.8
B	16 - 24	Yellowish brown to brown sandy clay loam to sandy loam, weakly columnar, nuciform, friable. Has occasional sandy lenses. pH 7.6
Bca	24 - 36	Greyish brown very fine sandy loam to silt loam. Fairly high in lime—often marly. pH 8.4
C	36 -	Brown to yellowish brown loamy sand with occasional laminae — rarely over 2 inches thick — of sandy or silty clay loam. pH 8.2

Agricultural Use: Leith soils are fairly good arable soils. While they do have a somewhat higher native fertility, most of what was said regarding the use of Culp soils applies equally well to Leith soils.

3. Sands

Sands are found in association with Culp soils and in fairly large areas adjacent to the Smoky river. They appear to be of alluvial origin and are sometimes underlain by heavier textured materials at depths of 4 to 6 feet below the surface. Their topography is undulating to rolling. Much of the area appears to consist of old dunes that are now fairly well grassed over. While most of the present tree cover is fire-killed, it appears to have consisted of good stands of pine, spruce and aspen poplar. Sedges and mosses are of common occurrence in many of the poorly drained depressional portions of these areas.

There are approximately 56,000 acres in which sand is predominant. These areas were outlined on the basis of information obtained on exploratory traverses and as a result their boundaries are not very well established. No attempt was made to classify these soils with respect to types of sand or to types of profiles. The following is a description of a sand profile that is commonly found in the undulating to gently rolling, well drained portions of the sand areas.

Horizon	Depth in Inches	Description
A_0	0 - 2	Greyish brown sand to loamy sand held together loosely by organic debris. pH 6.8 to 7.2
A_1	2 - 8	Yellowish brown sand to loamy sand held together loosely. Some firmness due to organic fibre. Often pale brown to greyish brown in color. pH 7.2 to 7.6
B	8 - 42	Yellowish brown sand with occasional thin laminae of silty or sandy clay loam. pH 7.7 to 7.9
Bca	42 - 48	Greyish brown sand to sandy loam with lime in heavier laminae. pH 8.0 to 8.4
C	48 -	Brown to greyish brown sand with occasional pebbles. pH 8.0 to 8.2

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

F. Soils Developed on Alluvial Deposited Materials

This parent material is found on river terraces and flood plains. It is similar to the alluvial-lacustrine and alluvial-aeolian materials but is of much more recent origin. As a result, the soils formed on this material 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 from those found on the lower terraces and more recent flood plains. The former are often darker colored as the result of having a greater accumulation of organic matter. The following are the soils formed on this more recent alluvial material:

(a) Spirit River Series: (Black sandy loam to silt loam)

A small area of Spirit River soils (about 1,600 acres) is outlined just west of Rycroft. The area is stone-free and appears to be an upper terrace of the Spirit river. It has a very gently sloping, smooth topography. The native cover appears to have been a fairly open parkland in which grasses were predominant.

Spirit River soils are well drained black soils that have a weakly developed soil profile. The A horizon is usually fairly thick and very dark brown to black in color. The brownish colored B horizon has little definite structure and consists of a sequence of depositional strata. The texture usually varies from light loam to silt loam and depends on the depth and nature of the various strata. Following is a description of a profile typical of the Spirit River series:

Horizon	Depth in Inches	Description
A_1	0 - 6	Very dark brown to black loam to silt loam, weakly granular. Some firmness largely due to organic fibre. pH 7.2
B	6 - 30	Brown to yellowish brown deposited 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:
	6 - 10	Brown to yellowish brown loam to silt loam.
	10 - 20	Yellowish brown very fine sandy loam to silt loam.
	20 - 22	Light yellowish brown loamy sand.
	22 - 30	Brown to yellowish brown clay loam—weakly nuciform.
Bca	30 -	Yellowish brown silt loam—low to moderate lime content. pH 8.1

Agricultural Use: Spirit River soils are very good soils that have a fairly high native fertility. However, they have been cultivated for a long time and may have been some of the first soils farmed in the surveyed area. Their fibre content is low and soil drifting is becoming a problem. Thus, rotations that include grasses and legumes should replace the present continuous wheat-fallow rotations.

(b) Alluvium

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. The soils 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. These flats are variable in size and often badly cut up by oxbows and old stream courses. They are found mainly in the valleys of the Peace and Smoky rivers and the largest occur in the vicinity of Watino. In all, about 12,000 acres of such river flat and bench lands are outlined on the soil map.

Darker colored, often more mature soils are found on the higher and older benches. The following is a description of a profile found on one of the upper benches of the Smoky river flat near Watino.

Horizon	Depth in Inches	Description
A	0 - 8	Black grading to dark brown, silt loam to very fine sandy loam, weakly nuciform. Some firmness largely due to organic fibre. pH 6.8
B	8 - 24	Brown to yellowish brown silt and very fine sand strata. pH 5.7
	24 -	Gravel.

Agricultural Use: Soils formed on recent river deposits are usually fairly good to good arable soils. However, they are often excessively well drained soils and tend to be droughty. It would appear that the organic matter content of these soils should be built up and maintained at a fairly high level. At the present time much of this land is being used for the growing of cereal grains and hay crops.

G. Soils Developed on Coarse Outwash 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 or along some of the lower slopes of these areas. The largest of these islands are outlined in the eastern part of the mapped area. The soils formed on this material are coarse textured and quite variable. The surface is usually a sandy loam that may be gravelly or stony. The subsoil may contain thick gravel lenses or may be a deep deposit of gravel and cobble stones.

(a) Clouston Series: (Grey wooded gravelly or stony loamy sand to sandy loam)

There are about 7,500 acres of Clouston soils in the mapped area. They are found on undulating to gently rolling bench lands and sometimes on slight ridges or knolls. The largest of these areas are outlined on the soil map. Occasional small areas also occur in association with Braeburn and Donnelly soils. Clouston soils are gravelly and stony soils that have a leached profile similar to that of grey wooded soils. They are excessively drained, coarse textured soils that often have a lime accumulation horizon at depths of about 48 inches.

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 lands. There are some gravel pits in the Clouston soil areas but they do not appear to be of commercial importance.

H. Soils Developed on Relatively Thin Alluvial 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 about 30 inches. Most frequently they are about 12 to 18 inches thick. They occur on many of the lower slopes of the till areas or on the uplands adjoining some of the drainage courses. Thus they may be either shallow beach or flood plain deposits. The underlying heavier textured material may be till, stratified till or lacustrine material. The 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. Accordingly the soils formed on this overlying material are grouped as follows:

1. Fairly Uniform Sandy or Silty Material Overlying Lacustrine or Stratified Till Deposits

These shallow alluvial deposits are found south of Codesa, west of Peoria, and west of Rycroft. They may be the result of a flooding over of the adjacent stream courses.

(a) Peoria Series: (Degraded black to black sandy loam to silt loam)

Peoria soils predominate in about 15,000 acres of the mapped area. They are 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. This depth is quite variable however and in some areas Falher and Rycroft soils are associated with or may predominate over Peoria soils.

They are well drained to poorly drained soils depending on position and on the depth of the overlying material. They have a level to undulating topography and are found in areas characterized by a fairly open woodland or parkland vegetation. Peoria soils are degraded black to black soils. 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 often weakly platy. Like Spirit River soils they do not have a very well developed profile. The following is a description of a profile typical of the Peoria series:

Horizon	Depth in Inches	Description
A_1	0 - 6	Dark brown to black loam to silt loam, weakly prismatic. pH 6.7
A_3	6 - 12	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
B	12 - 26	Brown to yellowish brown depositional strata that have little definite structure but do have some evidence of compaction.
		The following are typical strata.
	12 - 18	Brown to yellowish brown fine sandy loam to loam, weakly blocky. pH 7.5
	18 - 26	Yellowish brown to reddish brown loamy sand. The lowest part of the B horizon may be gravelly. pH 8.0
D	26 -	Dark grey clay, mottled and frequently laminated. Lime is found in the upper 6 inches of this material. pH 8.2

Agricultural Use: Peoria soils are good to very good arable soils. 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 and often tight 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 12 inches below the surface. Deep rooted legumes that will penetrate and open up this substratum should improve this soil.

2. Variable Sandy to Silty Shore Line Material Overlying Till or Stratified Till Deposits

This material may contain gravel lenses and stones and in some cases is not unlike that of Clouston soils. The deposit is shallow, however, and seldom 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.

(a) Codesa Series: (Grey wooded sandy loam to loam)

Soils of this series predominate in about 33,000 acres in the mapped area. They are well drained soils with an undulating to gently rolling topography in which smooth slopes are predominant. The sandy to silty parent material is underlain at varying depths by grey to greyish brown colored clay to clay loam. As a result, the soils formed on till or stratified till are frequently associated with or may predominate over Codesa soils. The native cover is a fairly heavy woodland vegetation consisting of aspen poplar, spruce, pine, shrubs and coarse grasses.

Codesa soils are sandy and may be gravelly or stony. They usually have a light brownish grey to yellowish brown, weakly developed profile in which the lighter colored A_2 horizon often has a platy or weakly platy structure. In the lower part of the profile there is often a gravelly lens at the contact with the underlying heavier textured material. Following is a description of a profile typical of the Codesa series:

Horizon	Depth in Inches	Description
A_0	0 - 2	Dark brown to black organic debris. pH 7.6
A_1	2 - 4	Light brownish grey loam to sandy loam having some firmness. Often absent. pH 7.4
A_2	4 - 8	Light yellowish brown fine sandy loam to loamy sand, coarse platy to weakly platy. pH 5.7
B	8 - 16	Yellowish brown sandy loam to loamy sand, very little definite structure, occasionally stratified and some evidence of compaction. Gravel lenses and stones of common occurrence. pH 5.6
D	16 -	Dark greyish brown to brown stratified till or till in which lime is found at depths of 30 to 36 inches below the surface. pH 7.0

Agricultural Use: Areas of Codesa soils range from non-arable to fairly good arable lands depending on the nature of the upper parent material. Those which are predominantly gravelly or quite stony should not be cultivated. Codesa soils are fairly loose and tend to have a low fertility reserve. They are vulnerable to both wind and water erosion. Grasses and legumes will help to bind the loose soil aggregates. The heavy textured and often compact underlying material is usually better supplied with the required mineral plant foods than the sandier upper deposit. Deep rooted legumes will help to open up this compact substratum and will replenish the supply of plant foods in the upper deposit. Supplementary applications of fertilizer may also prove beneficial in establishing a mixed farming agriculture on these soils.

(b) Belloy Series: (Degraded black to black sandy loam to silt loam)

Belloy soils predominate in about 75,000 acres, chiefly in the western half of the mapped area. They are very similar to Codesa soils except that they have a thicker and darker colored A_1 horizon. The native cover is a fairly open woodland or parkland vegetation.

Belloy soils are generally more variable than Peoria soils and have variable gravelly lenses and stones. In this area they are usually formed on deposits that are somewhat shallower than those of Peoria soils. The depth to the underlying heavier textured deposits is quite variable with the result that Landry and Esher soils, or in some areas, Kavanagh soils are frequently associated with or may predominate over Belloy soils. They are degraded black to black soils in which the upper part of the profile is brown to black in color while the lower part is yellowish brown in color and often platy. There is usually a gravelly or stony lens at the contact with the underlying heavier textured and often darker colored material. Following is a description of a profile typical of the Belloy series:

Horizon	Depth in Inches	Description
A_0	0 - 1	Very dark brown to black organic debris. pH 7.8
A_1	1 - 7	Black grading to brown in the lower part, sandy loam to silt loam, weakly prismatic, friable. pH 7.0
A_2	7 - 10	Light yellowish brown sandy loam, weakly platy to coarse platy, friable. pH 5.8
B	10 - 18	Yellowish brown sandy or silty 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	18 - 36	Dark greyish brown to dark yellowish brown stratified till or till in which lime is found at depths of 24 to 30 inches. pH 7.4

Agricultural Use: If they are not too gravelly or stony, Belloy soils are good arable soils. They usually have a fairly high native fertility, but they can deteriorate fairly rapidly unless the fibre and organic matter content is maintained at a satisfactory level. They are adapted to mixed farming and suitable for a fairly wide range of crops. 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 and in replenishing the plant food reserves in the upper horizons.

In the surveyed area it would appear that there is a rapid deterioration of the mineral plant food reserves in soils developed on some of the alluvial deposits. Present indications are that these soils usually respond to fertilizer amendments. Field trials conducted by the Beaverlodge Experimental Station, the Department of Soils and the Consolidated Mining and Smelting Company indicate that there is often a marked response to applications of ammonium phosphate and that there may be a response to amendments of sulphur or potash on some of these soils.

I. Soils Developed on Relatively Undisturbed Residual Materials

In the Rycroft and Watino sheets there are two types of parent material that are developed on or close to bedrock. Near Codesa, Wanham and Spirit River there are outcrops of what appears to be the Bad Heart formation. The soils developed in these relatively small areas are reddish brown in color and have pieces of sandstone throughout their profile. In the vicinities of Kakut lake, Heart Valley and Bad Heart, thin surfaced solonetz-like soils are of common occurrence. They appear to be closely underlain by saline sandy shale and resemble similar soils that are formed on such material in other parts of the province. No exposures of this bedrock were found within a few feet of the surface, but the nature of the parent material would seem to justify the assumption that bedrock is relatively close and that it has exerted a major influence in the development of that parent material.

1. Reddish Brown Sandstone

This material is found very near the surface and caps the north slopes of the slight elevations that are found just south of Codesa, Wanham and Spirit River. It is brick red in color and has a striking appearance in exposed road cuts.

(a) Rahab Series: (Sandy loam to loam, lithosol)

There are about 1,400 acres in which Rahab soils predominate. They are developed on or in very close association with the underlying reddish brown sandstone. Rahab soils have a reddish brown to dark reddish brown surface horizon that is from 2 to 6 inches thick. The subsoil consists of a variable mixture of weathered bedrock material and fragments of sandstone. Areas of Rahab soils are small and frequently difficult to separate on this scale of mapping.

Agricultural Use: Rahab soils are often quite shallow and their parent material is relatively impervious to both water and root penetration. They are inferior agricultural soils and the shallower members should not be cultivated.

2. Saline, Sandy Shale

In the mapped area there are thin surfaced solonetz-like soils developed on shallow till deposits that are closely underlain by parent rock. These till deposits are usually strongly cemented and contain a high proportion of saline sandy shale material that appears to be derived from the underlying Wapiti formation.

(a) Kavanagh Series: (Degraded black to black loam to heavy loam)

Kavanagh soils predominate in about 7,200 acres in the southwestern part of the mapped area. They usually occur in relatively small areas either alone or in association with some of the Braeburn, Saddle, and Esher soils. In the vicinity of Heart Valley they are found in association with Belloy soils and their parent material may form the D horizon of some of these soils. Kavanagh soils are found on depressional to gently rolling topography usually on or at the base of long smooth slopes. The native cover consists of scrub poplar, willow and the coarser grasses including some of the salt resistant varieties.

Kavanagh soils are poorly drained. They have a thin dark greyish brown to black surface layer and a subsoil that is strongly cemented and relatively impervious to both root and water penetration. 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 excessive surface salt concentrations or salt crusts do not occur in association with Kavanagh soils.

The following is a generalized description of a profile typical of the Kavanagh series. It appears to be a solonetz-like profile that has some of the characteristics of a solodized solonetz and some of a podsolized profile. A similar profile is typical of soils developed primarily on Edmonton parent rock and found in the vicinity of Kavanagh. They are described in the report titled "Soil Survey of Peace Hills Sheet."

Horizon	Depth in Inches	Description
A_1	0 - 4	Greyish brown to very dark brown loam to clay loam. Very little structure. Often overlain with an A_0 horizon. pH 5.0 to 6.0
A_2	4 - 6	Light yellowish brown sandy loam, vesicular, coarse platy, tending to nuciform. pH 5.3 to 6.3
B_2	6 - 10	Dark greyish brown to very dark grey clay loam, very firm to indurated round topped columns, blocky mesostructure. pH 4.8 to 5.8
B_3	10 - 22	Greyish brown to dark greyish brown clay loam, massive, blocky to nuciform mesostructure. pH 6.3 to 7.3
Bca	22 - 28	Greyish brown to dark greyish brown clay loam to loam. Occasional sandy streaks, high in salts. pH 7.3

The whole profile has occasional stones and except for the A horizons it is very firm when dry.

Agricultural Use: Kavanagh soils are inferior agricultural soils. Their very firm, dark colored subsurface layer 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 by occasional deep plowing or by growing deep rooted crops. The former method does not appear satisfactory since the power required for deep plowing tends to make the operation too costly. On the other hand, such crops as sweet clover can 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 will in time improve the structure of this undesirable subsoil. Until then, however, it is poor to fair arable land, whose undesirable characteristics are most apparent following heavy rains and during prolonged dry spells.

J. Organic Soils

Organic soils are found in low poorly drained areas. They occur in patches of varying size associated with practically all of the soil series mapped in this area. They are particularly prevalent in the Falher, Judah, Davis and Culp soil areas and they occur extensively in some of the sand areas. The native cover consists of sedges and other moisture-loving coarse grasses, mosses, and in some of the larger areas variable stands of willow, spruce and tamarack.

Organic soils have an accumulation of organic matter that usually exceeds a thickness of 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 was made to separate them on the basis of the characteristics of the D horizon.

(a) Eaglesham Series: (Sedge peat)

There are approximately 76,000 acres of Eaglesham soils in the many scattered and usually small areas outlined on the soil map. No estimate is made of the extent of their occurrence in the numerous low spots that are too small to outline on this scale of mapping. However, their relative distribution, in areas in which they are of significant occurrence, is indicated by means of map symbols. They are associated, to a variable extent, with most of the soils of this area.

The organic material of Eaglesham soils consists entirely or predominantly of sedge peat which, in this area, seldom exceeds a thickness of 30 inches. There is a considerable variation, however, in the thickness of the peat and in the nature of the underlying material. The following is a description of a profile typical of the Eaglesham series:

Horizon	Depth in Inches	Description
1.	0 - 16	Dark brown to brown partially decomposed sedge and rush remains. pH 5.8
2.	16 - 18	Dark brown to black fairly well decomposed sedge and rush remains. pH 6.8
3.	18 - 20	Black, well decomposed muck in which there are few recognizable leaf and stem remains. pH 7.3
4. (D)	20 - 28	Light brownish grey to grey clay, fine granular, numerous rusty stains or streaks. pH 7.8
5. (Ca)	28 - 36	Grey to dark grey clay, fine granular, moderate lime. Rusty stains or streaks are found in the upper 4 inches. pH 7.9

This profile is found on heavy textured lacustrine deposited material. Similar profiles are also found on the other materials described in the preceding portion of this report. For example, the following is a description of an Eaglesham profile found on light textured alluvial material in the area southeast of Eaglesham:

Horizon	Depth in Inches	Description
1.	0 - 16	Brown to very dark brown sedge peat. pH 6.6
2.	16 - 24	Very dark brown sandy muck. pH 5.8
3. (D)	24 - 36	Light yellowish brown fine sand. pH 5.6
4. (D)	36 - 42	Grey to dark grey sandy clay loam — iron stained, firm. pH 7.9
5. (Ca)	42 - 48	Similar to above horizon but has occasional bands of sand and is moderately high in lime. pH 8.3

Agricultural Use: In wooded areas 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 often 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 is sufficiently improved, coarse grains can be grown successfully. In many portions of the Falher soil areas it is very difficult to distinguish old peat soils from the better drained soils after prolonged cultivation.

The deeper Eaglesham soils in which the organic accumulation exceeds a thickness of about 30 inches, should not generally be cultivated. They are often quite wet and, while the depth of organic material can be reduced by draining and burning such areas, they should not be disturbed since they may be of value in maintaining ground water supplies. Areas of such soils are found adjoining Lac Magliore, Kakut lake and in what is locally known as Egg lake, south of Eaglesham. Other areas are found south of Donnelly and in small patches elsewhere in the mapped area. In many cases, portions of these areas are being cultivated at the present time but this practice should be discontinued. The community can ill afford the loss of at least the larger of its natural water reservoirs.

(b) Kenzie Series: (Moss peat "muskeg")

Soils of this series are of relatively infrequent occurrence in this area. They have an accumulation of moss peat and areas of these soils are commonly referred to as "muskegs." The larger of such areas are outlined and make up a total of approximately 10,000 acres in the mapped area. In addition, numerous small areas are indicated but not outlined in parts of the southern and eastern portions of the area. Kenzie soils are found in poorly drained depressional areas in which the native cover consists of sphagnum moss and ledum shrub, occassional sedges, and variable stands of spruce, tamarack, birch and willow.

The organic material of Kenzie soils is usually much coarser and woodier than that of Eaglesham soils. It consists of moss peat or a mixture of moss and sedge peat in which the moss peat is predominant. In this area the organic accumulation rarely exceeds a thickness of about 30 inches. The following is description of a profile typical of the Kenzie series:

Horizon	Depth in Inches	Description
1.	0 - 8	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.	8 - 13	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. pH 4.3
3.	13 - 19	Dark brown to very dark brown fairly well decomposed peat that often contains recognizable stems and woody remains. pH 4.8
4. (D)	19 - 28	Light yellowish brown to light brownish grey fine sandy loam, coarse blocky, very firm, occasional rusty streaks. pH 6.8
5. (D)	28 - 34	Grey and light brownish grey clay, coarse nuciform, firm, granular mesostructure. Contains rusty stains or streaks. pH 7.0
6. (D)	34 - 40	Greyish brown clay, fine granular, firm. pH 7.2

The thickness of the organic accumulation is quite variable and in areas adjoining the mapped area it often exceeds 36 inches. Similarly the underlying material may differ appreciably from that described. Kenzie soils are found on most of the parent materials described in the preceding part of this report.

Agricultural Use: Kenzie soils are inferior agricultural soils. The peat is not usually in an advanced stage of decomposition and it would require a considerable time after drainage before these soils are in a proper condition for seeding. Most of the Kenzie soil areas are not being cultivated at the present time. It would appear most desirable from the standpoint of moisture conservation that at least the larger of these areas be protected and permanently withheld from cultivation.

DESCRIPTION OF MAPPED AREAS

The mapped areas are designated usually by two series names. In each case the first named series is believed to be predominant while the second named series is the most significant of the associated soils in each mapped area. Reference then to the series descriptions will enable the reader to familiarize himself with the dominant characteristics of each outlined area. However, the use of only two series names in the designation is not sufficient to denote the range of variability in various soil areas. In many cases, soils forming but minor percentages of the mapped areas are nevertheless of significant occurrence and in small local areas that do not appear on the soil map they may be predominant. Since the soils are quite variable in this area, and since it has not been possible to outline small areas or adequately indicate the range of variability on this scale of mapping, the following brief descriptions of some of the mapped areas may be helpful in interpreting the accompanying soil map.

Throughout the mapped area soils that are formed on the same type of parent material but differ in the color of their surface horizons, often occur in very close association with each other. This may be due to differences in the direction of slope or in micro-relief. In such cases it is not possible to outline each separate soil series on this scale of mapping, but an attempt is made to outline the darker colored areas from the lighter colored greyer ones and to indicate this difference by differing combinations of series names. For example, near Falher, various areas are outlined and designated as Falher-Rycroft, Falher-Nampa, Nampa-Falher or Falher-Prestville. In these areas all four of the soil series developed on lacustrine parent material may occur, but the two selected indicate the dominant characteristics of each outlined area. Thus Falher-Rycroft are darker colored areas than the Falher-Nampa areas, but not as dark as the Rycroft-Falher areas. The Nampa-Falher areas are depressional and quite grey, while the Falher-Prestville are also somewhat depressional, but the low areas have an appreciable proportion of thin peat soils. Usually the first named series forms over 50 percent of the area while the second named makes up from 25 to 50 percent of the area. Similar considerations form the basis of separating other soil areas in which the soils are developed on the same type of parent material. In no case does the use of just the two series names imply the absence of soils other than those indicated in the designation.

In a large proportion of the mapped area soils developed on different types of parent material are found in close association with each other. Such soils are difficult to separate and the soil areas are difficult to designate in such a way as to indicate the range of variability in both color and parent material. In the Braeburn-Donnelly and Donnelly-Braeburn soil areas, for example, the predominant soils are designated in the order of their occurrence in each of these areas. However, minor proportions of Saddle and Esher soils may occur and quite often Codesa and Clouston soils are found in association with these soils. The latter may occur in small patches and may predominate in some parts of these areas. While the larger areas are outlined, the numerous small patches could not be shown on this soil map. Similarly only the larger areas of organic soils are outlined or indicated. Thus a Donnelly-Braeburn soil area consists of both Donnelly and Braeburn soils, with the former usually predominant, and it may include some Esher, Saddle, Codesa, Clouston, depression podsol and organic soils.

The depth and distribution of the alluvial deposited materials is very variable in this area. In many of the Peoria, Belloy and Codesa soil areas the underlying heavier textured material may be found within about 18 inches of the surface. It may therefore affect the growth and development of crops in such areas. Thus in most cases the second series name selected for those areas is that of the soil developed on the heavier material even though it may not occur to a sufficient extent to be included as part of the designation of that area. A Belloy-Esher soil area, for example, would consist of Belloy soils underlain at varying depths by modified lacustrine material. It would include an appreciable proportion of Esher soils but these would not necessarily occur to a greater extent than Codesa, Eaglesham or other related soils. In many of the Bronco, Judah, Davis and Culp soil areas however, the underlying, often heavier textured material is usually much deeper in all except some of the lower lying portions and in the fringe portions of these areas. In the low-lying portions both Wanham and Nampa soils are of common occurrence either alone or in association with each other. Thus, the Judah-Nampa soil areas have many depressional portions in which Nampa soils are often found. However, Wanham soils, thin organic and organic soils may be just as common in these portions but they are more closely related to Judah soils, and their occurrence may be less significant agriculturally, than that of Nampa soils.

Some of the large poorly drained portions of these areas are difficult to designate adequately. The Nampa-Judah area north of Tangent is one which has Nampa, Judah, Wanham, Prestville, Davis, Eaglesham and Kenzie soils. The area may have been originally a large bog in which islands of Judah and Davis soils were common. Much of the peat has been burned off and drainage has been improved with the result that soils not unlike Nampa soils prevail in the low flat portions of this area, while on the better drained islands Judah soils are predominant. The larger areas of organic soils are outlined or indicated in those portions where they are of significant occurrence. The distribution of organic soils in this and the neighboring Davis-Judah soil areas was determined largely from aerial photographs since these areas were relatively inaccessible at the time of survey. The Wanham - Nampa - Judah soil area extending from near Wanham to just beyond Codesa consists of a mixture of soils found in a low-lying area fringing the heavier textured soil areas to the south. The alluvial deposition in this area is often shallow and while Wanham, Nampa and Judah soils are most common, Falher soils are found in some of the better drained positions and their heavier textured parent material may underlie the thin phase Judah soils in this area. In other fringe areas the occurrence of Bronco and Judah soils is confined to the better drained humps or knolls of such areas. Near Rycroft, Bronco soils often occur on isolated knolls scattered throughout an otherwise level to undulating area. Falher or Rycroft soils are found on the lower slopes and level areas adjacent to these knolls. Thus depending on the relative proportions of each, such areas are designated as Rycroft-Bronco, Falher-Bronco or Bronco-Falher. They may and often do include varying but usually minor proportions of Nampa, Wanham and Judah soils.

In addition to designating each soil area by a series name or by a combination of series names to indicate the dominant characteristics of that area, other supplementary characteristics are indicated on the soil map. The topography phase of each soil area is indicated by means of hatchuring. The various topography phases are indicated on the map according to the separations referred to in the map legend and described in a previous section of this report.

The steeply sloping and rough land bordering the stream courses is mapped as *Eroded Land.* About 218,000 acres of such land are found adjacent to the drainage courses and in the many deep coulees that are characteristic of much of this area. Eroded land is of value as pasture and woodland and as such it serves a very useful purpose. Overgrazing, indiscriminate removal of tree cover or cultivation should not be permitted in such areas. 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. (See Plate III, Fig. 2.) In addition to the topography phases, other features that are important from the standpoint of land use, are indicated wherever possible. For example, the excessively stony area south west of Wanham is designated as Codesa-Braeburn *stony phase.*

The dominant characteristics of each mapped area will be apparent if the reader refers to the description of the designated soil series and notes whatever other features are indicated in the area under consideration. The information is not presented in sufficient detail, however, to show the variations that may exist in individual farm units. It cannot therefore be used as the sole basis in determining the value of farm units for sale or assessment purposes.

SOIL RATING

In describing the soils of the Rycroft and Watino sheets reference has been made to a comparative rating as regards their native productivity. This rating is based on a consideration of such factors as the type of soil profile, degree of stoniness, and topography. The effect of these factors is considered in establishing a productivity grouping. This grouping is based on the past performance of somewhat similar soils under existing farm practices. It serves only to compare the native productivity of the soils in this area and is not intended to indicate present or potential capabilities. No attempt is made to state the type of crop that should be produced nor is it possible to set any definite productivity limits for these groups in this area.

Accompanying this report is a soil rating map prepared on the scale of four miles to the inch. This map divides the area into five land classes: one pasture and four arable. These classes are indicated by numbers that appear on the legend of the map. Since the nature of the native 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 land class groups outlined in the surveyed area:

Group 1.	Pasture and woodland	395,000 acres
Group 4.	Poor to fair arable land	95,000 acres
Group 5.	Fair to fairly good arable land	415,000 acres
Group 6.	Fairly good to good arable land	580,000 acres
Group 7.	Good to very good arable land	280,000 acres

In some cases subdivisions were made in the different groups and there is some overlapping between the various groups. For example, two areas may appear on the soil rating map as Group 7, that is good to very good arable land. In the descriptions of the dominant series, one series may be listed as good and be near the bottom of that class while another may be listed as very good and be near the top of that class. However, the final rating of those areas is conditioned by the rating and distribution of the other soils intimately associated with the dominant series.

In considering the rating and productivity grouping of the soils in the surveyed area it must be borne in mind that a satisfactory system of rating grey wooded soils has not yet been worked out. This is largely due to the fact that long time average yields of crops grown in the recommended rotations are not yet available. The rating used in preparing the productivity grouping proposed on the soil rating map is based largely on the past performance of somewhat similar soils under the prevailing grain-summerfallow system of cropping. At best it indicates only the native productivity of these soils measured in terms of average wheat yield. 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 from 20 to 25 bushels of wheat per seeded acre. These are tentative limits suggested to give an approximate relationship between the native fertility of the various groups. They are not entirely satisfactory nor can they 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 rather wide variety of other crops. Furthermore, while their native fertility may be quite low they respond very favorably to good management practices supplemented, when necessary, with amendments of commercial fertilizer. For example, according to the system used in preparing this productivity grouping, the soils on the Department of Soils Experimental Farm at Breton could not be included in a group higher than Group 5. Yet the value of the crops grown in the rotations on the Breton farm compares favorably with the value of the average grain crops grown on the black soils typical of Groups 7 and 8. Many farmers in the Rycroft and Watino sheets have had similar experiences, and with continued good management practices their average returns will continue to be higher than those suggested in this productivity grouping. Furthermore, as better management practices become more widely established, the proposed productivity grouping for most of the arable soils in this area might be raised one category.

MECHANICAL AND CHEMICAL ANALYSIS OF SOILS

Mechanical Analysis

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 Rycroft and Watino 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 .002 mm. in diameter, whereas the sand fraction includes all particles above .05 mm. in diameter. In the last column of Table 8 each horizon, of the profiles analyzed, is given a textural classification based on the guide proposed by the U.S. Bureau of Soils in September 1947.

The data in Table 8 indicate a marked similarity in the proportions of the different fractions occurring in the various horizons of the profiles typical of the Esher, Nampa and Rycroft series. Very often the only difference between the soils of the Esher and Rycroft series, for example, is that the former appear to have a somewhat browner and stonier profile than that of the Rycroft series. However, the material on which they have developed is usually not as uniform nor as dark colored as that of the Rycroft soils. The proportions of the different fractions will vary much more in the Donnelly-Landry group than in the Nampa-Rycroft group of soils. The Davis, Judah and Bronco soils are generally higher in silt and lower in clay than the Rycroft and Landry groups.

The data also indicate an apparent tendency in the greyer soils and the solonetzic soils towards an accumulation of the finer particles in the upper part of the B horizon. However, considerably more work of this nature should be done to warrant further comment in that regard. The predominantly silty texture is an outstanding characteristic of the soils in this area.

TABLE 8.—Mechanical Analysis of Some Representative Soil Profiles

Sample No.	Depth in inches	Horizon	Sand above .05mm	Silt .05mm-.002mm	Clay less than .002mm	Texture as per U.S. Guide
			Calculated on a percent basis			
Braeburn Series—Grey wooded loam, sec. 13-80-21 W. 5th						
2505	0-2	A_0 & A_1	45	50	5	Si.L.-S.L.
2506	2-6	A_2	37	55	8	Si.L.
2507	6-8	A_3	26	56	18	Si.L.
2508	8-14	B_2	25	39	36	C.L.
2509	14-34	B_3	30	46	24	L.
2510	34-40	Bca	25	48	27	C.L.-L.
Esher Series—Degraded black silt loam, sec. 16-77-5 W. 6th						
2797	0-4	A_1	35	53	12	Si.L.
2798	4-6	A_2	21	60	19	Si.L.
2799	6-8	A_3 (B_1)	8	46	46	Si.C.L.-Si.C.
2800	8-14	B_2	9	43	48	Si.C.
2801	14-24	B_3	11	37	52	C.
2802	24-34	Bca	15	47	38	Si.C.L.
2803	34-44	C	10	40	50	Si.C.-C.
Nampa Series—Grey wooded silt loam at Illustration Station, sec. 2-78-20 W. 5th						
2689	2-6	A_2	18	64	18	Si.L.
2690	6-9	A_3 (B_1)	12	49	39	Si.C.L.
2691	9-15	B_2	10	43	47	Si.C.
2692	15-21	B_3	10	34	56	Si.C-C.
2693	21-24	B_4	10	43	47	Si.C.
2694	25-30	Bca	4	54	42	Si.C.-Si.C.L.
Rycroft Series—Black silt loam, sec. 16-78-5 W. 6th						
2791	0-6	A_1	28	57	15	Si.L.
2792	6-12	A_3 (B_1)	15	55	30	Si.C.L.
2793	12-18	B_2	5	42	53	Si.C.
2794	18-26	B_3	7	48	45	Si.C.
2795	26-32	Bca	8	37	55	C.
Judah Series—Degraded black (brown forest) silt loam, sec. 8-78-22 W. 5th						
2482	1-3	A_1	18	67	15	Si.L.
2483	3-6	A_3	17	66	17	Si.L.
2484 2485 2486	6-24	B	7	59	34	Si.C.L.
2487	24-36	Bca	8	60	32	Si.C.L.
2488	at 36	C	5	58	37	Si.C.L.
Bronco Series—Black silt loam, sec. 31-78-5 W. 6th						
2749	0-3	A_1	36	55	9	Si.L.
2750	3-6	A_3	12	68	20	Si.L.
2751	6-10	B_1	11	68	21	Si.L.
2752	10-16	B_2	8	66	26	Si.L.
2753	16-24	B_3	9	50	41	Si.C.L.-Si.C.
Davis Series—Grey wooded silt loam, sec. 28-78-25 W. 5th						
2299 2300	4-10	A_2 & A_3	22	61	17	Si.L.
2301	10-28	B	4	57	39	Si.C.L.
2302	28-36	Bca	11	67	22	Si.L.

TABLE 8.—Mechanical Analysis of Some Representative Soil Profiles (Continued)

Sample No.	Depth in inches	Horizon	Sand above .05mm	Silt .05mm-.002mm	Clay less than .002mm	Texture as per U.S. Guide
			Calculated on a percent basis			
Culp Series—Grey wooded loamy sand, sec. 36-77-24 W. 5th						
2517	2-8	A_2	83	16	1	L.S.
2518	8-14	A_3	90	8	2	L.S.-S.
2519	14-24	B	76	14	10	S.L.
2520, 2521, 2522	24-36	Bca	87	8	5	L.S.
2523	at 48	C	86	9	5	L.S.
Peoria Series—Degraded black silt loam, sec. 21-76-3 W. 6th						
2315	0-8	A_1	44	50	16	Si.L.-L.
2316	8-12	A_3	50	36	14	L.
2317	12-14	B	50	32	20	L.
2318	14-24	D	30	39	31	C.L.
Kavanagh Series—Black silt loam solonetz, sec. 22-76-3 W. 6th						
2310	0-4	A_1	31	61	8	Si.L.
2311	4-6	A_2	31	58	11	Si.L.
2312, 2313	6-18	B	19	38	43	C.
2314	18-24	Bca	25	49	26	C.L.-L.

Chemical Analysis

Nitrogen, phosphorus, calcium, magnesium and soil acidity analyses were made on type profiles from the Rycroft and Watino sheets. A number of these are reported in Table 9.

The nitrogen content, which is directly related to the organic matter content, varies greatly in this area. There is sometimes as significant a difference in the nitrogen content between different types of black soils, for example, as there is between the black, degraded black, and grey wooded soils. Thus, the Kavanagh soils have 0.275 percent nitrogen in the surface foot whereas the other black soils average 0.46 percent nitrogen in the surface foot.

Increase in degradation results in a decrease in the nitrogen content of the surface horizons. While the black soils in this area average 0.46 percent nitrogen, the degraded black soils average 0.34 percent and the grey wooded soils average 0.153 percent nitrogen in the surface foot.

The A_0 horizon has the highest nitrogen content of any horizon and its depth materially affects the percentage of nitrogen that is present in the surface foot. Much of this horizon can be destroyed by fire. If destroyed, the nitrogen in the surface foot is reduced appreciably. In practically 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 in all of the heavier textured profiles of this area.

The average nitrogen content in the surface foot of soils sampled in other parts of Alberta is 0.407 percent for the black soils and 0.091 percent for the grey wooded soils. The nitrogen content of the soils in the surveyed area compares very favorably with these averages. Actually the grey wooded soils in the Rycroft and Watino sheets have a somewhat higher than average nitrogen content in the surface foot. Generally they do not have as thick an A_2 horizon as the grey soils developed in other parts of Alberta.

All the analyses reported in Table 9 were made on uncultivated soils and are believed to be representative of the virgin soil profiles. In the case of nitrogen the data represent the total amounts accumulated from the decay of vegetation over a long period of years. Continuous grain-fallow rotations, wind erosion, and water erosion all tend to reduce the proportion of the organic matter in the cultivated soils. This results in lower fertility, accelerated erosion and poorer physical condition. Analyses conducted at the University of Alberta indicate that there is a very marked decrease in the nitrogen content of cropped land as compared with the native sod. Every effort must be made to build up and maintain an adequate organic matter content. This need is particularly acute in the grey wooded soils since their organic matter content is naturally fairly low.

Phosphorus is a mineral element and the total amount in the soils is related directly to the soil's parent material. Analyses of the parent materials of this area indicate that while they cannot be considered deficient in phosphorus their natural supply tends to be low. The total phosphorus ranges from about 0.03 to 0.06 percent and it would appear that the Tangent, Davis and Culp soils are inclined to be somewhat lower in phosphorus than the Landry-Donnelly and the Rycroft-Nampa soils. The indications are that phosphorus may be one of the first elements that should be added artificially through the application of commercial fertilizer.

The phosphorus content of the surface foot varies from an average of 0.08 percent in the black soils to an average of 0.035 percent in the grey wooded soils. This is slightly lower than the average of black and grey wooded soils typical of other areas. There is a decrease in phosphorus with an increase in soil degradation but this decrease is not as marked as in the case of nitrogen. Furthermore, phosphorus is generally much more evenly distributed throughout the profile than is nitrogen.

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. Therefore, although there may be a fairly large amount of the mineral plant food in the soil there may not be sufficient in the available form to adequately supply that crop. Maintaining an adequate supply of organic matter is one of the best ways of providing a supply of available plant nutrients.

Ordinarily the calcium and magnesium content tends to be low in the surface horizons and much higher in some of the sub-surface horizons. This is due to the fact that, being slightly soluble, they are carried down by the percolating rain water. The depth to the horizon of calcium carbonate accumulation is a measure of the penetration of rain water. However some of these elements are returned to the surface horizons by the plant roots. For example, the A_0 horizons, consisting of semi-decomposed plant remains, often contain over one percent calcium. In the succeeding horizons the amount decreases to about half or less of that in the A_0 horizon until the lower B horizons are reached. In the Braeburn, Esher and Falher groups of soils there is usually about one to two percent calcium in the Bca or lime horizons. The calcium content of the Bca and C horizons of these soils tends to be somewhat lower than that of other similar heavy textured soils. However, in the Davis, Culp and Judah group the amount of calcium in the Bca horizon often exceeds five percent. The parent material of the latter group is much higher in calcium than that of the former group and in this respect it compares favorably with materials derived from some of the Cordilleran deposits. The lime carbonate (Bca) horizon is usually found at depths of 20 to 30 inches in the black and degraded black soils of this area and at depths of 30 to 40 inches below the surface in the grey wooded soils.

Some of the other elements necessary for plant growth, such as potassium, iron and sulphur were not determined on the samples collected in the Rycroft and Watino sheets. Analyses in other areas throughout the province indicate that potassium and iron are generally present in fairly large quantities. These experimental data indicate that sulphur may be deficient in some of the grey wooded soils. However, most of the grey wooded soils in this area are formed on parent material that contains varying amounts of gypsum (calcium sulphate).

The pH (soil 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 A_1 horizons range from pH 5.5 (slightly acid) to pH 7.7 (slightly alkaline). A pH value of 7.0 is neutral (neither acid nor alkaline). The most acid surface horizons are those of some of the grey wooded, solonetz, and organic soils. The most alkaline surface horizons are those of the soils developed on the limier parent materials typical of the Davis, Culp and Judah series. The A_2 and upper B horizons of degraded and grey wooded soils tend to be slightly acidic, and the uppermost B horizon is often the most acidic horizon of the profile. In the grey wooded soils reported in Table 9 it ranges from pH 4.7 in the Davis soils to pH 6.4 in the Culp soils. All pH determinations were made with a standard glass electrode pH meter on samples to which distilled water was added to give a soil-water ratio of 1:2.

The reactions of the soils in this area are of the same order as those of similar soils in other parts of Alberta. Generally speaking, the soils have not required the addition of lime for successful crop production. However in the case of such soils as those of the Donnelly, Nampa, and Kavanagh series the addition of lime might prove beneficial at least until such time as deep rooted crops can return enough of the calcium to the surface horizons.

In the profiles studied to date an alkali condition has not been encountered in the Rycroft and Watino sheets. In the horizons below the lime carbonate horizon the highest percentage of total salts has been approximately 2 percent. Most of this has been calcium sulphate which at that depth and in that concentration does not have a deleterious effect on crop production. However some of the salt crust formed on Kakut lake analyzed 4 percent total salts of which over half was sodium sulphate. No other salt encrusted areas were observed at the time of survey, and alkali does not appear to be a soil problem in the Rycroft and Watino sheets.

TABLE 9.—Chemical Composition of Representative Soil Profiles

			Percent						
Sample No.	Depth in inches	Horizon	Nitrogen	N in 1st 12″	P	P in 1st 12″	Ca	Mg	pH
Braeburn Series—Grey wooded loam, sec. 13-80-21 W. 5th									
2505	0-2	A_0 & A_1	0.860		0.080		1.24	0.41	6.9
2506	2-6	A_2	0.055		0.022		0.21	0.35	6.2
2507	6-8	A_3	0.055		0.017		0.22	0.48	5.2
2508	8-14	B_2	0.067	0.192	0.020	0.030	0.22	0.68	5.0
2509	14-34	B_3	0.067		0.038		0.27	0.58	6.9
2510	34-40	Bca	0.070				1.17	0.91	7.9
Donnelly Series—Grey wooded heavy loam, sec. 26-78-21 W. 5th									
2496	0-1	A_0	0.473		0.072		0.42	0.43	6.7
2497	1-3	A_2	0.088		0.023		0.18	0.37	5.9
2498	3-5	A_3 (B_1)	0.110		0.030		0.11	0.61	5.4
2499	5-11	B_2	0.110	0.136	0.034	0.035	0.14	0.81	5.1
2500	11-17	B_3	0.101		0.040		0.19	0.96	5.1
2501	17-23	B_4	0.107		0.059		0.37	0.99	7.2
2502	23-31	Bca	0.095				1.47	1.09	8.0
2503	31-37	B_{SO_4}	0.076				2.14	1.02	7.8
2504	37-46	C	0.095				1.89	0.99	7.8

TABLE 9.—Chemical Composition of Representative Soil Profiles (Continued)

Sample No.	Depth in inches	Horizon	Percent Nitrogen	N in 1st 12″	P	P in 1st 12″	Ca	Mg	pH
Esher Series—Degraded black silt loam, sec. 16-77-5 W. 6th									
2797	0-4	A_1	0.776		0.084		0.50	0.45	6.2
2798	4-6	A_2	0.365	0.446	0.122	0.076	0.30	0.42	6.1
2799	6-8	A_3 (B_1)	0.186		0.058		0.24	0.73	6.3
2800	8-14	B_2	0.286		0.055		0.29	0.74	6.6
2801	14-24	B_3	0.136		0.066		0.92	0.79	8.5
2802	24-34	Bca	0.115		0.065		1.53	1.04	8.0
2803	34-44	C	0.109		0.066		0.85	1.04	8.2
Nampa Series—Grey wooded silt loam at Illustration Station, sec. 2-78-20 W. 5th									
2688	0-2	A_0 & A_1	0.372		0.098		0.76	0.33	5.5
2689	2-6	A_2	0.061	0.125	0.034	0.047	0.31	0.31	5.2
2690	6-9	A_3 (B_1)	0.0915		0.035		0.25	0.61	5.0
2691	9-15	B_2	0.081		0.043		0.25	0.73	5.2
2692	15-21	B_3	0.075		0.052		0.30	0.92	7.6
2693	21-25	B_4	0.099		0.067		0.45	0.79	7.5
2694	25-30	Bca	0.087		0.079		1.23	0.77	7.6
Falher Series—Degraded black silt loam, sec. 6-78-21 W. 5th									
2461	0-1	A_0	1.101		0.219		1.59	0.81	7.6
2462	1-4	A_1	0.488		0.092		0.48	0.81	6.7
2463	4-8	A_3 (B_1)	0.214	0.329	0.045	0.068	0.27	0.62	5.7
2464	8-12	B_2	0.156		0.035		0.27	0.90	5.2
2465	12-18	B_3	0.134		0.041		0.26	0.91	5.0
2466	18-26	B_4	0.128		0.058		0.44	1.07	7.4
2467	26-30	Bca	0.110				1.55	1.24	8.1
Rycroft Series—Black silt loam, sec. 9-78-21 W. 5th									
2489	0-6	A_0 & A_1	0.753		0.109		0.53	0.63	6.8
2490	6-8	A_2	0.171		0.051		0.22	0.46	6.3
2491	8-10	A_3 (B_1)	0.113		0.034		0.23	0.57	6.4
2492	10-16	B_2	0.180	0.454	0.064	0.079	0.28	1.10	6.8
2493	16-22	B_3	0.162		0.063		0.50	1.03	7.7
2494	22-34	Bca	0.113				1.21	0.93	8.2
2495	34-42	B_{SO_4}	0.101				1.81	1.10	8.0
Prestville Series—Silty clay loam—thin peat, sec. 34-78-1 W. 6th									
2281	0-3	A_0	1.249		0.176		2.12	0.47	7.4
2282	3-7	A_1	0.477	0.54	0.155	0.13	0.66	0.60	6.9
2283	7-13	B_1	0.159		0.082		0.40	0.59	5.8
2284	13-20	B_2	0.125				0.40	0.67	5.9
Judah Series—Degraded black (brown forest) silt loam, sec. 8-78-22 W. 5th									
2481	0-1	A_0	0.790		0.090		1.35	0.51	7.4
2482	1-3	A_1	0.320		0.043		0.54	0.51	7.1
2483	3-6	A_3	0.128		0.017		0.31	0.51	6.7
2484	6-12	B_1	0.113	0.208	0.019	0.028	0.32	0.80	6.2
2485	12-18	B_2	0.101		0.026		0.39	0.93	5.7
2486	18-24	B_3	0.107		0.053		0.89	0.81	7.2
2487	24-36	Bca	0.092				9.02	1.14	8.2
2488	at 36	C	0.076				5.48	1.29	8.1

TABLE 9.—Chemical Composition of Representative Soil Profiles (Continued)

			Percent						
Sample No.	Depth in inches	Horizon	Nitrogen	N in 1st 12″	P	P in 1st 12″	Ca	Mg	pH
Judah Series—Degraded black (brown forest) silt loam, sec. 22-78-1 W. 6th									
2275	0-3	A_0	1.199		0.097		2.02	0.47	7.5
2276	3-7	A_1	0.264		0.049		0.45	0.48	7.0
2277	7-11	A_3	0.100	0.429	0.049	0.059	0.22	0.58	6.6
2278	11-17	B_1	0.097		0.023		0.32	0.87	5.4
2279	17-23	B_2	0.105				0.42	0.86	6.5
2280	at 30	Bca					4.16	1.13	8.1
Bronco Series—Black silt loam, sec. 31-78-5 W. 6th									
2749	0-3	A_1	0.940		0.125		1.22	0.38	7.2
2750	3-8	A_3	0.516		0.101		0.76	0.59	6.5
2751	8-13	B_1	0.265	0.476	0.072	0.091	0.56	0.44	6.3
2752	13-20	B_2	0.139		0.063		0.54	0.66	6.4
2753	20-24	B_3	0.125		0.066		0.60	0.88	6.8
Davis Series—Grey wooded silt loam, sec. 11-78-23 W. 5th									
2475	0-2	A_0	0.470		0.050		0.65	0.28	7.0
2476	2-6	A_2	0.070		0.017		0.19	0.29	6.4
2477	6-12	B_1	0.082	0.143	0.019	0.023	0.13	0.62	5.6
2478	12-20	B_2	0.067		0.035		0.19	0.76	6.0
2479	20-32	Bca	0.058				6.46	1.21	8.6
2480	32-40	C	0.055				5.21	1.24	8.6
Davis Series—Grey wooded silt loam, sec. 30-79-4 W. 6th									
2305	0-2	A_0 & A_1	0.204		0.049		0.54	0.32	7.2
2306	2-6	A_2	0.151		0.036		0.38	0.42	7.0
2307	6-8	B_1	0.091	0.129	0.028	0.036	0.20	0.47	5.8
2308	8-14	B_2	0.088		0.034		0.30	0.73	4.7
2309	24-30	Bca					2.30	0.90	7.9
Tangent Series—Degraded black silt loam, sec. 20-80-1 W. 6th									
2779	0-3	A_1	0.581		0.076		0.86	0.37	7.7
2780	3-5	A_2	0.271	0.242	0.060	0.058	0.59	0.37	7.6
2781	5-8	A_3(AB)	0.100		0.035		0.27	0.37	7.4
2782	8-16	B_2	0.080		0.061		0.31	0.43	7.6
2783	16-30	Bca	0.071		0.079		6.53	0.88	8.6
Culp Series—Grey wooded loamy sand, sec. 36-77-24 W. 5th									
2516	0-2	A_0 & A_1	0.979		0.062		2.28	0.23	7.5
2517	2-8	A_2	0.043		0.033		0.19	0.18	7.3
2518	8-14	A_3	0.021	0.192	0.031	0.037	0.15	0.20	7.0
2519	14-20	B_2	0.049		0.020		0.17	0.30	6.4
2520	20-26	B_3	0.046		0.048		0.22	0.38	6.7
2521	26-32	B_4	0.046		0.035		1.88	0.55	8.0
2522	32-40	Bca	0.043				4.08	0.67	8.3
2523	40-48	Bca	0.027				4.55	0.71	8.4
Alluvium—Immature soil on river flat, sec. 3-78-24 W. 5th									
2303	0-8	A	0.428		0.102		0.66	0.30	6.8
2304	8-24	B	0.153	0.336	0.069	0.091	0.38	0.39	5.7

TABLE 9.—Chemical Composition of Representative Soil Profiles (Continued)

Sample No.	Depth in inches	Horizon	Percent Nitrogen	N in 1st 12″	P	P in 1st 12″	Ca	Mg	pH
Peoria Series—Black silt loam, sec. 1-78-1 W. 6th									
2285	0-8	A_1	0.766		0.092		0.62	0.41	6.7
2286	8-12	A_3	0.094	0.534	0.047	0.78	0.22	0.30	6.7
2287	12-16	B	0.102		0.045		0.30	0.46	6.9
2288	16-24	D	0.105		0.062		0.38	0.63	7.8
2289	24-30	ca					5.82	1.03	8.1
Peoria Series—Degraded black silt loam, sec. 21-76-3 W. 6th									
2315	0-8	A_1	0.219		0.055		0.26	0.32	6.3
2316	8-12	A_3	0.066	0.168	0.073	0.061	0.14	0.33	6.0
2317	12-14	B	0.074		0.035		0.20	0.43	5.7
2318	14-24	D	0.071		0.063		0.18	0.58	5.6
Kavanagh Series—Black silt loam solonetz, sec. 22-76-3 W. 6th									
2310	0-4	A_1	0.505		0.106		0.20	0.36	6.0
2311	4-6	A_2	0.176	0.275	0.078	0.086	0.20	0.26	6.1
2312	6-8	B_{21}	0.139		0.054		0.16	0.53	6.7
2313	8-14	B_{22}	0.162				0.18	0.63	7.5
Eaglesham Series—Sedge peat soil, sec. 21-79-21 W. 5th									
2511	0-16	1	1.031	1.031	0.094	0.094	1.53	0.25	5.8
2512	16-18	2	0.796		0.080		0.98	0.75	6.8
2513	18-20	3	0.354		0.071		0.79	0.82	7.3
2514	20-28	4 (D)	0.119		0.118		0.98	0.74	7.8
2515	28-36	5 (ca)	0.113				2.48	1.03	7.9
Kenzie Series—Moss peat soil, sec. 29-75-18 W. 5th									
2864	0-8	1	0.708		0.049		0.82	0.18	4.7
2865	8-13	2	0.507	0.641	0.040	0.046	1.12	0.10	4.3
2866	13-19	3	1.117		0.038		1.82	0.14	4.8
2867	19-28	4 (D)	0.025		0.031		0.32	0.31	6.8
2868	28-34	5 (D)	0.078		0.045		0.66	0.74	7.0
2869	34-40	6 (D)	0.090		0.075		0.62	0.61	7.2

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 processes have not acted long enough to produce distinct soil horizons.

Available plant nutrients—Plant nutrients in soluable 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.

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.

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

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

Glei—A soil horizon in which the material has been modified by a fluctuating water table. It is frequently mottled with rusty brown and grey and is generally compact and sticky.

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 grey wooded 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 light colored surface horizons.

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 microrelief.

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

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.

Stones—In this report no attempt is made to classify stones according to size or material. Most of the stones are granites and quartzites, and vary from cobbles to large boulders. The following broad classification is used in designating their frequency of occurrence:

Stones few—Stones sparsely scattered over the fields. Picking if required will yield not more than about one load per acre.

Stones some—Indicates numbers in sufficient amount that they hinder cultivation and must be removed—possibly three to five loads per acre.

Stones many—Fairly stony land—possibly ten or more loads per acre.

Very stony—Indicates land on which it may be unprofitable to clear the stones.

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 depth as bands, and those over 12 inches in depth are referred to in this report as beds.

Structure (soil)—The aggregates into which the individual soil particles are arranged. Often one type of aggregate occurs within another. For example, the columnar structure of solonetzic soils will break down into smaller aggregates. The term macrostructure is used to designate the large columnar structure and mesostructure for the smaller blocky or nuciform aggregates. Still finer subdivisions of structure are sometimes referred to as microstructure. The following structures are recognized 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 the vertical axis longer than the horizontal and with fairly well defined and regular edges and surfaces. The tops may be rounded. Usually found in the B_2 horizon.

Prismatic—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well defined 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.

Various grades of structure depend on the degree of distinctness of aggregation and the durability of the aggregates to displacement or gentle crushing. The terms used to denote the grades of structure are: structureless, weak, moderate and strong.

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.

Texture (soil)—Refers to the relative proportion of the various size groups of individual soil grains. Size groups larger than .05 mm. in diameter are called sand, those from .05 mm. to .002 mm. are called silt, and those less than .002 mm. in diameter are called clay. The relative proportion of these soil separates in the soil classes most commonly referred to in this report is as follows:

Sand: contains over 90% sand sized soil grains.

Loamy sand: contains from 80% to 90% sand sized soil grains.

Sandy loam: contains from 50% to 80% sand and not more than 25% clay sized soil grains.

Loam: contains not more than 50% sand, not more than 50% silt and not more than 25% clay sized soil grains.

Silt loam: contains over 50% silt sized soil grains.

Clay loam: contains from 25% to 40% clay sized soil grains.

Clay: contains over 40% clay sized soil grains.

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.

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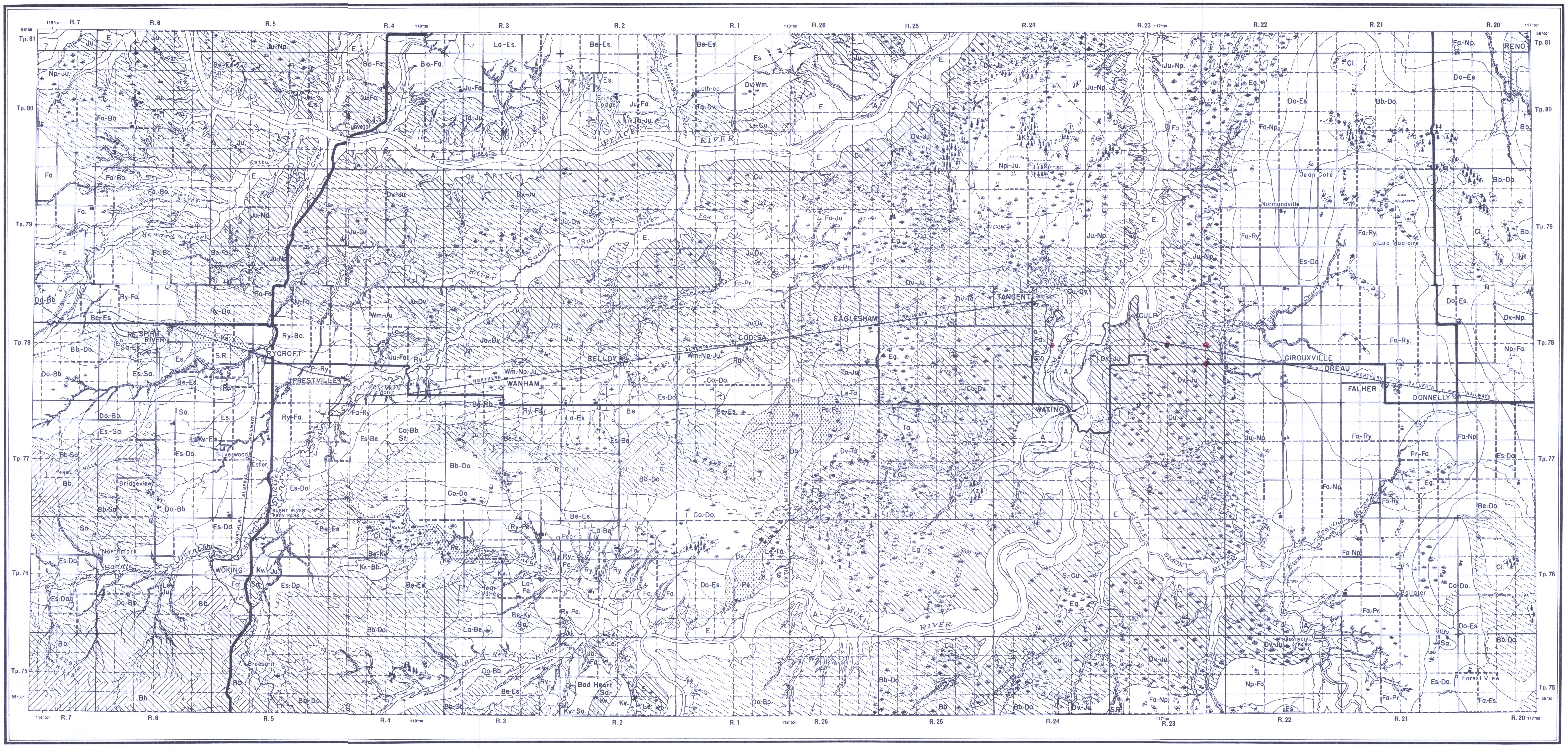
SOIL MAP OF THE RYCROFT AND WATINO SHEETS

PROVINCE OF ALBERTA

Scale 3 Miles to 1 inch

2 1 0 2 4 6 8 10 Miles



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

Compiled, drawn and published by the Research Council of Alberta, Edmonton, 1950, from base maps supplied by the Hydrographic and Map Service, Department of Mines and Resources, Ottawa.

LEGEND

SOIL SERIES

Soils developed on glacial till:

- **Braeburn**— loam to heavy loam, grey wooded — Bb.
- **Saddle**— loam to heavy loam, solod, degraded black — Sa.

Soils developed on stratified till or modified lacustrine material:

- **Donnelly**— heavy loam to clay loam, solodic, grey wooded — Do.
- **Esher**— heavy loam to clay loam, solod to solodized solonetz, degraded black — Es.
- **Landry**— silt loam to clay loam, solod to solodized solonetz, black — La.

Soils developed on lacustrine deposited material:

- **Nampa**— heavy loam to clay loam, solodic, grey wooded — Np.
- **Falher**— silty loam to clay loam, solodized solonetz, degraded black — Fa.
- **Rycroft**— silt loam to clay loam, solodized solonetz, black — Ry.
- **Prestville**— thin peat — Pr.

Soils developed on alluvial-lacustrine deposited material:

- **Judah**— silt loam to silty clay loam, degraded black or brown forest — Ju.
- **Bronco**— silt loam to silty clay loam, black — Bo.
- **Wanham**— depression podsol — Wm.

Soils developed on alluvial and aeolian deposited materials:

- **Davis**— loam to silt loam, grey wooded — Dv.
- **Tangent**— silty loam to silty clay loam, degraded black or brown forest — Ta.
- **Culp**— loamy sand to sandy loam, grey wooded — Cu.
- **Leith**— loamy sand to sandy loam, degraded black — Le.
- **Sand**— not differentiated as to series or profile type — S.

Soils developed on alluvial deposited materials:

- **Spirit River**— sandy loam to silt loam, immature, black — S.R.
- **Alluvium**— undifferentiated recent river deposits — A.

Soils developed on coarse outwash materials:

- **Clouston**— gravelly or stony loamy sand to sandy loam, grey wooded — Cl.

Soils developed on relatively thin alluvial deposits that overlie other heavier textured deposits:

- **Peoria**— sandy loam to silt loam, degraded black to black — Pe.
- **Codesa**— sandy loam to loam, grey wooded — Co.
- **Belloy**— sandy loam to silt loam, often gravelly, degraded black to black — Be.

Soils developed on relatively undisturbed residual materials:

- **Rahab**— sandy loam to loam, reddish brown, lithosol — Rb.
- **Kavanagh**— loam to heavy loam, solonetz, degraded black to black — Kv.

Organic Soils:

- **Eaglesham**— sedge peat — and Eg.
- **Kenzie**— moss peat ("muskeg") — and Kz

TOPOGRAPHY PHASES

Percent Slope	Mapped Phases
0.0 — 0.5 0.5 — 1.5	Level and undulating
0.5 — 1.5 2 — 5 6 — 9	Gently Rolling
6 — 9 10 — 15	Rolling
16 — 30	Hilly

Irregular, often steeply sloping banks adjacent to drainage courses—Eroded — E.

OTHER FEATURES

- Stony phase — St.
- Soil boundaries (determined)
- Soil boundaries (conjectured)
- Topography boundaries

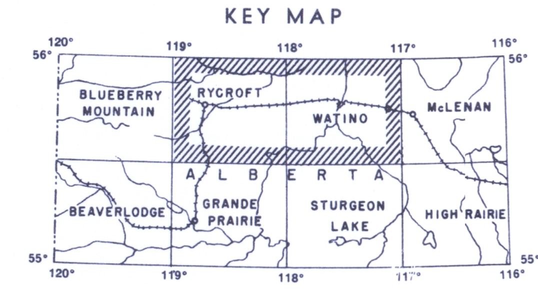
REFERENCE

- Roads — gravelled highway
  - — graded highway
  - — local road, well travelled
  - — local road, slightly travelled
  - — wagon road or trail
- Railway
- Projected railway
- Township boundary (surveyed)
- Township boundary (unsurveyed)
- Township corners
- Section line
- Intermittent stream
- Permanent lake
- Non-permanent lake
- Town (or built-up area)
- Church
- School
- Post Office at town or village
- Ferry

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



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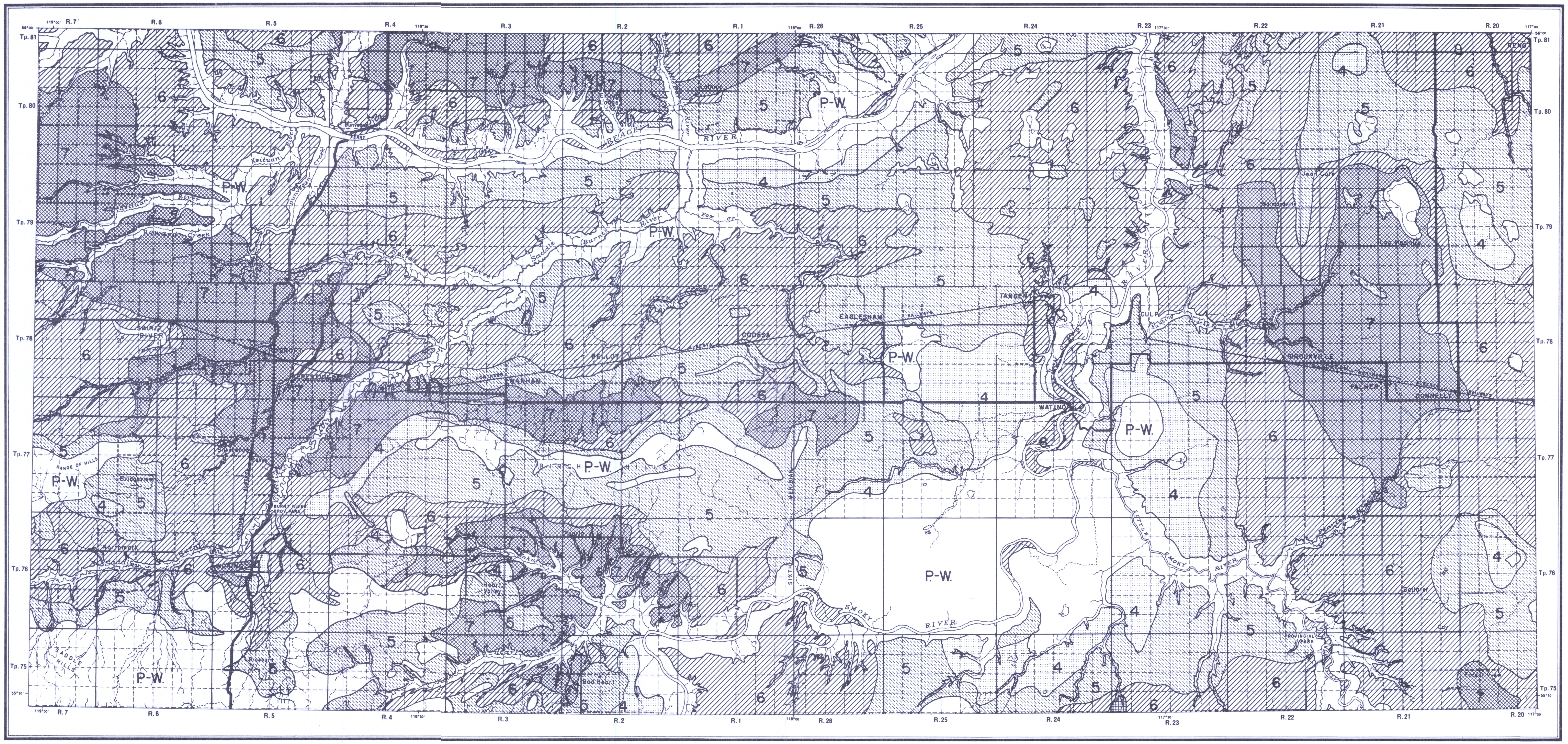
SOIL RATING MAP OF THE RYCROFT AND WATINO SHEETS

PROVINCE OF ALBERTA

Scale 4 Miles to 1 inch



Rating based on Soil and other Physical Features as determined by the Alberta Soil Survey, 1945, 1946 and 1947. This Map to be used in connection with Soil Map and Report.

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

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