University of Alberta — *Edmonton, Canada*
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SOIL SURVEY OF PEACE HILLS SHEET

BY

W. E. Bowser and R. L. Erdman
Dominion Experimental Farms Service

AND

F. A. Wyatt and J. D. Newton
University of Alberta

Report No. 14 of the Alberta Soil Survey

Experimental Farms Service, Dominion Department of Agriculture
in co-operation with the
Department of Soils, University of Alberta

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The Soil Survey report of the Peace Hills sheet is the result of co-operation between the Dominion Department of Agriculture and the Soils Department of the University of Alberta.

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The report is published with the approval of the Committee on Agricultural Extension and Publications of the University.

PREFACE

A soil survey is in reality an inventory of the soil resources. Soils vary, one to another: for example, differences in color, texture and structure are often readily seen. They vary also in plant food and alkali salt content. The inherent characteristics of any soil determine its productive capacity and also determine the most desirable methods to be used in farming it.

This report describes the properties of the surface and subsoil of the various soil types, and gives the fertility invoice of the principal types. It describes the topography, drainage, and alkali problems of the area. Methods of soil management and possible utilization of the area are discussed. It also contains a brief discussion of the climate and agricultural development of the area, together with the important farm crops and transportation facilities.

The soil map is an important part of this report. It is made on the scale of three miles to the inch, and shows not only the different soil types represented by different colors and symbols, but also important physical features such as topography, railroads, streams and towns. The soil map serves as a basis by which the better land can be distinguished from the poorer land, and therefore indicates the most desirable method of utilization. Two other maps accompany this report; one shows the distribution of the cultivated, abandoned, and virgin lands in the area, and the other shows the possible utilization of the area.

The report and map of the Peace Hills sheet differs from our previous soil reports in that it records the soil profile types by specific name. The method of classification used was that agreed upon at a soil survey conference held in Ottawa in May, 1945. Among other things this will give uniformity to the soil maps across the Dominion. The main part of this report of the Peace Hills sheet describes the properties of the major soil types found in the area. In the write-up of each soil member or type, the first portion gives a description of the area in which the soil is found together with a fairly complete profile description; the second portion gives a brief discussion of some of the agricultural problems relating to that soil type together with some of the more easily recognized features of the soil profile. By using this brief description together with the soil map, it is hoped that the reader will be able to recognize the soil profiles found in his own farm and community. As the successful business man must know his stock of merchandise, so the successful farmer must know the characteristics and requirements of the soil he farms.

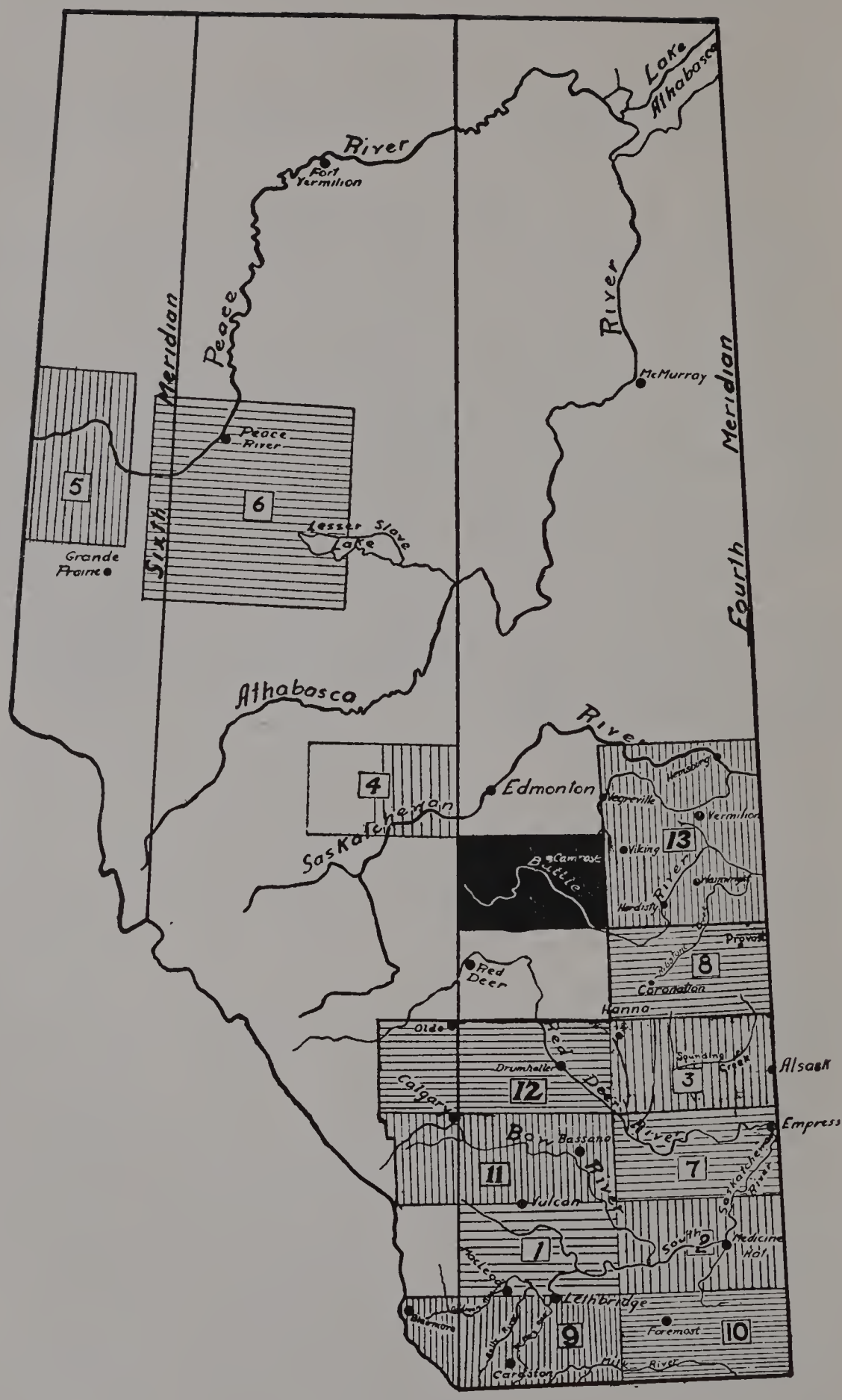
The classification of our soil resource into its respective types is necessary before intelligent use can be made of all the other scientific agricultural information now available to our farm people. It is our sincere hope that this report will help to stimulate a better understanding of the soil and its use, an understanding essential to full production without the all too frequent soil erosion.

Note to the Reader

This report, of necessity, must describe the soil types found in the area in specific scientific terminology, since soil workers in other places as well as workers in other sciences make use of these data. However, a great number of non-technical people read this report, among these the farmers of the area. An attempt has therefore been made to provide this group of readers with essential information in non-technical terms. The sub-sections on "Agricultural Use" under each soil type are so written, and there is a glossary at the back of this report defining some of the more frequently used scientific terms.

It is suggested that the reader find the name of the soil type on his farm or community from the soil map, and then read the section on its agricultural use in the report. The more technical profile descriptions can be studied at first hand in a nearby road cut.

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 area, (7) Rainy Hills sheet, (8) Sullivan Lake sheet. (9) Lethbridge and Pincher Creek sheets, (10) Milk River sheet, (11) Blackfoot and Calgary sheets, (12) Rosebud and Banff sheets, (13) Vermilion and Wainwright sheets, (in black) Peace Hills sheet.

Note: Reports for areas 1 to 6 inclusive out of print.

Soils Survey of Peace Hills Sheet

By

W. E. Bowser* and R. L. Erdman*

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And

F. A. WYATT** and J. D. NEWTON***

(*University of Alberta*)

DESCRIPTION OF AREA

The Peace Hills sheet, number 265, is located in Central Alberta and comprises an area approximately 81 miles east and west by 48 miles north and south. More exactly it consists of townships 41 to 48 inclusive within ranges 15 to 28 inclusive west of the 4th meridian. (See plate I.)

The surveyed area extends in the east from a point 6 miles south of Forestburg to Bruce, and in the west from Gull Lake to about 10 miles north of Pigeon Lake. Lacombe is just south of the south boundary, and Edmonton is 25 miles north of the north boundary.

The soil map for the area described above represents 112 townships or portions thereof or approximately 2,500,000 acres.

AGRICULTURAL DEVELOPMENT

In 1883, the year the railway reached Calgary, a stage coach service was inaugurated between Calgary and Edmonton. Two of the stopping places along its route were in the Peace Hills sheet, namely, at the crossing of Battle river and at the Peace Hills. Scattered settlement began at this time. However the completion of the Calgary-Edmonton railway in 1891 marked the first real settlement of this area. In 1885 a block house (which still stands) was built on the banks of Bigstone creek, north of the present city of Wetaskiwin, as a protection for the white settlers, who were there at that time.

Although off the main fur trade highways, many of Alberta's early travellers passed through this area. Records would indicate that the wanderings of Anthony Henry and

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**Professor of Soils, deceased.

***Professor of Soils—University of Alberta.

Special acknowledgment is due T. W. Peters, Soil Specialist, who assisted with the field work and the preparation of the report, and to J. N. Leat, R. S. Baptie and D. Sparrow.

Peter Pond took them through this area; Governor Simpson of the Hudson's Bay Company visited Gull lake in 1841; Father Lacombe and Rev. John McDougall were frequent visitors to the Indians here; and Captain Palliser's party made several traverses of the area in 1858 and '59 while exploring the agricultural possibilities of Western Canada for the British government.

This area has been a battle ground between the Cree and the Blackfoot Indian Tribes. The name Peace Hills commemorates a Peace Pact made between these two tribes. The site of this pact was in the hills adjacent to Wetaskiwin, an Indian name meaning Hills of Peace. Following the Indian treaties of the '80's a reservation was established between the present towns of Ponoka and Wetaskiwin. Although reduced somewhat from its original boundaries, the Hobbema reserve, as it is now commonly known, still supports a sizable Indian population.

In 1906 construction was started on the C.P.R. line from Wetaskiwin east through Camrose; this was followed by the building of the Tofield-Camrose-Calgary line, then the Camrose-Alliance line and lastly the Vegreville-Camrose-Stettler line.

The census of 1901 showed that less than 5,000 acres of wheat were grown over the entire Peace Hills sheet. By 1910 this wheat acreage had increased to about 75,000 acres. Table 1 gives the acreage sown to the major crops in 1920, 1930 and 1940. These figures are also broken down to show the acreages in the respective zones. From this table it is seen that wheat is the major crop in the thin black zone. In the black and grey wooded zones the 1940 census showed the total wheat acreage lower than the coarse grains acreages. In both of these zones the oat acreage is higher than the barley acreage. Only a limited acreage of rye is grown. The total in cereal crops in 1940 was 861,000 acres. Adding to this an estimate of the acreage in hay and in summer fallow, it is calculated that in 1940 there were about 1,250,000 acres under cultivation. The survey calculated that in 1946 there were approximately 1,450,000 acres under cultivation. This is out of a land area of about 2,470,000 acres.

The cultivation map (see Plate VI) shows the distribution of the cultivated acreage on this sheet. This map shows that although cultivation is fairly uniformly spread over the entire area, most of the quarter sections have less than 140 acres cultivated. This indicates that there is still some uncultivated arable land on most of the farms. Some of this uncultivated land, however, is under native tree cover. Such woodlots and windbreaks are a valuable asset. In general the farm

homes in this area are fairly good to very good, and over most of the area there appears to be a condition of permanency and stability. The black and grey wooded areas, in particular, are developing a mixed farming agriculture with a considerable number of hogs and dairy cattle. The appearance of more seeded pasture and hay fields is an encouraging sign. It is suggested that in the more humid sections of this sheet, at least, more grass and less fallow is desirable. Such is the way to greater stability of income and to the permanent productivity of our soil resources.

From available records it is estimated that the average wheat yield in the thin black zone is 16 bu. per acre and in the black zone between 19 and 20 bu. per acre. These yields cover all soil types and many different types of farm practice. Some of the better soil types should give a higher yield than this, and many individual farmers have exceeded these averages by a considerable margin.

TABLE 1.—ACREAGE IN CEREAL CROPS BY ZONES IN PEACE HILLS SHEET

Year	Thin Black	Black	Grey Wooded	Total in Crop
1920	110,000	310,000	20,000	440,000
1930	178,000	565,000	40,000	784,000
1940	193,000	623,000	45,000	861,000

ACREAGE BY PRINCIPAL CROPS

	Thin Black		Black		Grey Wooded	
Year	Wheat	Coarse Grains	Wheat	Coarse Grains	Wheat	Coarse Grains
1920	40,000	70,000	55,000	255,000	2,000	18,000
1930	140,000	38,000	310,000	255,000	16,000	24,000
1940	137,000	56,000	297,000	326,000	11,000	34,000

TRANSPORTATION

The main transcontinental line of the Canadian National Railway cuts the north-east corner of the Peace Hills sheet. The town of Bruce is on this line. The Edmonton-Calgary line operated by the Canadian Pacific Railway traverses the west central portion of the sheet. The city of Wetaskiwin (3150*) and the towns of Ponoka (1300), Hobbema and Millet (345) are on this line. The Edmonton-Winnipeg line of the Canadian Pacific Railway branches off the Edmonton-Calgary line at Wetaskiwin east through Gwynne, Bittern Lake, Camrose (2941), Bawlf (229), Daysland (458) and Strome (231). The Lacombe-Coronation branch of the C.P.R. runs just south of this sheet, and it actually cuts into the sheet a mile west of Chigwell.

Two lines of the Canadian National Railway traverse the sheet from north to south, both passing through the town of Camrose. One of these, the Calgary-Tofield branch, has on it the towns of Bashaw (508), Ferintosh (181) and New Norway (177). The other, the Calgary-Vegreville branch has on it the towns of Round Hill, Edberg (163), Meeting Creek and

*Population figures from the 1946 census.

Donalda (216). Two other Canadian National Railway lines radiate from Camrose: the Strathcona branch connecting Camrose and Edmonton via Hay Lakes (196), and the Alliance branch running in a south-easterly direction through the towns of Kelsey, Heisler and Forestburg (239). A Branch line of the Canadian Pacific Railway runs west from Leduc (six miles north of Kavanagh) passing just north of the north-west corner of the sheet, and after going through Breton which is 20 miles west of the sheet, turns south by south-east to pass along the west side of Gull Lake, and into Lacombe which lies two miles south of the sheet line on the Calgary-Edmonton line. The area is well supplied with railway facilities—very few places being over 15 miles from a railway.

The area is also fairly well supplied with highway facilities. The hard-surfaced Edmonton-Calgary highway parallels the Edmonton-Calgary railway line. Gravelled roads connect Wetaskiwin and Pigeon Lake; Wetaskiwin-Camrose-Strome; Camrose-Bashaw; Ponoka-Bashaw; and the Edmonton-Wainwright highway cuts the north-east corner of the sheet at Bruce. Numerous market roads traverse the area and some of these are partially gravelled.

TOPOGRAPHY

The Peace Hills sheet lies about half way up the third prairie steppe and is, in general, an undulating plain. The west side of the sheet has an elevation of from about 3000 feet in the south-west corner to just over 2600 feet in the north-west corner, and the east side from 2250 feet in the north-east corner to 2350 feet in the south-east corner. There is, then, roughly a 500 foot drop in general elevation from west to east. The high point in the sheet is a hill in Tp. 41 R. 28 just north of Gull Lake, namely, 3200 feet, and the low point on the sheet is the Battle river channel in Tp. 41 R. 16, just under 2200 feet.

In general there are four main topographic units in this area. The eastern half of the sheet is a relatively level plain of thin ground moraine. There is a fall of about 200 feet in the plain from west to east. It has been mapped as depressional to gently undulating. The only prominent elevation is Dried Meat Hill in Tp. 45 R. 19 which reaches an elevation of nearly 2500 feet. The second topographic unit is the Beaverhills moraine, a terminal moraine. This runs north and south practically through the centre of the sheet. It varies from about 6 miles wide west of New Norway to about 30 miles wide at Bashaw. Portions of this moraine, particularly around Bashaw, are quite hilly.

The third topographic unit is the relatively level area in the west, central and north-western portion of the sheet. This

includes the Wetaskiwin laking basin and the sorted ground moraine and sorted residual areas lying north and west of Wetaskiwin. This general area has had considerable water sorting and contains most of the sandy alluvial soils: the Peace Hills, adjacent to Wetaskiwin, are in the main dune-like sandy hills. There is a gradual transition from this area to the morained area along the west side, which is the eastern edge of the Duffield moraine. This moraine in the Peace Hills sheet is mainly of undulating to gently rolling topography.

Four topography classes are shown on the soil map by means of a hachured legend. The data in table 2 give the acreage and percentage distribution of the main topographic classes in the Peace Hills sheet. Approximately 71 per cent of the entire sheet is mapped as level to undulating (the unhachured portion of the sheet) and well over half of this is nearer level than undulating. As described earlier most of this topography type lies in the east half of the sheet and in the north west quarter.

Approximately 17 per cent is mapped as gently rolling. Land of this topographic class offers little obstruction to cultivation, the slopes are gentle, and in general the hills are low. Most of the slopes are between 4 and 8 per cent. Soils with this slope offer a water erosion problem, often quite serious. Most of the gently rolling topography occurs associated with the terminal moraines.

Rolling land makes up only approximately 5 per cent of the total area. Rolling land is considered, if other conditions are favorable, as arable. This class includes low choppy hills and fairly high ridges with long uniform slopes. Most of the slopes are between 8 and 15 per cent. Any cultivation of the rolling land in the sheet, which has a relatively high rainfall, should at all times give consideration to the control of water erosion. Most of the rolling land occurs in the Beaverhills moraine between Donalda and Ferintosh. There are numerous small lakes and sloughs throughout this rolling area and the adjacent hilly areas.

Hilly land makes up only 1 per cent of the total area. Most of the hilly land occurs in the moraine just north of Bashaw. Most of these areas are non-arable; they are pasture lands. The slopes are quite steep and even. Overgrazing of the native pasture will permit water erosion. Most of the northern slopes are tree covered; the southern slopes generally have more of a parkland character.

Approximately 2 per cent of the area is mapped as eroded lands (these are colored red on the soil map). The eroded areas occur mainly along Battle river, Meeting creek and Coal lake. In general, they are steep slopes and are non

arable. Some are tree covered, some are grass covered and a few spots are relatively bare bedrock exposures. Along most of Battle river the tree growth is confined to the south bank (the northern slope).

TABLE 2.—EXTENT OF TOPOGRAPHY DIVISIONS IN THE PEACE HILLS SHEET

Division	Acres	% of Total
Hilly	23,000	.9
Rolling	135,000	5.4
Gently rolling	417,000	16.7
Level and undulating	1,775,000	71
Eroded lands	50,000	2
Water	75,000	3
River bottom	25,000	1
	2,500,000	100

DRAINAGE

The major portion of the Peace Hills sheet is drained by the Battle river, a tributory of the North Saskatchewan river. The extreme north-west corner drains directly into the North Saskatchewan river, and the extreme north-east corner into the North Saskatchewan via the Vermilion river. A portion in the south central part of the sheet drains south into the Red Deer river and thence into the South Saskatchewan river.

The Battle river, which has its origin in Battle lakes just west of Pigeon lake, enters the sheet in Tp. 45 R. 28 at an elevation of about 2700 feet. From here it follows a very tortuous course, south through Ponoka, north to Gwynne, east to near Camrose and then south again to leave the sheet in Tp. 41 R. 16 at an elevation of just under 2200 feet. The Battle valley varies from about 200 feet deep in Tp. 41 R. 16 to practically no valley other than the present river channel east of Hobbema.

Pipestone creek with its tributary, Bigstone creek, runs into Battle river near Gwynne. These creeks carry some water throughout the summer during most years.

Meeting creek is an intermittent stream that drains from the New Norway plain into Battle river; it joins Battle river in Tp. 41 R. 17 by way of a wide, deeply eroded valley. Dried Meat Creek is also an intermittent stream that drains the lower land between Daysland and Rosalind west into Battle river. Camrose creek, also intermittent, begins in the moraine near Hay Lakes and drains south through the Camrose plain into Battle river. A dam on this creek supplies water to the town of Camrose.

Conjuring and Whitemud creeks have their origin in the gently undulating area west of Millet and flow north directly into North Saskatchewan river. The depressional areas southwest of Bruce drain by way of artificial drains into the Torlea flats and thence to Vermilion river. Parlby creek and its

tributaries drain the area between Bashaw and Morningside into Red Deer river.

There are some fairly large fresh-water lakes in this sheet. Gull lake in the south-west corner is a summer resort lake as also is Pigeon lake west of Wetaskiwin. Both have extensive sandy beaches; the Pigeon lake sand is very high in quartz. Buffalo lake, south of Bashaw, is also a resort lake. It is surrounded by rough morainal topography.

Bittern lake west of Camrose is a shallow lake on the edge of the Beaverhills moraine. The water is somewhat saline. Hay Lake, lying just north of Bittern lake is a very shallow body of water. During most summers it recedes sufficiently to permit the cutting of large quantities of slough hay. Red Deer lake, north of Bashaw is an inland basin.

Dried Meat lake lies in Battle river valley and is actually part of the river. Coal lake, north of Gwynne, also lies in a stream valley. This valley, from 100 to 200 feet deep, suggests that Battle river at one time connected with North Saskatchewan river via Blackmud creek and Whitemud creek. At present there is a height of land in this valley just north of the Peace Hills sheet.

There are numerous small lakes and sloughs in the area and most of them retain water throughout the year. The outer edges of some provide a coarse slough hay.

A few springs were found in the moraine areas. Only one flowing well was seen during the survey; this was in the Battle river valley near Menaik.

Wells in the plains area east of Camrose and Battle river are generally deep and often somewhat saline. West of this, well water is more readily obtainable and generally is of good quality. There are indications, however, that with increased cultivation, continued clearing of the tree cover and in places the construction of artificial drains, the water table is lowering necessitating deeper wells. If this trend continues, real hardships can result to both rural and urban residents. Information, preparatory to a conservation program, on ground water supplies is urgently needed.

SOIL FORMING FACTORS

This section of the report gives a brief discussion of the principle factors responsible for forming the soils of the Peace Hills sheet. The long time climatic conditions that have prevailed, have induced a particular vegetative growth. These two interrelated external forces acting on the original surface mantle of the earth, have produced the present soil profile. Since the soil profile is the basis of soil classification, a study of the soil-forming factors operative in this area is essential.

CLIMATE

The climate of the Peace Hills sheet varies somewhat from west to east. The variation, however, is mainly in the amount of total precipitation, in general there being a decrease in rainfall from west to east. The eastern section of the sheet also tends to have a lower mean temperature during the winter months. Although the weather records are for a relatively short period of time, the variation in soil profile and vegetation would indicate that this decrease in total precipitation has existed for a considerable length of time. The soil profile varies from deep in the west to relatively thin in the eastern section. The general vegetation changes from open parkland in the east to practically continuous forest on the west side. How climate has effected these will be discussed more fully in other sections of the report.

Wind data has been taken at Lacombe and should be fairly representative of the sheet. Table 3 gives a summary of wind velocity and direction for various centres in the province.

TABLE 3.—SUMMARY OF WIND VELOCITY AND DIRECTION

	Total Av. annual mileage	Av. miles /hr.	Predominant direction
Medicine Hat	78,000	8.9	W. & S.W.
Lethbridge	82,000	9.4	W.
Calgary	79,000	9.0	N.W.
Lacombe	39,000	4.5	Variable
Fairview	61,000	7.0	Westerly

From the table it can be seen that at Lacombe there is no definite prevailing wind direction and also that the total average annual mileage is the lowest of the stations reported. Winds of gale proportions are relatively infrequent in this area.

Edmonton receives about 2200 hours of bright sunshine per year out of a possible total of approximately 4,450 hours. The average for this sheet should be approximately the same as the Edmonton figure.

All the meteorological data given in this report are compiled from the Dominion meteorological records. Reports from the following stations are included: Edmonton, Wetaskiwin and Lacombe in the black soil zone; Viking and Sedgewick in the thin black soil zone just east of the surveyed area in the Wainwright sheet.

Table 4 gives the average monthly, seasonal and annual precipitation at Edmonton, Wetaskiwin, Lacombe, Viking and Sedgewick. In this table the year is divided into three sections namely, the previous fall, winter and growing season. This is done because it is thought that the previous fall's plus the growing season's moisture is fairly closely related to the crop growth obtained. The figures in table 4 indicate a decrease in precipitation from west to east. The data shown

TABLE 4.—PRECIPITATION IN INCHES. MONTHLY AND SEASONAL DISTRIBUTION FOR STATIONS ON OR NEAR THE PEACE HILLS SHEET

	Edmonton (57 yrs.)		Wetaskiwin (33 yrs.)		Lacombe (34 yrs.)		Viking (17 yrs.)		Sedgewick (18 yrs.)	
September	1.33		1.50		1.60		1.33		1.21	
October	.75		.61		.85		.66		.85	
Total Previous Fall	——	2.08	——	2.11	——	2.45	——	1.99	——	2.06
November	.75		.68		.67		.56		.47	
December	.81		.82		.67		.57		.47	
January	.88		.80		.63		.80		.33	
February	.64		.68		.58		.67		.35	
March	.76		.89		.70		.95		.66	
Total Winter	——	3.84	——	3.87	——	3.25	——	3.55	——	2.28
April	.88		.88		1.07		.99		1.12	
May	1.85		1.80		1.96		1.76		1.43	
June	3.06		3.18		3.35		2.86		2.92	
July	3.32		2.63		2.62		2.76		2.47	
August	2.35		2.26		2.30		2.27		2.07	
Total Growing Season	——	11.46	——	10.75	——	11.30	——	10.64	——	10.01
Total	17.38		16.73		17.00		16.18		14.35	

for Viking and Sedgewick are for a relatively short period of time, and longer averages may change these figures.

Sedgewick has a total of 14.35 inches (18 year average) of precipitation as compared to 17.38 inches (57 year average) at Edmonton. Lacombe, Wetaskiwin and Viking receive nearly as much precipitation as Edmonton, there being one inch or less difference.

A large percentage of the precipitation that falls during the winter months in Alberta is lost by evaporation in the winter and during the spring run-off. As a result the moisture that falls throughout the previous fall and the growing season is largely effective in determining the crop produced. Fortunately in Alberta a large percentage of the annual precipitation comes during this effective period. From the figures in table 4 it can be calculated that 75 per cent or over of the annual moisture falls during this effective period for all the stations reported.

At all the stations reported in table 4 June and July are the months of greatest rainfall. These are the important growing months. However, there must be sufficient reserve moisture to carry the crop into June, hence the necessity for conserving the previous fall's precipitation. Between five and six inches falls during June and July in the Peace Hills sheet, and this with some reserve moisture in the spring is usually sufficient to produce a fair crop.

During the period from 1908 to 1937 at Lacombe the rainfall has varied from a maximum of 25.17 inches in 1927 to a minimum of 12.44 inches in 1922. At Edmonton for a period of 55 years from 1883 to 1937 the total annual precipitation varied from 8.16 inches in 1889 to 30.83 inches in 1926. All the years reporting less than 11 inches for this period were prior to 1900.

Although annual precipitation figures are of value, their interpretation must consider certain factors. It may be said that below a certain minimum precipitation it is practically impossible to grow a crop and that what rain does fall has a low efficiency factor. However it should be remembered that such factors as rainfall distribution, the amount of evaporation, the soil type, and the type of farm management influence the efficiency of the rainfall. In general, the rainfall is more effective in the northern part of the province than in the southern. This is due to a lower rate of evaporation. The factors of soil type and farm management are discussed elsewhere in this report.

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. It must be noted that the frost-free period

is ended as soon as the temperature reaches 32°F. Yet this temperature will not damage most crops. Thus the frost-free period is not in general as long as the growing season. Frost will vary with changes in relief or topography.

In a statistical atlas published by the Dominion Bureau of Statistics in 1931 the killing frost is placed at 29°F. The authors prepared a map on this basis from which it can be shown that Edmonton has about 115 days, Lacombe 105 days and Sedgewick 105 free of killing frosts. Using 32°F as the limit of the frost free period, Edmonton has about 95 days (32 yr. average), Lacombe 77 days (32 yr. average). Although early fall frosts do occur occasionally in the surveyed area, in general it can be stated that frost is not a serious handicap to cereal production.

The climate of this sheet is characterized by moderately warm summer and relatively cold winter temperatures. Table 5 gives the monthly, seasonal and annual mean temperatures for stations on or near the surveyed area. The mean temperatures reported in this table are the average temperatures for the month. The yearly mean temperature is about 36°F. Viking and Sedgewick report 33.9°F and 33.6°F respectively, but longer averages may change these figures.

In general there is a lower mean temperature in the eastern section of the surveyed area. Over the entire area July is, on the average, the warmest month and January the coldest. In general the summers are warm and permit rapid growth. As this area is outside the Chinook belt, snow lies on the ground throughout the winter.

VEGETATION

This description of the vegetation of the Peace Hills sheet is confined to the dominant vegetation in each of the three major soil zones, i.e., the Grey Wooded, the Black, and the Thin Black. The prime purpose is to list the dominant native vegetation in each of these three zones as it is found today. This recognizes the fact that the present vegetative cover may or may not be the same type of vegetation existing during the formation of the present soil profiles found in these zones. There is quite naturally a gradation or tension belt between the vegetative zones, just as there is between the soil zones, so that any line drawn is necessarily arbitrary. There are, however, recognizable vegetative differences between the zones proper. In general, there is a change from open park-land on the east side to practically continuous forest on the west side.

The eastern edge of the main grey wooded soil zone lies along the western edge of the Peace Hills sheet. This zone is characterized by a dominance of fairly heavy tree cover,

TABLE 5.—MONTHLY, SEASONAL AND ANNUAL MEAN TEMPERATURES FOR STATIONS ON OR NEAR THE PEACE HILLS SHEET

(Temperature in Degrees Fahrenheit)

	Edmonton 57 yrs.	Wetaskiwin 25 yrs.	Lacombe 34 yrs.	Camrose 10 yrs.	Alix 30 yrs.	Viking 12 yrs.	Sedgewick 18 yrs.
September	50.1	49.8	48.1	48.2	49.7	47.5	47.5
October	40.8	41.2	38.8	39.5	39.2	39.0	40.0
Previous Fall Average	45.5	45.5	43.5	43.9	44.5	43.3	43.8
November	25.5	24.2	22.5	25.0	25.7	22.5	22.0
December	13.9	12.7	16.5	10.7	13.2	12.0	12.0
January	6.2	10.7	6.5	3.1	6.3	2.5	2.0
February	11.6	12.6	10.0	9.1	13.5	5.0	4.0
March	23.3	22.8	23.2	22.0	24.1	18.0	16.8
Winter Average	16.1	16.6	15.7	14.0	16.6	15.0	11.4
April	39.6	38.3	39.4	37.2	39.2	37.5	36.0
May	51.1	49.9	48.8	50.5	50.8	48.0	48.5
June	57.3	56.5	56.0	56.3	56.3	56.5	56.0
July	61.4	61.8	59.0	61.9	61.9	59.5	59.4
August	59.4	58.8	56.5	59.4	59.3	58.0	58.5
Growing Season Aver.	53.8	53.1	51.9	53.1	53.5	51.9	51.7
Year Average	36.7	36.6	35.4	35.2	36.6	33.9	33.6

with the native grasses occuring mainly in the lower areas. Some of the trees are large enough to be of commercial value.

The black soil zone occupies the west central portion of the Peace Hills sheet. The tree cover in this zone is not as continuous as in the grey wooded zone, and the amount and kind of trees vary somewhat between the different soil types. The black soil zone may properly be regarded as a vegetative transition belt between the heavy tree area to the west and the prairie grassland to the east. In general it is parkland country with varying amounts of open country. These open areas may be mainly grass covered or they may be dominated by a low shrub cover. Where possible, differences in vegetative cover between soils have been indicated in the description of the soil types.

The thin black soil zone occupies the east side of the Peace Hills sheet. As indicated previously, this area is predominantly a grassland vegetation. The tree growth is confined to isolated clumps usually found on northern slopes and in moist spots. There is a relative uniformity in vegetative cover and type throughout this zone, due in part to the fact that two soil types make up most of the soil in this zone.

The soil profile that develops in any one place is the result of the influence of a number of factors; one of these factors is the native vegetative cover. In fact the close relationship between plants and the soil on which they grow is of prime importance from the standpoint of soil classification. For example, in this area under heavy woods a grey soil develops, 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. Other differences also develop: the grey soil tends to be more acidic and the lime carbonate accumulation horizon tends to be at a greater depth from the surface than in the black soil. The greatest percentage of grey-black transition soils are found at the edge of the heavily wooded area, particularly just east of the grey wooded zone line. This might indicate that these soils have been under the influence of tree cover for a much shorter period of time than have the grey soils to the west; that is, they have not had time to entirely lose the black surface horizon that developed under an earlier grass cover.

Along the same general approach as briefly suggested above, native vegetative cover can be used as an indicator of the type of soil profile found in an area. For example, in the wooded area a soil developed under a Jack pine forest cover may differ from a soil developed under a poplar forest cover. In the grassland areas, grass species are good indicators of natural drainage; some grasses thrive under moist condi-

tions, others under semi-arid conditions. Likewise some grasses, such as salt grass, are alkali tolerant; others, such as Kentucky blue grass, thrive best on a neutral soil: sphagnum moss, found in some of the peat areas, grows in acid soil conditions. The above are only examples of soil-plant relationships. Those who work with the soil in any area soon discover many more.

The dominant vegetation of the Peace Hills sheet is listed by zones in table 6. This table lists only the dominant species, i.e., those listed as occuring in only one or two of the three zones may actually occur in the others, but in minor amounts.

TABLE 6.—DOMINANT VEGETATION BY ZONES OF THE PEACE HILLS SHEET

Trees and Shrubs

Scientific Name	Common Name	Grey Soil	Black Soil	Thin Black Soil
Populus tremuloides	Aspen poplar	*	*	*
Populus balsamifera	Balsam poplar	*	*	
Picea glauca	White spruce	*	*	
Cornus stolonifera	Dogwood	*		
Salix spp.	Willow	*	*	*
Ribes spp.	Currant	*		
Lonicera involucrata	Honeysuckle	*	*	
Rosa spp.	Rose	*	*	*
Viburnum pauciflorum	Cranberry	*	*	
Rubus strigosus	Raspberry	*	*	
Symphoricarpos pauciflorum	Snowberry		*	*
Amelanchier alnifolia	Juneberry		*	
Corylus rostrata	Hazelnut		*	
Prunus spp.	Chokecherries		*	
Elaeagnus argentea	Silver bush			*

Native Grasses

Scientific Name	Common Name	Grey Soil	Black Soil	Thin Black Soil
Koeleria gracilis	Junegrass		*	*
Agropyron pauciflorum	Slender wheatgrass	*	*	*
Agropyron subsecundum	Bearded wheatgrass	*	*	*
Agropyron dasystachyum	Thickspike wheatgrass	*	*	*
Agropyron smithii	Bluestem	*	*	*
Stipa comata	Needle and thread		*	
Stipa viridula	Green needlegrass		*	
Stipa spartea	Porcupine grass		*	
Avena Hookeri	Spike oat		*	*
Poa interior	Inland Bluegrass		*	*
Poa palustris	Redtop	*	*	*
Poa canbyi	Canby Bluegrass		*	*
Poa pratensis	Kentucky blue grass		*	*
Festuca scabrella	Rough fescue		*	*
Bouteloua gracilis	Blue grama grass		*	*
Sium cicutaefolium	Water parsnip		*	
Glyceria grandis	Manna grass		*	
Hordeum jubatum	Wild barley		*	
Calamagrostis inexpansa	Northern reedgrass		*	
Carex spp.	Sedges			*
Calamagrostis canadensis	Bluejoint	*	*	*

Weeds.

Although not necessarily native vegetation, the weeds found in this sheet are a definite factor affecting crop production. The three most prevalent weeds in the surveyed area are Canada thistle (Cirsium arvense), sow thistle (Sonchus arvensis), and wild oats (Avena fatua). In addition,

scattered infestations of the following weeds contribute further to the reduction of crop yields in the area: hoary cress (Lepidium draba), leafy spurge (Euphorbia esula), wild mustard (Brassica arvensis), hare's-ear mustard (Coringia orientalis), tartary buckwheat (Fagopyrum tataricum), night flowering catchfly (Silene noctiflora), and bladder campion (Silene latifolia). Other weeds are also found in the area, but the degree of infestation is usually not so heavy as with those mentioned above.

Weed infestation on the black and thin black soils is comparatively greater than on the grey wooded soils. The latter soils were settled more recently, and, as a result, tend to be cleaner and better suited to seed production. Farmers should use every means possible to combat the ever increasing weed problem. Those farmers on the more recently settled soils are in the best position in this regard, for the best method of controlling weeds is to prevent initial infestations.

THE SOILS' PARENT MATERIAL

The Peace Hills sheet was practically all, if not all, covered by the Keewatin Glaciation. This ice sheet moved in a general south-westerly direction, and in passing over the area, mixed materials it had carried for a considerable distance with the material from the immediately underlying bedrock. This glacial drift was deposited as a mantle over the area, the depth varying greatly from place to place; and this mixed drift is the parent material of most of the soil in this area. Since the material deposition in any one place was mainly of immediate or local origin, there is a marked similarity between the surface glacial drift and the underlying bedrock. In a few places the agents of erosion have removed all the drift, with the exception of the larger erratics; so that in these spots the original bedrock is the parent material of the present soil profile. Examples of this are found in the Kavanagh and Torlea soils. Wind and water have further sorted and moved the drift material, and in some places there is a deposition of aeolian or lacustrine material over the glacial till. A considerable portion of the Peace Hills sheet has been so modified and the Peace Hills, Irma, Wetaskiwin-Navarre-Malmo and Ponoka soils are examples of this.

The uppermost bedrock horizons vary from upper Cretaceous on the eastern side of the sheet to lower Tertiary on the western side.* Pale and Variegated beds (Belly River) are uppermost in the extreme north-east corner; that is, in the eastern half of township 48, Range 15. This formation extends south just east of the sheet line. Lying immediately

*Plate 9 gives the geologic formations in the Peace Hills sheet. This plate was prepared by the Dept. of Geology, University of Alberta.

west of the Belly River is a narrow strip of Bearpaw shale. On the average this strip is less than six miles in width[1]. "The Bearpaw formation consists chiefly of dark grey clay shales and sandy shales of marine depositions. There are several thin beds of light grey bentonite interstratified with the shales . . ." In places there is a high content of gypsum salt in this Bearpaw shale and it is suggested that this has contributed much of the gypsum occurring in the drift covering the east half of the sheet.

The uppermost bedrock horizon between the Bearpaw and a line beginning in the north-west corner of the sheet, township 48, range 27, and carrying south-east through Ponoka and then east by south-east to Buffalo lake is Edmonton formation. That is Edmonton formation is the immediately underlying bedrock formation over at least three quarters of the sheet. It and the two previously mentioned formations are of upper cretaceous age.

(1) "The Edmonton formation . . . consists largely of sediments deposited under fresh and brackish water conditions . . . The composition of the strata varies greatly both laterally and vertically. The Edmonton formation . . . consists of fine grained sandstones, highly calcareous sandstones, sandy shale, bentonitic sandstones and shales, bentonite, ironstone bands, carbonaceous shales, and coal. Bentonite is the prevailing constituent throughout the whole series of beds." It is thought that this formation has contributed the greatest amount to the drift sheet and hence to the soils' parent material.

The uppermost bedrock in the south-western quarter of the sheet is Paskapoo formation; that is, it lies immediately west of the Edmonton formation. (1) "Paskapoo is lower Tertiary in age . . . and consists chiefly of soft, grey, clayey and calcareous sandstones, and soft shales and clays. The formation is of freshwater deposition." Some of the drift overlying this formation has a medium to high lime carbonate content.

As stated earlier in this section, most of the area is covered by a mantle of glacial drift originating, in the main, from the immediately underlying bedrock. A terminal moraine, the Beaverhills moraine, cuts through the centre of the sheet from Buffalo lake to Big Hay lake. The material in this moraine is mainly of Edmonton formation origin. It is a brown sandy clay till, containing many small bits of coal and

(1) The statements above appearing in quotation marks are extracted from Alberta Research Council report No. 34, titled, "Geology" by J. A. Allan, Professor of Geology, University of Alberta. For a more complete discussion of Alberta Geology, the reader is referred to this and other publications by Dr. Allan.

ironstone. Beaverhills, Angus Ridge and Cooking Lake soils are found on this moraine.

The large relatively level plain east of the above described terminal moraine covers the east portion of the sheet. The drift cover varies greatly in depth but is in general relatively shallow. This material is also mainly of Edmonton origin with, however, a small percentage of Bearpaw shale. The material, then, contains some salt as well as some bentonite. Most of the soils on this drift area are solonetzic, as for example the Camrose, Angus Ridge, Killam and Daysland soils.

The relatively level area west of the Beaverhills terminal moraine, adjacent to Ponoka, Wetaskiwin and Millet, is also covered with glacial drift but much of the immediate surface has been retransported and sorted: as in the other two areas described, the original material is mainly of Edmonton formation origin. Both wind and water have been responsible for the subsequent resorting of the till. The Wetaskiwin plain is primarily of glacial lacustrine deposition; the areas of Peace Hills loamy sand and sandy loam are primarily aeolian and the remainder, mapped primarily as Ponoka loam, is mainly of shallow alluvial lacustrine deposition. The greatest percentage of soils in this area is solodic. Throughout this general area, and particularly adjacent to Kavanagh, there are spots where the drift mantle is very thin to non-existent. In these areas, mapped as Kavanagh Loam, the parent material is from Edmonton formation either in situ or only slightly sorted.

The Duffield moraine touches the western side of the Peace Hills sheet, particularly in the south-western portion. The material in the moraine is mainly of Paskapoo origin. This is brown sandy clay loam parent material low in salt content and medium to high in lime carbonate content. Most of the soils on this moraine are podsolic and are mapped as Breton soils.

The above descriptions indicate that a large percentage of the drift sheet that covers this area is of Edmonton formation origin. Although there is considerable variation in this formation, the large percentage of it is sandy shale, high in bentonite and containing some salt. These factors are, it is believed, somewhat responsible for the high percentage of solonetzic soils in the area.

SOIL FORMATION

Soil is defined as that part of the earth's surface that is utilized by the growing plant, and may vary from a few inches to several feet in thickness. A vertical cross section of this layer is called the soil profile. This profile differs markedly from the underlying rock material. The most important of

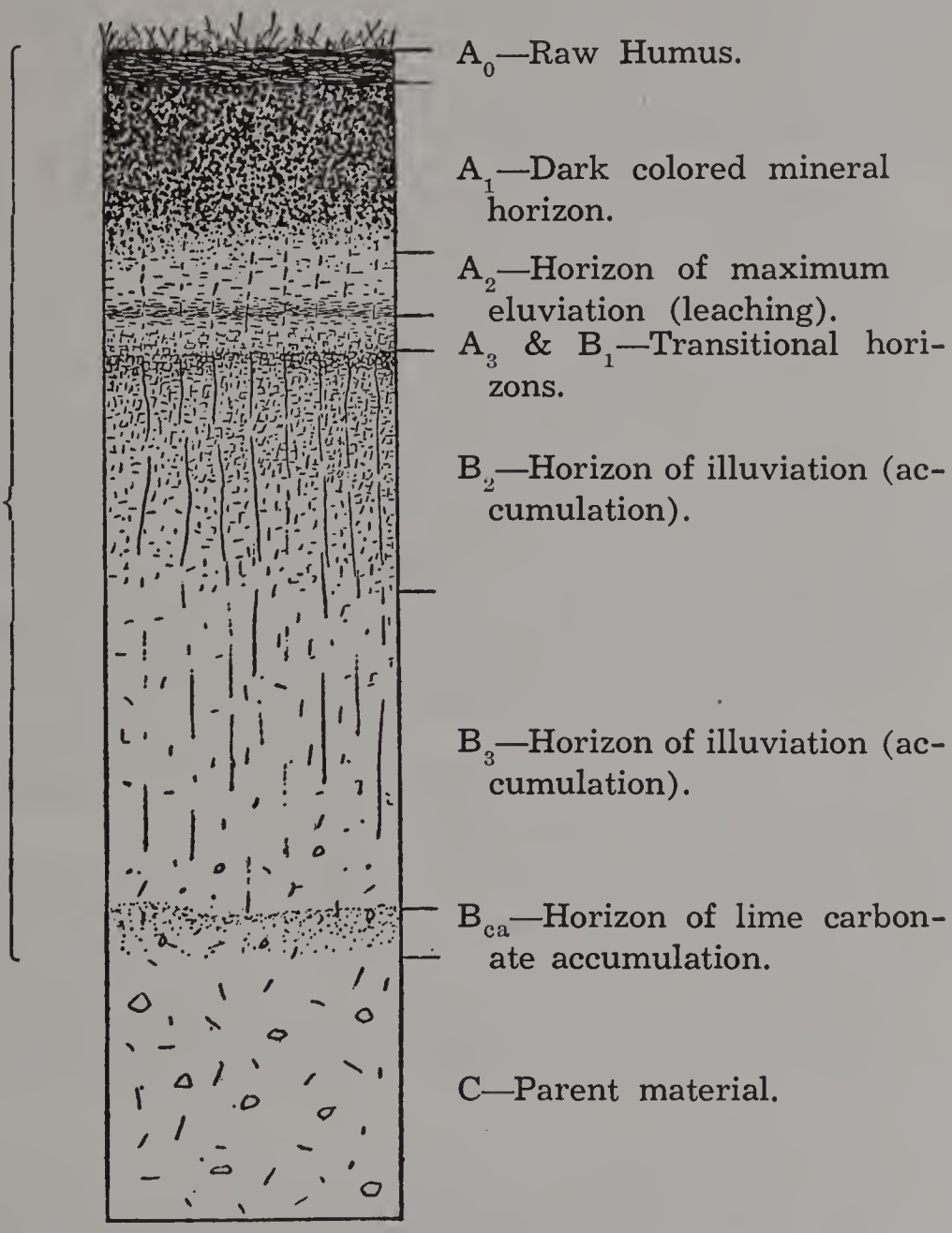
these is the occurrence of layers or horizons in the profile. This development of horizons in the soil profile is the result of climate, vegetation, and soil micro-organisms acting on the original parent material over a long period of time: the effectiveness of these is influenced by relief and external and internal drainage. Since one or all of these factors may change from place to place, a great number of soil profiles are found.

The soils' parent material is of rock origin and imparts definite characteristics to the soil profile; it influences the present texture of the soil and it also largely determines the amount and kind of mineral plant foods and alkali salts present. That is, certain soil differences are inherited from the parent material. On this parent material deposited by moving ice sheets, wind or water, the agents of soil formation, namely, climate, vegetation and soil micro-organisms, work. The rock particles weather and decompose into a more finely divided condition. The soluble portions formed are then carried downward by the percolating rain water. Concurrent with this, there is a return of plant foods by way of grass and tree roots from the lower portions of the profile to the plant superstructure. When the plant dies its remains decay and the humus formed tends to collect on or in the surface horizon giving it a dark color. This humus is also constantly decaying and liberating plant foods that may be carried downward by the rain or may be re-used by plants. The materials carried down by the percolating water tend to be deposited at lower depths and may give rise to the more compact heavier textured subsurface horizons. Plate II gives a schematic picture of a soil profile together with the names of the various horizons. The A horizons are the portions of the profile from which materials are leached by the rainwater and in which in most soil profiles, the organic matter accumulates, the B horizons are the portions in which the materials carried from A are deposited, and the C horizon is the relatively unaltered parent material. Where material different from that in which the solum has formed underlies the solum it is referred to as the D horizon.

The above brief discussion indicates that soil formation is a complex process that is slowly but continuously going on. It should be added, however, that with the advent of cultivation, a completely new environment may be established and the soil forming processes thereby altered.

The interaction of these soil forming factors as applied to the Peace Hills sheet has resulted in many different soil types. For example, the lower rainfall in the thin black zone has formed a thinner profile and a lower accumulation of surface humus than in the black zone. The relatively humid condition in the grey wooded zone has resulted in excessive

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_{20}, B_{21}, etc.

leaching of the mineral plant foods and the rapid decomposition of the organic litter. The result is usually a very light colored surface horizon underneath the leaf mat. In addition to these zonal climatic differences there are also local climatic differences due to local changes in topography. For example, the soil moisture condition in a valley is quite different from that on the adjoining slope; these differences have resulted in different soil profiles being formed. Differences in soil drainage affect the movement of salts through the profile, and this in turn is reflected in the type of profile formed. All of these factors help determine the type of profile

formed at any one spot, and each profile offers its own specific agricultural problems and potentialities.

The following is a brief description of the principal profile types found in the Peace Hills sheet.

A. **Grass and Parkland Region.**

1. **Chernozem:** Profile found on relatively non-saline parent material in the well drained topographic position. Chernozem soils have a black surface (A_1) horizon. The intermediate textured soils have a fairly well defined **prismatic** structure in the B horizon and often in the lower portion of the A horizon. The heavy textured soils usually have a fairly well defined **granular** structure. The light textured soils have a tendency to a single grain structure. The lower portion of the B horizon has a lime carbonate accumulation.
2. **Solodized Solonetz:** Profile usually found on saline parent material in areas of somewhat impeded drainage. In the black and thin black soil zones there is usually some black A_1 horizon. It has a grey A_2 horizon and a hard, compact columnar B_2 horizon. The B_3 horizon is more friable than the B_2 horizon.
3. **Solodic:** Profile found in the moderately well-drained topographic position. It may be a remnant of a solodized solonetz profile. It has a fairly deep prismatic A_1 horizon, a more or less moderately developed A_2 horizon and a thin blocky to nuciform B_2 horizon.

B. **Forest Region.**

1. **Degraded Black** (transition): Profile usually found in the moderately to well-drained topographic position. It has a dark grey to brown granular to platy A horizon: it may have a few inches of black A_1over a grey A_2. The B horizon is generally of a nuciform structure.
2. **Grey Wooded:** Profile in the moderately to well-drained topographic position. It has a deep ashy grey to light grey brown A_2 horizon, and a compact, blocky to nuciform B horizon. The dark colored A_1 horizon is usually thin and may be almost imperceptible. Lime carbonate is usually present in the C horizon and may occur in the lower portion of the B horizon.

C. **Depressional Areas.**

1. **Meadow Profile:** Profile found in the ill to moderately well-drained topographic positions. It has a deep, dark A horizon and a mottled B horizon. Lime carbonate may be present in the A horizon as well as the B

horizon. In general it has a very weak structural development.

2. **Slough Podsol:** Profile found in the ill to moderately well drained topographic position usually under aspen-willow cover. It has a deep grey A_2 horizon and a heavy "sticky" subsoil. Rusty streaks are found in the subsoil and often in the A_2 horizon.
3. **Peat:** Profile found in ill-drained topographic positions. It has an accumulation of organic material (peat) overlying a grey mottled mineral subsoil.

SOILS

This section of the report describes the soil types found and mapped on the Peace Hills sheet. These types are grouped first under their respective soil zones and secondly under similar types of parent material. Immediately following is a brief discussion of the procedure used in soil mapping.

SOIL CLASSIFICATION AND MAPPING

Briefly put, soil classification means the identification and description of profile types and then showing the genetic relationship of one profile type to another. Soil mapping means determining the area and extent of each soil type. As far as available information will permit, this report attempts also to relate each soil type to an agricultural use classification.

The soils of the Peace Hills sheet were mapped on a soil type basis; that is the major profile types were identified and named. The name given to a soil type is usually a place name where this type was of dominant occurrence. A soil type may occur in an area to the practical exclusion of all other types, but more often it occurs in intimate association with other types. For example, the higher well-drained positions have one profile type, the lower ill-drained positions have another profile type. Where more than one profile type occurs in one mapped area, the approximate percentage of each type is shown on the soil map.

All the soil types in any one zone formed from similar parent material have certain common inherited characteristics. These areas of similar parent material usually form a specific landscape type and the related profiles in the area occur in a specific pattern. As a result most of the mixed areas appearing on the map are composed of profile types on similar parent material. There are, however, areas where two parent materials were so intimately mixed that separation was not practical on the scale of mapping used. An example of this is the area just east of Camrose where ridges of sorted fine sandy loam occur in what is predominately an area of ground moraine.

There are also areas mapped where soil types of two different soil climatic zones occur. For example, in the moraine adjacent to Hay Lakes there are areas where black and podsolic (grey) soils occur in close association.

It is seen from table 7 below that most of the profile types mapped are of a loam texture. Actually loam textured soils make up over 80 percent of the entire sheet. A loam soil is of intermediate texture; that is, neither the sand, silt nor clay, predominate. Loam soils generally do not erode as readily as do soils of either a lighter or heavier texture.

About 12 percent of the area is mapped as sandy loams. Sandy loam soils have a predominance of sand in their composition, generally between 65 and 80 percent sand. They are lighter in texture, are more vulnerable to wind erosion and usually are lower in natural fertility than the loam soils. Loamy sand is lighter (more sandy) than sandy loam. Only 1 percent of the area is mapped as loamy sand.

Silty clay loam is a heavier textured soil than is a loam soil: that is, it contains a higher percentage of the finer silt and clay patricles. Less than 1 percent of the area is mapped as silty clay loam.

Some soil areas, principally the Navarre and Malmo types, are described as loam to silt loam. These soils are generally slightly heavier than the loam areas. They contain a higher percentage of silt particles and less sand particles than the loam soils.

Table 7 gives the named soil types mapped in the Peace Hills sheet. They are grouped to show the relationship between the types.

In the descriptions to follow each of these soil types is described, a generalized profile description is given as well as information regarding their agricultural use. The reaction (pH) is given for each profile described. These pH's are for the profiles analysed and are not necessarily averages.

TABLE 7.—SOIL TYPES OF THE PEACE HILLS SHEET

Grey Wooded Soils.

A. Soils developed on glacial till:
  1. Till mainly of Paskapoo[1] origin.
    (a) Breton loam.
    (b) Strongly podsolized Breton loam.
    (c) Breton sandy loam.
  2. Till mainly of Edmonton[1] origin.
    (a) Cooking Lake loam.

Degraded Black Soil (grey-black transition).

A. Soils developed on glacial till:
  1. Till of mixed Edmonton[1] and Paskapoo[1] origin.
    (a) Falun loam.
  2. Till mainly of Edmonton[1] origin.
    (a) Weakly podsolized Cooking Lake loam.

B. Soils developed on alluvial-aeolian deposition:
  1. Parent Material Highly Quartzitic.
    (a) Carvel Sandy loam.

Black Soils.

A. Soils developed on glacial till:
   1. Till mainly of Edmonton[1] origin.
      (a) Angus Ridge loam (solodic profile).
      (b) Beaverhills loam (prismatic chernozem profile).
      (c) Camrose loam (solodized solonetz profile).
      (d) Slough podsols.

B. Soils developed on glacial lacustrine deposited materials:
   1. Somewhat calcareous clay parent material.
      (a) Mazy silty clay loam (prismatic to granular chernozem profile).
   2. Somewhat saline sandy clay parent material.
      (a) Wetaskiwin loam and heavy loam (solodized solonetz profile).
      (b) Navarre loam and silt loam (slightly salinized prismatic-chernozem profile).
      (c) Malmo loam (solodic profile).

C. Soils developed on alluvial-lacustrine deposited materials:
   1. Variable sandy loam to clay loam parent material that may contain gravel lenses.
      (a) Ponoka loam (solodic to prismatic-chernozem).
   2. Calcareous silty parent material.
      (a) Penhold loam (prismatic-chernozem profile).
      (b) Penhold Meadow Silt Loam (Meadow profile).

D. Soils developed on alluvial-aeolian deposited materials:
   1. Sandy loam to loamy sand parent material (highly quartzitic).
      (a) Peace Hills loamy sand (weakly structured profile).
      (b) Peace Hills sandy loam and fine sandy loam (slightly solodic profile).

E. Soils developed on coarse outwash materials:
   1. Ferintosh sandy loam (weakly structured profile).

F. Soils developed on relatively undisturbed residual material:
   1. Somewhat saline sandstones and shales.
      (a) Kavanagh loam (solonetz to solodized-solonetz profile).

Thin Black Soils.

A. Soils developed on glacial till:
   1. Till mainly of Edmonton[1] origin.
      (a) Killam loam (solodized solonetz profile).
      (b) Daysland loam (solodic profile).
      (c) Elnora loam (prismatic-chernozem profile).
      (d) Slough podsols.

B. Soils developed on glacial-lacustrine deposited materials:
   1. Slightly saline silty clay parent material.
      (a) Gadsby silt loam and silty clay loam (solodized solonetz profile).

C. Soils developed on alluvial-aeolian deposited materials:
   1. Sandy loam to loamy sand parent material.
      (a) Irma Sandy Loam and Fine Sandy Loam (slightly solodic profile).

D. Soils developed on relatively undisturbed residual material:
   1. Somewhat saline sandy shales and shales.
      (a) Torlea loam (solonetz to solodized solonetz profile).

Miscellaneous Soils.

A. Alluvium—Recent River Deposits.

B. Gravel Beds.

C. Organic Soils.
   (a) Sedge peats.
   (b) Mixed sedge and sphagnum peats.

D. Sand dunes.

E. Eroded Lands.

[1]For a description of Edmonton and Paskapoo formations see the section on "The Soils' Parent Material."

GREY WOODED SOILS

The grey wooded soils in Alberta lie mainly in the Western and Northern part of the province; that is, in the forested portion of the province. This area is referred to as the Grey Wooded Soil Zone. The eastern side of the zone cuts into the western edge of the Peace Hills sheet. The zone line is shown on the map. These soils are podsolized soils formed under sub-humid conditions, conditions that are the result of a fairly

high rainfall, a low rate of evaporation and a forest cover. The average annual rainfall over most of the grey wooded zone in this sheet is about 19 inches and the average annual temperature is about 35°F. This humid condition causes a rapid decomposition of the organic material (leaves and roots) that collect on or near the surface of the soil. The products of the decomposition partly pass out into the air as a gas and are partly carried down to the lower horizons of the profile by the percolating rain water. This results in a leached, light-colored surface or A_2 horizon that is relatively low in fertility. The average nitrogen content of the surface foot of these grey wooded soils is about 0.1%. In general, then, it can be said that these soils are characterized by a very thin or absent black A_1 or surface horizon, an ashy light grey-brown surface or A_2 horizon and a fairly compact brown B_2 or subsurface horizon. There are varying amounts of the A_0 and A_{00} horizons (surface leaf mat) present. Most of these grey wooded soil profiles have a Ca. (lime) concentration horizon at a depth averaging about 50 to 60 inches from the surface.

Islands of grey wooded soils occur in some of the morainal areas outside of the main grey wooded soil zone. Such islands are found in the Peace Hills sheet north-west of Camrose and east of Ponoka.

A. Grey Wooded Soils Developed on Glacial Till

1. *Parent Material Mainly of Paskapoo Formation Origin.*

The Paskapoo formation is a fresh water deposition of Early Tertiary age. It consists chiefly of soft grey clayey, somewhat calcareous sandstones and soft clays and shales. The till formed from the Paskapoo is generally of a brown color, is gritty, and has a medium to medium high lime content. The two major soil types formed on this material are shown on the soil map, namely, the moderately podsolized and the strongly podsolized Breton loams (a small area of Breton sandy loam is also mapped). Minor percentages of the following profiles will also be found, however, in association with the above two: Peaty spots in the depressions, weakly podsolized soils on some of the lower slopes, and some islands of black soil on better drained low lands. Following is a description of the three types mapped.

(a) BRETON LOAM (map symbol Bn. L.)

Breton Loam is a fairly well to well drained soil usually found on undulating to rolling morainal topography. The native cover is mainly aspen poplar with some black poplar and spruce. Stones are few to some in number (mixed granites and sandstones) and, although significant, do not generally offer undue obstruction to cultivation.

Breton loam is found in the Peace Hills sheet along the west side. It is the eastern edge of a much larger area that

continues westward into the Brazeau sheet. There are 26,000 acres of Breton loam mapped. The following is a generalized description of a Breton loam profile.

Inches

1- 3 A_0—Leaf mat. pH 6.2 to 6.6.
1- 2 A_1—Dark brown loam—loose. pH 6.0 to 6.3.
4- 7 A_2—Light grey brown, platy—loam to sandy loam—easily crushing into small irregular fragments. pH 5.8 to 6.2.
1- 2 A_3—Brown, porous, firm. Breaks to nutty fragments. pH 5.8 to 6.2.
10-20 B_2—Brown to dark brown clay loam to clay—medium nutty to blocky. pH 5.5 to 6.0.
10-20 B_3—Brown, medium nutty but less well defined than B_2. pH 6.5 to 7.0.
Ca—at average of 48″—often spotted with lime. pH 7.5
C —Fairly uniform brown sandy clay loam to clay till. Highly silicious. pH 7.6.

The plowed field is generally of a light grey brown color and tends to bake and crust on exposure.

Agricultural Use.

The Breton loam is relatively low in natural fertility. The leaching process by which these soils have formed has tended to remove most of the soluble plant foods from the upper horizons. Due to the fact, however, that the rain water on the average does not penetrate beyond 4 or 5 feet, many of these plant foods are deposited in the lower horizons, beginning with the heavy textured B horizon. Consequently the lower horizons are generally better supplied with mineral plant food elements than is the surface horizon.

The main management problems associated with the cultivation of this soil, then, are: first the incorporation of organic matter into the surface horizon to provide a better structure and to provide readily available plant food for the young plants. This can be done mainly by growing clover and alfalfa which also adds the much needed nitrogen. And, secondly, to supply the mineral plant foods that may be deficient either due to leaching or because of a lack in the original parent material. Information to date indicates that Breton loam is primarily deficient in the element, sulphur. As cropping continues it is believed that other mineral deficiencies will become apparent. Due to the high lime content of the parent material and the fact that this material is within the range of the plant roots, the Breton soils have not become extremely acid and little response has yet been obtained from the application of lime.

Wheat grown on this soil is usually low in protein content and hence of inferior quality. For the same reason, however, good malting barley can be grown. Legumes do well and legume seed production has proved quite successful.

In general Breton loam is a soil low in natural fertility but conversely is a soil that lies in a relatively high rainfall belt.

The profile is adequately drained and the subsoil is fairly well supplied with most of the required mineral plant foods. It therefore is a responsive soil, responding favourably to correct management practices.

Where the heavy textured B horizon is quite close to the surface, water erosion may take place on the sloping land. It is necessary to take every precaution to prevent this. Likewise since the A horizon is loose and generally somewhat sandy in nature, wind erosion has also taken place. This is particularly apparent where long stretches have been cleared without leaving adequate windbreaks. The leaving of natural windbreaks should receive more consideration when new lands are being brought under cultivation. Such windbreaks have values other than the prevention of erosion.

(b) STRONGLY PODSOLIZED BRETON LOAM

[map symbol Bn.L. (S.P.)]

This soil differs from Breton loam mainly in having a more deeply leached A_2 horizon; there may be from 7 inches to 12 or more inches of the ashy light colored A_2 horizon. (See Plate III, fig. 3.)

This profile is generally found on the higher lands and there may be a higher content of sand in the parent material. The Ca. (lime) horizon is usually found at a greater depth than in the less severely podsolized Breton loam. There are 50,000 acres mapped.

Agricultural Use.

The strongly podsolized Breton loam is generally less fertile than the Breton loam and it, therefore, will require a longer and more complete building up process before satisfactory yields can be expected. In general, only the better topography classes of this soil type should be considered as arable land; the rougher phases might better be left in native forest.

(c) BRETON SANDY LOAM (map symbol Bn.S.L.)

A small area (500 acres) of sandy loam was mapped east of Pigeon lake. Tentatively this has been left in the Breton profile type. It is quite strongly degraded and is found on rolling topography. It is inferior soil.

2. *Parent Material Mainly of Edmonton Formation Origin.*

Edmonton formation is a freshwater deposition of upper Cretaceous age. It consists of soft sandstones, sandy shales, bentonitic clays and coal seams. The till formed from the Edmonton formation is of a brown color, is fairly heavy textured and contains a considerable amount of coal and ironstones. A small quantity of Bearpaw shale may be mixed with this till (this shale contains appreciable amounts of gypsum). One soil type is shown on the soil map, namely the moderately podsolized loam. As in the Breton soil areas,

small patches of grey-black soil, black soil and peat are found. Following is a description of the one type mapped in this group.

(a) COOKING LAKE LOAM (map symbol Cl. L.)

Cooking Lake loam is found in the Peace Hills sheet primarily in the northern portion of the Beaverhills moraine; some is mapped on the higher morainal lands east of Ponoka. The first mentioned area is the southern end of a much larger area in the Edmonton Sheet. There are 46,000 acres of Cooking Lake loam mapped.

The topographic features, the native vegetative cover and the principal solum characteristics of Cooking Lake loam are very similar to the descriptions given for Breton loam. The main solum difference is in the B horizon, the Cooking Lake being more blocky and more strongly stained. There is also some difference between the two parent materials; as has been stated, one is of Paskapoo origin and the other of Edmonton origin. It may be significant that total magnesium analysis of C horizon samples showed that the general Cooking Lake area was consistently higher in magnesium than was the general Breton area.

With the above exceptions then, the generalized description given for the solum of the Breton loam can be used to describe the Cooking Lake loam. The reason for tentatively separating these two soils will be given in the section on agricultural use below.

Agricultural Use.

With one exception what was said regarding the agricultural use of the Breton soil can also be said of the Cooking Lake soil. Fertility trials have been fairly extensively conducted on the Breton soils and certain mineral deficiencies have been clearly established. Such is not the case in the Cooking Lake soils. For example, sulphur deficiency may or may not be such an important factor in the Cooking Lake soils. This surmise is based on the fact that a small percentage of Bearpaw shale, a shale high in gypsum salt, occurs in the parent till. It is certain, however, that there is just as great a need for the incorporation of green manure into these soils as there is into the Breton soils. More fertility trials are needed before the fertility requirements can be specifically known. It will be possible then to determine whether or not these two soils should be mapped separately.

DEGRADED BLACK (GREY-BLACK TRANSITION) SOILS

The degraded black soils in Alberta in general occur in a narrow transition belt between the grey wooded soil zone and the black soil zone. However, there are numerous islands of these transition soils within the main black zone and within

the main grey wooded zone. These soils are usually tree covered, although the forest cover is not generally as heavy as in the grey wooded soil areas. Degraded black soils are transitional in nature, that is, in some profile characteristics they are intermediate between the black and the grey profiles. Podsolization has taken place to a limited degree, producing an A horizon that is either of a brown to dark brown color, or that has a significant amount of black A_1 horizon over a relatively thin light brown A_2 horizon (the plowed field is generally darker in color than is the grey wooded soil areas). The average nitrogen content of the surface foot of these soils is about 0.3 percent. There is a fairly compact B_2 horizon and the Ca. (lime) horizon averages 45 to 50 inches from the surface. An A_0 horizon is usually present but is relatively thin.

A. Degraded Black Soils Developed on Glacial Till

(a) FALUN LOAM (map symbol Fn. L)

Falun loam is a medium textured degraded black soil developed on glacial till mainly of "Paskapoo" origin. (See Soil Parent Material page 21.). In the Peace Hills sheet most of the Falun loam areas lie close to the contact between the Edmonton and Paskapoo formations. The parent till in these areas is consequently somewhat mixed.

It is a fairly well to well drained soil usually found on gently undulating to gently rolling topography. The native vegetative cover is mainly aspen poplar with varying amounts of black poplar. Stones are few to some in number.

Falun loam is found in the Peace Hills sheet along the west side and east of Ponoka. There are 163,000 acres mapped.

There is a considerable range in the degree of podsolization in the Falun loam areas, that is, all the way from an only slightly degraded black to profiles that approach Breton loam. Numerous small areas of black soil, grey wooded soil and peat are often associated with the Falun loam (See Plate III, fig. 1).

The following generalized description of a Falun loam profile is intermediate between the two extremes.

Inches	
1	A_0—Grass and leaf mould. pH 6.0 to 6.5.
9	A_1—Brown to dark brown loam: weakly platy. pH 6.1.
3	A_2—Brown to light brown loam, platy to fragmental. pH 5.7 to 5.9.
½- 2	A_3—Brown to light brown, heavy loam, somewhat porous medium nuciform; this horizon may be absent. pH 5.8 to 6.0.
20-30	B —Dark brown clay loam, large blocky to nuciform. Slight staining on the cleavage faces. pH 6.0 to 6.3.
	Ca—at 40″ to 50″ from the surface—usually only a slight lime concentration. pH 7.5.
	C —Brown clay to clay loam till; often lime spotted. pH 7.7.

Agricultural Use.

The Falun loam is, as would be expected, about intermediate in native fertility between the black soils and the grey wooded soils. They are therefore fairly fertile soils and since they are in a relatively high rainfall zone, produce fairly satisfactorily during the first few years of cultivation. They do, however, soon respond to the inclusion of green manure crops, principally legumes. There is insufficient fertilizer data available on these soils, but indications are that some response is usually obtained from the addition of ammonium phosphate together with sulphate.

The Falun loams are mixed farming soils and wheat should form a minor part of the rotation, emphasis being placed on hay and pasture crops and coarse grains.

Since many of these soils are on sloping land, they are subject to water erosion. The inclusion of organic matter in the surface and the elimination of any cultivation up and down the slopes should both receive consideration.

(b) WEAKLY PODSOLIZED COOKING LAKE LOAM

[map symbol Cl.L. (W.P.)]

This is the grey-black soil that is associated with the grey wooded Cooking Lake loam. That is, it is formed on glacial till primarily of Edmonton origin. What has been said regarding the similarity between Breton loam and Cooking Lake loam applies equally well regarding Falun loam and weakly podsolized Cooking Lake loam. The generalized description given for a Falun loam profile applies quite well to this profile type with the same possible exception, that is, a more blocky, somewhat harder, and more strongly stained B horizon.

Due to the fact that only a limited acreage of the soil type has been mapped (approximately 12,000 acres) and that there have not been any fertility experiments conducted on the areas mapped, no specific fertilizer practices can be recommended. What has been said regarding the Falun loam, however, should in the main, be applicable on the weakly podsolized Cooking Lake loam.

B. Degraded Black Soils Developed on Alluvial-Aeolian Material

(a) CARVEL SANDY LOAMS (map symbol Cv.S.L.)

The Carvel sandy loams are light textured degraded black soils developed on highly silicious transported material of mixed upper Cretaceous and Tertiary origin. Only a limited acreage (about 1,500) of this occurs in the Peace Hills sheet, namely, around the edge of Pigeon Lake. Because of the limited amount it was not thought advisable to establish specific soil types.

The topography varies from level to undulating and drainage from fair to good. In general the portion close to the lake edge has a water table fairly close to the surface. The portion on the higher land bordering the Cooking Lake loam is well to excessively drained. The profiles on the first, namely, near the lake edge, have a fairly deep, dark brown A horizon. There is however a general increase in the amount of podsolization towards the higher land, indicated by an increasing thickness of the light grey-brown A_2 horizon. There is also a general decrease in depth of sandy deposition from the lake shore out; near the outer edge of the area the underlying till is within solum depth.

Agricultural Use.

The darker soils of the Carvel should be fairly productive, particularly for the garden crops needed to supply the local resort. The more strongly podsolized uplands are better left in woodlot.

BLACK SOILS

The black soils of Alberta lie mainly in a triangular area between the points of Olds, Westlock and Lloydminster. This is the Parkland section of the province and is referred to as the black soil zone. This zone includes about two-thirds of the Peace Hills sheet. The eastern edge of this area is marked by the main zone line dividing it from the thin black zone, and the western edge is terminated by the grey black transition soils. The average rainfall in the black zone portion of this sheet is between 17 and 18 inches, and the average annual temperature about 36°F. The black soils within the zone generally have 6 inches or more of black surface soil and the average nitrogen content of the surface foot is between 0.4 and 0.5 percent. From the point of view of nitrogen and organic matter these soils are very rich soils. Generally they are also well supplied with the mineral plant foods, although after some years of cropping they often become deficient in available phosphorus.

A. Black Soils Developed on Glacial Till

1. *Parent Material mainly of Edmonton formation origin.*

The glacial till, mainly of Edmonton origin (see page 22) in this area generally is of a brown to grey brown color and of a sandy clay texture. It has a low to medium lime carbonate content and contains Precambrian rocks, ironstones and coal. This till is spread as a relatively thin ground moraine over the Camrose plain, but is generally much deeper in the Beaverhills terminal moraine. It would appear that there is a little more Bearpaw shale in the ground moraine material than in the terminal moraine. The above two mentioned areas

Fig. 1.—An area of mixed Falun and Breton soil types. The greyer Breton soil is usually confined to the higher land in these mixed areas.

Fig. 2.—A shallow sedge peat in the wooded area. These grow good hay crops. Mixed farming is desirable here.

Fig. 3.—A strongly podsolized Breton loam. Note the depth of ashy A_2 horizon. This soil type should be "built up" by the use of legumes and mineral fertilizers.

Fig. 1.—The level alluvial plain at New Norway. This is primarily a mixture of Ponoka loam and Peace Hills fine sandy loam. Angus Ridge loam occurs where the underlying till comes to the surface. It is good arable land.

Fig. 2.—Profile of Peace Hills fine sandy loam. Note the deep A_1 horizon (18″). This soil will erode with the wind unless the organic matter content of the surface soil is maintained.

Fig. 3.—Profile of Ponoka loam. Note the deep black A_1 horizon and the thin A_2 horizon. This is a solodic profile. Usually the underlying glacial till is found within three to five feet of the surface.

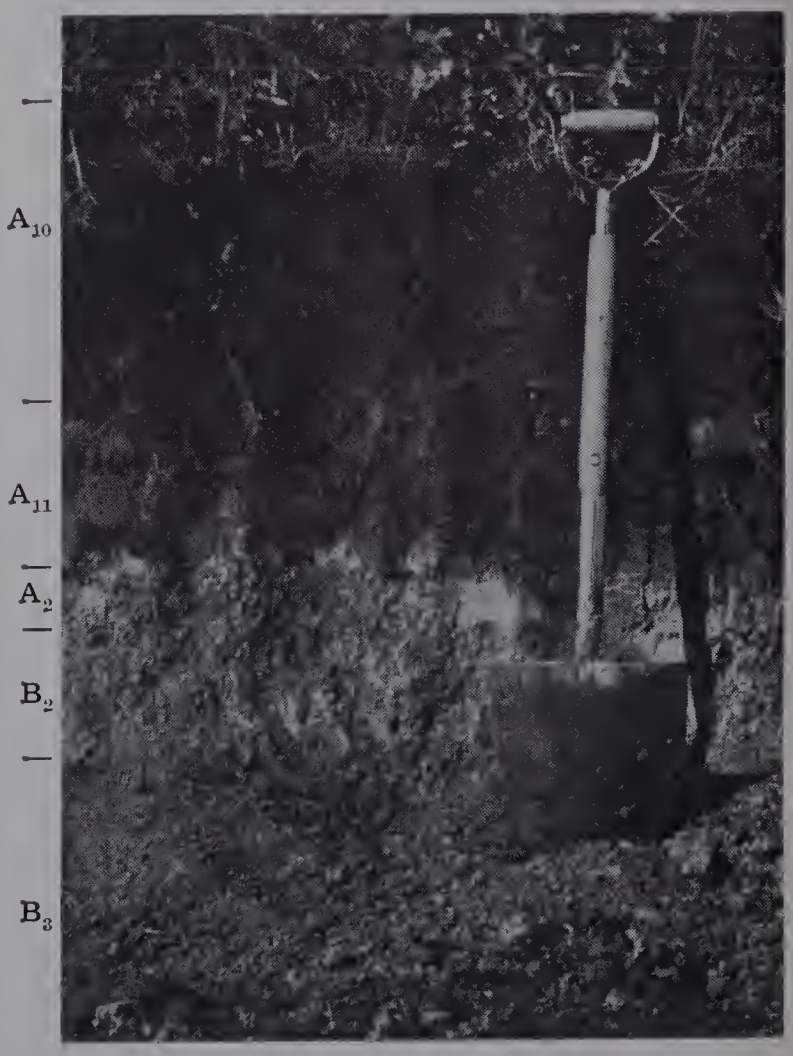


Fig. 1.—A gently rolling area in the Beaverhills moraine. There is considerable variation in profile type from the hill tops to the valley depressions. In the black zone this moraine was originally all tree covered.

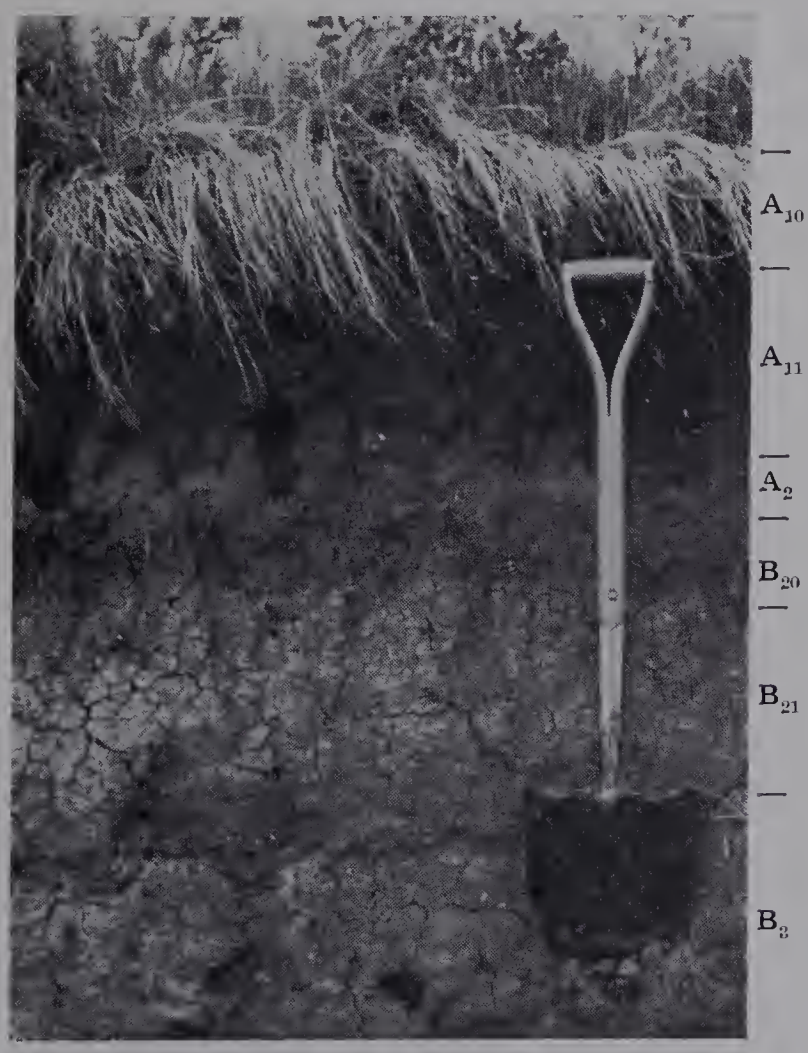


Fig. 2.—A profile of Angus Ridge loam. This is a solodic profile formed on glacial till. It is found in the Beaverhills moraines associated with Beaverhills loam and Camrose loam. It is very good arable land.

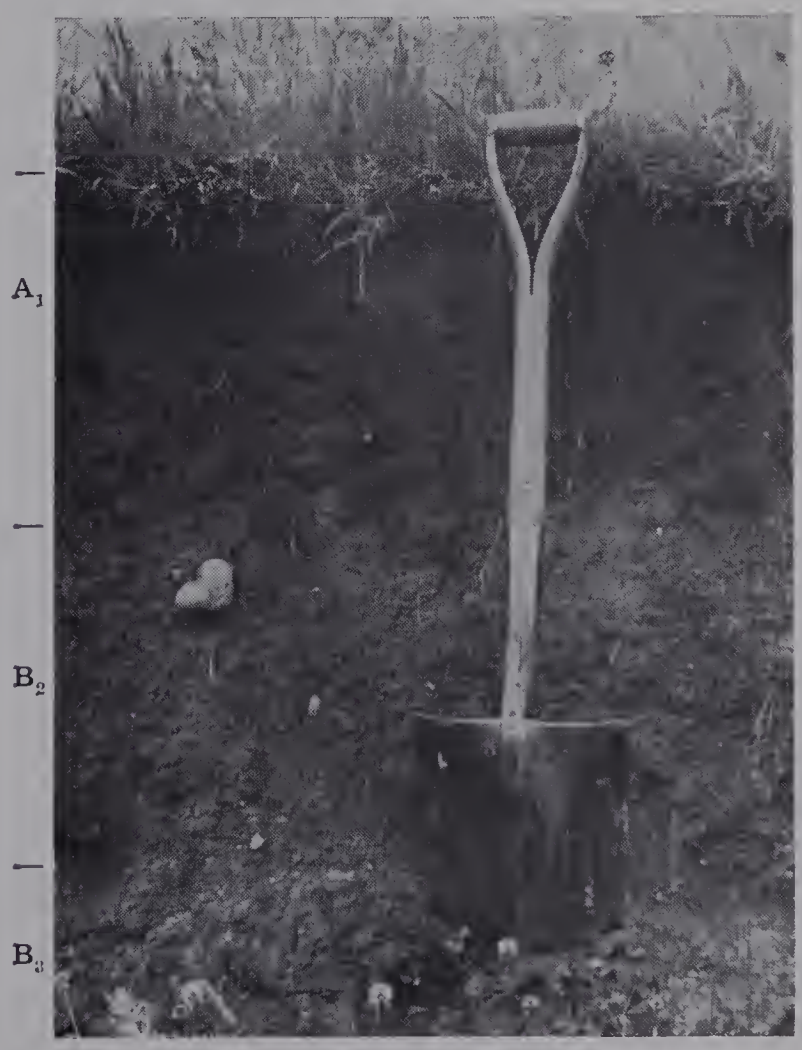


Fig. 3.—A profile of Beaverhills loam. It is the (normal) prismatic-chernozem profile. It usually occurs nearer to the hill tops than the Angus Ridge loam. The depth of black A_1 varies considerably; some of the hill tops may be quite thin.

PLA

Present Cultivated, Abandoned an

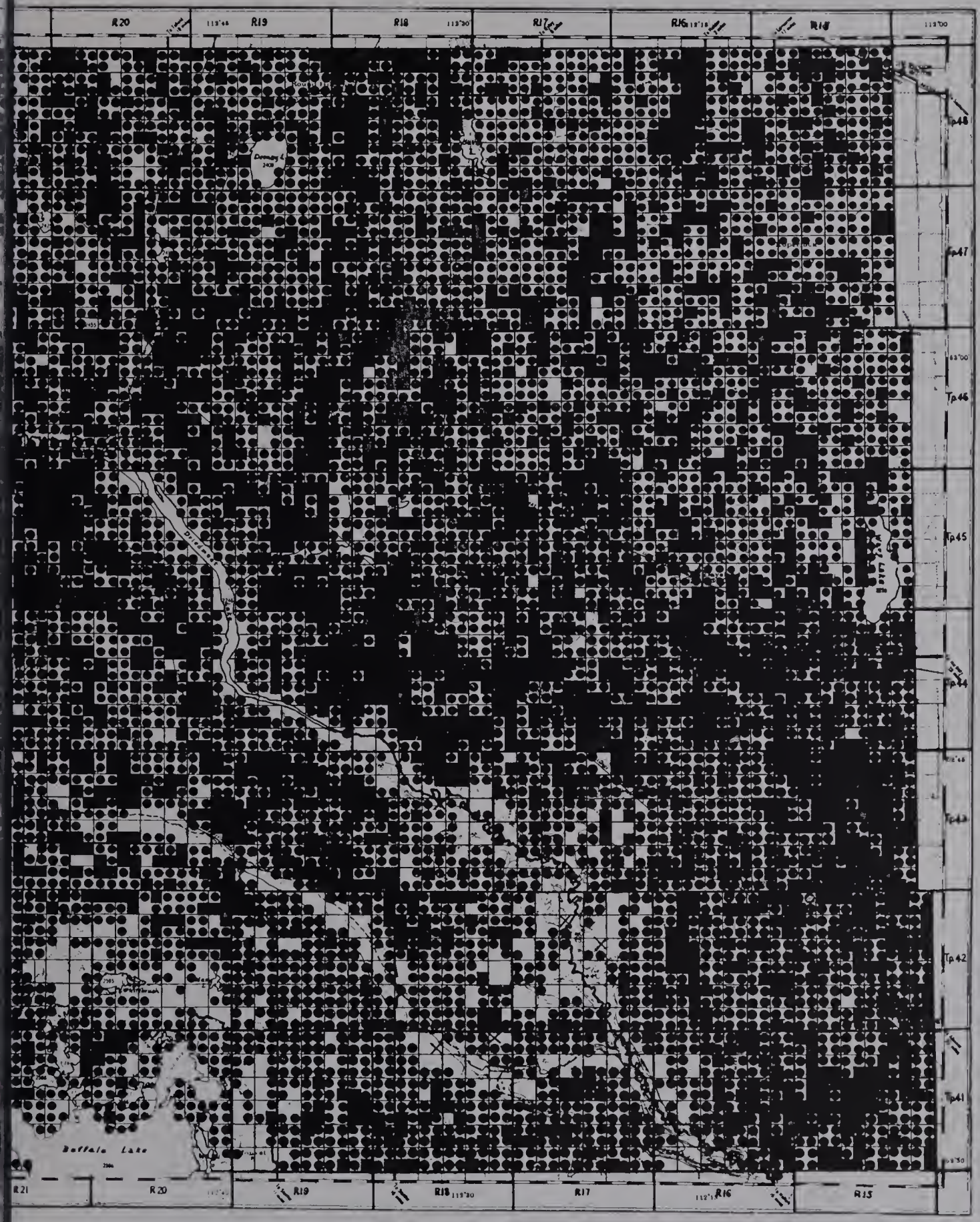
Le

Completely Cultivated (140-160 acres) .....

Partially Cultivated (10-140 acres) .....

VI

Virgin Lands of Peace Hills Sheet



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

Virgin Lands (Idle and Pasture) ..... ☐

PLATE VII

Fig. 1.—A profile of Daysland loam. This is a solodic profile. The accumulated drift has been blown off the adjoining field. It is usually found associated with Elnora loam and Killam loam. It is good arable land.

Fig. 2.—A profile of Killam loam. This is the solodized-solonetz profile. Note the sharp break between the A_2 and B_2 horizons. It is fair to fairly good arable land depending mainly on the depth of A_1 (surface) horizon and amount of salt present.

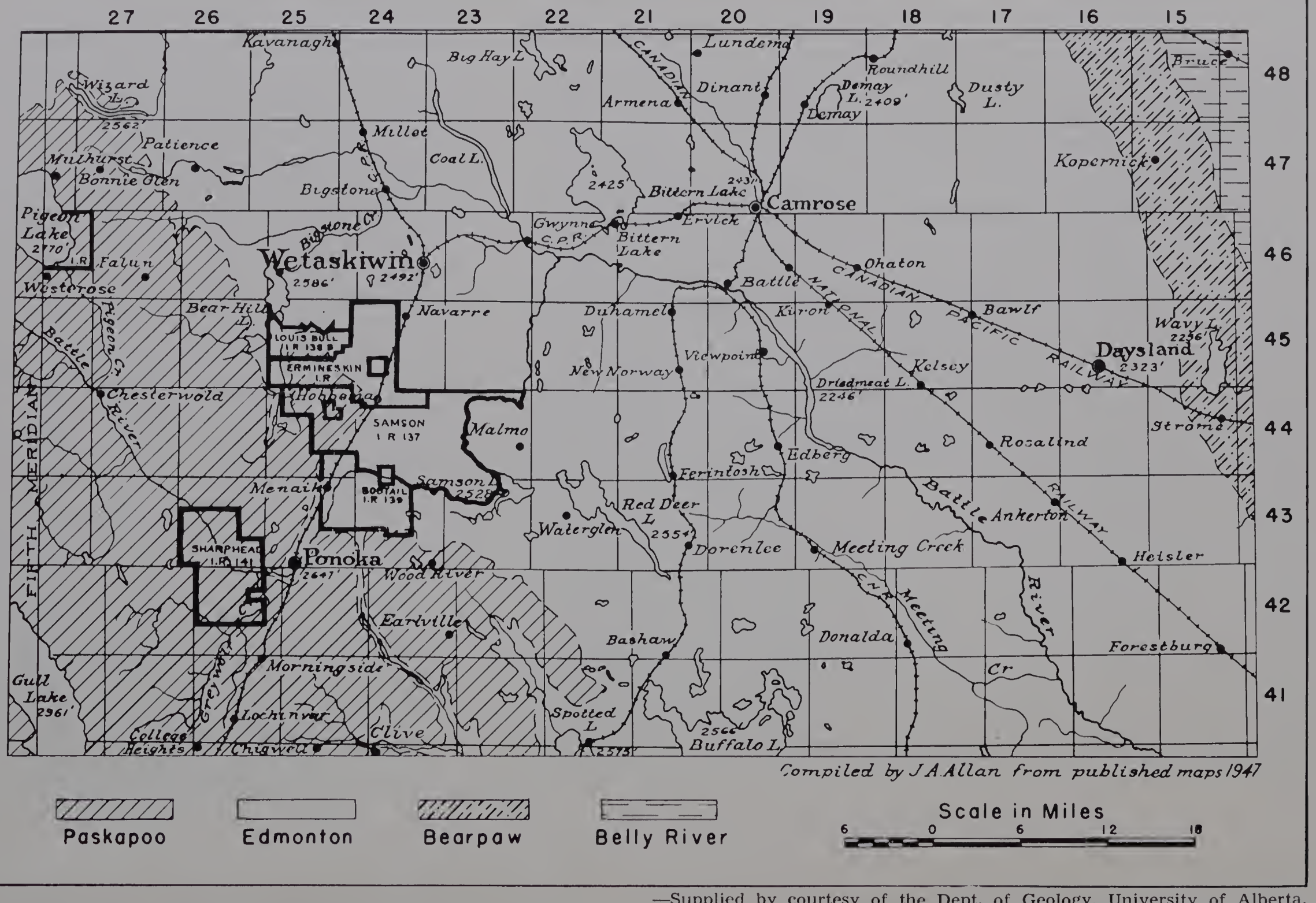
Fig. 1.—Water erosion on Killam loam. A heavy downpour or spring runoff may wash away the entire A_1 horizon. (See Plate VII, fig. 2).

Fig. 2.—Water erosion in morainal topography primarily of Beaverhills loam and Angus Ridge loam soil types. Maintaining the organic matter and practising contour farming will help to prevent this loss.

Fig. 3.—Battle river valley. This is the main natural drainage system in the Peace Hills sheet. The steep banks should be left in native cover to prevent erosion.

PLATE IX

GEOLOGY OF THE PEACE HILLS SHEET



Compiled by J.A.Allan from published maps 1947

Paskapoo | Edmonton | Bearpaw | Belly River

Scale in Miles

6 0 6 12 18

—Supplied by courtesy of the Dept. of Geology, University of Alberta.

have quite different landscapes; one is a fairly level plain and the other a rolling moraine (see Plate V, fig. 1). The same profile types occur in both but in quite different percentages. The following profile types have been mapped: Beaverhills loam, Camrose loam and heavy loam, Angus Ridge loam, and slough podsol. Minor percentages of Ponoka loam on some of the lower slopes where there has been surface deposition and black meadow soils in some of the lower lands also occur but are not shown on the map.

The meadow soils occur where drainage is somewhat impeded. They are generally quite fertile soils having upwards of 16 inches of black surface. The lower portion of the A horizon may contain carbonates. The depressional areas are slough podsols or marsh lands.

In the terminal moraine, which extends north and south through about the middle of the sheet, there are small areas of Falun loam and Cooking Lake loam particularly on the northern slopes. This is especially true from Dorenlee north. Towards the northern side of the sheet the grey wooded soils are of more frequent occurrence and on the Edmonton Sheet to the north practically the entire moraine is of grey soils.

On the main Camrose plain, Camrose loam (the solodized solonetz profile) is of most frequent occurrence and forms over 50 percent of the total area. Angus Ridge loam (solodic profile) and Beaverhills loam (prismatic-chernozem profile) are found on the well drained higher land, and slough podsols or marshes occupy the depressions. In the Beaverhills moraine Angus Ridge loam and Beaverhills loam are of about equal distribution, and the two make up about 75 percent of the area. Beaverhills loam occurs on the crowns and Angus Ridge loam on the hill slopes. Camrose loam or meadow soils, or both, may occur on the lower slopes adjacent to the marshy kettle holes.

Following is a description of the four main soil types formed on this till.

(a) ANGUS RIDGE LOAM (map symbol Ar.L.)

Angus Ridge loam is a soil of fairly good to good drainage found on gently undulating to rolling topography. The native cover is grass and shrubs with bluffs mainly of aspen poplar. This soil type occurs over much of the Black zone in this sheet and, in places, is the dominant profile. In the Beaverhills moraine it is found associated with Beaverhills loam, and both east and west of this moraine is found associated with Ponoka loam. In all there are 355,000 acres mapped.

The following is a generalized description of an Angus Ridge loam profile: it is a solodic profile.

Inches

7 A_{10}—Black loam weakly irregular prismatic. pH 7.0.
7 A_{11}—Black loam, firm, irregular prismatic with horizontal cleavage lines. pH 6.0.
1- 2 A_2—Grey black to grey brown loam. Firm, somewhat porous, pronounced silica grains showing. Structure similar to A_{11}. pH 5.9.
7 B_2—Bright brown clay loam. Medium columnar, breaking readily into medium blocks. pH 5.6.
18 B_3—Brown clay loam to clay, some vertical cleavage lines. Weakly nuciform to massive. pH 6.5.
Ca—at about 40″—low to medium lime content. pH 7.8.
C —Brown till. pH 7.7.

This profile generally occupies the well drained higher land. In the gently undulating topography of the Camrose plain, it usually occurs over the knoll and part of the way down the slopes. No visible salt concentration was noted in the Angus Ridge profiles to at least 50 inches. Although mechanical analysis showed no difference between the parent till of Angus Ridge loam as compared to Camrose loam, the filtration rate was about three times as fast in the Angus Ridge parent material. Some thinner profiles of this member are found, profiles that are tending towards the solodized solonetz.

Agricultural Use.

The Angus Ridge loam is found on the more nearly level topographic phases. It has a fairly high natural fertility and a desirable profile structure throughout and is, therefore, adaptable to a wide range of crops. The Angus Ridge profile can be distinguished by a deep black surface, a thin grey subsurface horizon and a brown clay subsoil that contains stones, coal flecks and small ironstones (see Plate V, fig. 2). It is good to excellent arable land.

Since it is a very productive soil and consequently a valuable asset, every precaution should be taken to see that this productivity is maintained. This warning, we think, is timely because too often, soils of high native fertility are the last to receive conservation attention. The owners as well as the community can ill afford to allow deterioration to take place. This soil type is adapted to a mixed farming agriculture; a continuous cereal-fallow rotation should not be continued.

(b) BEAVERHILLS LOAM (map symbol Bh.L.)

Beaverhills loam is a soil with good drainage found on undulating to hilly topography. The native cover is a parkland vegetation of grass, shrubs and poplar. In the Beaverhills moraine this profile makes up from 30 to 60 percent of the total area. There are 240,000 acres mapped.

The following is a generalized description of a Beaverhills loam profile: it is a prismatic-chernozem profile.

Inches

6 A_{10}—Black loam, weakly prismatic, crushes easily to small crumbs. pH 6.0.

4 A_{11}—Dark brown loam to heavy loam, weakly prismatic. pH 6.0.

15-30 B —Brown to bright brown clay loam. Widely separated vertical cleavage lines. pH 6.5.

Ca—at about 36″. pH 7.8.

C —Brown till with little or no salt. pH 7.8.

In rolling topography this profile occurs on the knolls and part of the way down the slope. The dry knolls have a thinner profile than the one described: some of the table lands may have a deeper profile. There is indication of columnar structure in the B horizon in some of the Beaverhills profiles.

Agricultural Use.

Beaverhills loam is the "normal" black loam and can be distinguished from the Angus Ridge loam by the absence of the light-colored subsurface horizon (see Plate V, Fig. 3). That is, there usually is a gradual change from the black surface to the brown to dark brown subsoil. In the main, Beaverhills loam occupies the well drained topographic position. This soil type from a texture, structure, and plant food point of view is very good arable land. Its final rating will, however, depend on the topography class; the hilly areas, for example, are mainly pasture lands.

In the more rolling lands of the terminal moraine, Beaverhills loam occurs in intimate association with Angus Ridge loam, Camrose loam and others. A discussion on agricultural use in this area must, then, be primarily of the complete association rather than of the individual soil types. The main problem in this area is the prevention of water erosion. At present, slopes up to and above 15 percent are being cultivated. This is dangerous practice unless erosion control measures are adopted (see Plate VIII, Fig. 2). Since the two dominant profiles, (Angus Ridge and Beaverhills make up about 75 percent of the total) have fairly receptive subsoils, the amount of erosion to date has not been excessive. However with continued cultivation it will become more apparent. The slopes should not be cultivated up and down the slope and should not be, at any one time, completely in fallow. In other words, some form of contour farming should, at all times, be practised. In general the steeper the slope the thinner the surface soil and therefore erosion, both wind and water, will tend to expose the less fertile subsoil. Contour farming in these areas would have another advantage,

namely, that generally the fields would be of one soil type. This makes for a uniformity of crop growth and uniformity in ripening, a condition not possible if all types from the shallow Beaverhills loam on the knolls to deep meadow soils in the valleys, are in one field. These meadow soils are best adapted to hay and pasture crops and some coarse grains.

Where Beaverhills loam occurs on the undulating lands east and west of the moraine, it is usually in association with Angus Ridge loam or Ponoka loam and can be satisfactorily farmed with both of these.

(c) CAMROSE LOAM (map symbol Cam.L.)

Camrose loam is a soil of poor to fairly good drainage usually found on level to gently undulating topography. The native cover is mainly grass and small shrubs. The main area of Camrose loam is on the level Camrose plain adjacent to the town of Camrose where it makes up about 60 percent of the area. In all there are about 275,000 acres mapped.

The following is a generalized description of a Camrose loam profile: it is a solodized solonetz profile.

Inches	
5	A_{10}—Black loam, irregular prismatic, crushes readily to small crumbs. pH 6.2.
5	A_{11}—Black loam, prismatic. pH 6.2.
2	A_{20}—Grey black loam, prismatic to columnar. pH 6.7.
1	A_{21}—Grey gritty loam. Weakly platy and porous. pH 6.7.
8	B_2—Very dark brown clay loam to clay. Columnar with flat or rounded tops; medium blocky meso-structure. pH 7.4.
15	B_3—Brown clay loam to clay. Columnar to massive. pH 7.2.
	Ca—(Lime) at about 36″ from surface. Low concentration. pH 8.1.
	SO_4—(Salt) at from 30″ to 40″ from surface, variable concentration.
	C —Brown to grey brown till. This till, because of the salt content, is often in a semi-deflocculated condition causing very slow water penetration. pH 8.1.

This profile has ten to twelve inches of A horizon and occupies the moderately to fairly well drained positions: it is generally found on the very gentle slopes. A thinner phase of this profile, namely, one with four to six inches of A_1 and practically no A_2 may be found farther down the slope and bordering the depressions. This latter profile is included with the Camrose loam because it is still slightly solodized, although it more closely approaches the solonetz. This thinner profile has only poor to moderate drainage, and may have varying amounts of red mottling in the B horizon. There is usually a higher salt concentration than in the better drained profile.

Agricultural Use.

The profile characteristics of the Camrose loam indicate its main management problems. Those characteristics are a relatively loose, black surface horizon, a very hard columnar subsurface horizon, and a salt concentration layer in the subsoil. Because of this hard subsoil horizon these soils are often called gumbo soils by the local residents.

The surface soil in its native state is well supplied with organic matter and usually fairly well supplied with the mineral plant foods. It does, however, tend to be somewhat loose and is consequently vulnerable to wind erosion. The fibre content of these soils should not be allowed to become materially reduced. In those areas where the surface horizon is thin, water erosion can be a serious problem. The tight, hard-structured subsoil absorbs water very slowly so that during heavy rains the thin surface may become so wet that it actually flows. This can eventually expose the less fertile and hard to cultivate subsoil (see Plate VIII, Fig. 1).

Besides absorbing water very slowly, this hard subsoil layer offers physical obstruction to root penetration. These facts are particularly apparent when the soil is rather dry. These objections are also more apparent in the thinner phase. Every effort should be made to keep this hard subsoil horizon loosened by cultivation or by root stalks.

Since the salt concentration is usually not high and contains considerable gypsum, alkali is not a serious problem. In some of the lower spots, however, it is in sufficient quantities and close enough to the surface to affect growth. Alkali resistant crops should be grown in these areas. Experimental information dealing with the fertility requirements of, and cultural practices on, these solodized solonetz soils is very badly needed.

Camrose loam is fairly good and good arable land and the deeper phase is adaptable to a fairly wide range of crops.

(d) SLOUGH PODSOL (map symbol Sl.Pd.)

Slough podsols are soils found in depressional spots. They have not in general received much deposition material nor have they been as continuously wet as the marshes. Most of them collect run-off water which remains for a few weeks each spring. They may also flood during heavy rains.

These soils are of fairly frequent occurrence on the Camrose plain and in places make up to 10 percent of the total area. The following is a generalized description of a slough podsol profile in this area.

Inches
4- 5 A_0 & A_1—Black, mainly organic (sedge). pH 6.3.
8 A_2—Grey sandy loam. Platy but breaks easily into small irregular fragments. pH 6.4.
2 A_3—Grey brown. pH 6.3.
Glei—Grey brown sorted till, heavily stained with iron. Massive. pH 6.2.

Agricultural Use.

These slough podsols that appear as grey spots in the field are lower in organic matter than the surrounding black soils. They tend to bake when dry and are often too wet to cultivate when the remainder of the field is right. Usually they are too small to treat separately from the remainder of the field.

Heavy application of barnyard manure improves the fertility and tilth of these soils. If they are fairly large it may be advantageous to seed them permanently down to a grass legume mixture containing, for example, Reeds canary grass or red top.

B. Black Soils of Glacial Lacustrine Deposition

1. *Somewhat Calcareous Clay Parent Material.*

These soils are formed on glacial lacustrine, clay parent material. It is material sorted out of till that is mainly of Edmonton origin. The parent material is brown to olive brown in color and contains shaley fragments. It has a medium to medium high lime carbonate content. Only one soil type is mapped.

(a) MAZY SILTY CLAY LOAM (map symbol Mz.Si.C.L.)

Mazy silty clay loam is a soil of fairly good to good drainage although due to the heavy texture drainage may be slow. It is usually found on gently undulating topography and occupies some bench lands, and some wide valleys within the Beaverhills moraine. That is, this lacustrine material has quite possibly been deposited during the period of ice cover as local deposition areas. Those areas on level bench lands are often on elevations nearly as high as any in the moraine: only 3,500 acres are mapped.

The following is a generalized profile description of a Mazy profile: it is a slightly solodic profile.

Inches
4 A_{10}—Black silt loam to silty clay loam, irregular, prismatic with tendency to granular structure. pH 7.0.
6 A_{11}—Black silty clay loam, granular with some vertical cleavage lines. pH 7.0.
A_2—Absent to 2″. Brown to grey brown, porous, nuciform. pH 6.7.
15 B —Brown to dark brown clay, fairly hard granular. pH 7.4.
Ca—At about 26″ to 36″. Brown to grey brown. pH 8.0.
C —Dark grey brown clay, stone free; may be varved at lower depth. pH 8.4.

Variations from this occur. These variations go from a near "normal" black earth profile with no perceptible A_2 horizon but containing a brown to dark brown A_3 horizon to a solod profile with mild platiness in the upper part of the A_2 horizon.

Agricultural Use.

The Mazy silty clay loam areas are quite easily identified. Along the graded roads the road surface is a granular clay much darker in color than in the surrounding loam areas. In the profile itself the dark clay granular structure is distinctive. Many small areas of this soil, too small to show in a map of the scale used, occur throughout the area.

Mazy silty clay loam is a relatively rich soil and due to the lime content can be fairly easily maintained in good tilth. It is good to very good arable land used at present primarily for wheat production. Providing its fertility is maintained and the organic matter content not allowed to materially decline, it should continue to be good wheat land. The organic matter can be maintained by periodically including a grass crop in the rotation. Heavy textured soils are generally the most vulnerable to water erosion. Simple precautionary measures such as maintaining the organic matter content with occasional grass crops and conversely reducing the number of fallow crops, and cultivating across rather than up and down the slopes should be adequate. This statement can be made because in general there are no steep sloping lands in the Mazy silty clay loam.

2. *Somewhat Saline Sandy Clay Parent Material.*

The soils in this group are on parent material that is sorted out of Edmonton and Paskapoo tills, mainly the former. It is a yellow brown to grey brown clay with varying quantities of silt and fine sand. Towards the lower depths, close to the till contact, there may be distinct varving. Some of the lenses are of a dark colored shaley clay. The parent clay has a medium to medium low lime content and a medium to medium heavy salt content. Three soil types appear on the map, namely, the Wetaskiwin, the Navarre, and the Malmo. However minor percentages of slough podsols and of solonetz profiles occur. Some Ponoka loam also occurs associated with the above soils.

(a) WETASKIWIN LOAM AND HEAVY LOAM
(map symbol Wkn.L. and Wkn.H.L.)

The Wetaskiwin Loams are moderately to fairly well drained soils usually found on level topography. The native cover is a parkland vegetation of grass, shrubs, willow and aspen poplar. The thinner phase of this type is generally

found under a grassland vegetation. Most of the Wetaskiwin loam occurs in the Wetaskiwin lacustrine plain where it makes up from 20 to 80 percent of the mapped areas. In all there are 56,000 acres mapped.

The following is a generalized description of a Wetaskiwin heavy loam profile. This is a solodized solonetz profile.

Inches

9 A_{10}—Loam to heavy loam that is black on the surface, but slightly grey black towards the bottom. Weakly columnar and somewhat porous. pH 6.0.

2 A_{11}—Grey black loam. More porous than A_{10}. pH 5.7.

2 A_2—Grey loam (sandy), similar macrostructure to A horizon but more porous. pH 6.4.

6 B_{20}—Very dark brown sandy clay, heavily stained, columnar with flat to rounded tops, hard medium blocky mesostructure. pH 7.6.

4 B_{21}—Greyish dark brown, less staining and less pronounced structure than in B_{20}. pH 7.9.

B_3 & SO_4—at 24″ to 30″. Brown, gritty clay, containing salt inclusions. pH 7.8.

Ca—at 30″ to 45″. Brown to dark brown, stone free, massive sandy clay; containing some lime and salt. pH 8.5.

The A_1 may vary from 6 to 12 inches in depth and the A_2 from 1 to 4 inches in depth. Still thinner members, that is with less than 6 inches of A_1 and less than 1 inch A_2 occur. These are approaching the solonetz profile.

This profile is very similar in solum characteristics to the Camrose loam, the principal difference being the mode of deposition of the parent material. This similarity is accounted for by the fact that both parent materials were from a common source and both contain approximately the same salts.

Agricultural Use.

The Wetaskiwin loam can be recognized by the hard columnar subsurface horizon with its rounded tops looking much like a cauliflower head. It can be distinguished from the Camrose loam by the fact that it is usually on more level topography and both the surface and subsoil are practically stone free.

What was said regarding the agricultural use of the Camrose loam would apply equally well to Wetaskiwin loam and the reader is referred to this section on page 41.

Wetaskiwin loam is fairly good to good arable land. In this area, particularly, it is adapted to mixed farming. Deep rooted legumes that will penetrate the hard subsurface horizon should improve this soil.

(b) NAVARRE LOAM AND SILT LOAM
(map symbol Nv.L. and Nv.Si.L.)

The Navarre loams are poor to fairly well drained soils, usually found on level to depressional topography. The native cover was parkland vegetation of grass, shrubs and willow. Most of the Navarre loam occurs in the Wetaskiwin lacustrine plain. In all there are 42,000 acres mapped.

The following is a generalized description of a Navarre loam profile. It is, genetically, between the prismatic-chernozem and the black meadow types.

Inches

12 A_1—Black silty loam, mildly prismatic, somewhat loose near the top. (Up to 20″ of black A occurs). pH 8.1.

12-15 B_2—Brown to dark grey brown sandy clay loam to clay. Breaks into a small nuciform to granular meso-structure. pH 7.9.

Ca—May occur anywhere from 10″ below the surface to 30″ below.

SO_4–May occur in medium to low concentrations to the top of the B horizon.

C —Brown uniform silty clay. pH 7.6.

There are, then, varying amounts of calcification and salinization in these profiles. Fairly heavy salt concentrations were apparent in the road cuts caused presumably by seepage from the surrounding higher land. No excessive salt concentrations however were found in the top three feet of most profiles. Some artificial drainage has been done in this area.

Agricultural Use.

Navarre loam is distinguished by a deep black surface, a sharp break from the black surface horizon to the brown subsurface horizon, and by the presence of white salt seepage spots along the exposed road cuts.

Navarre silty loam is fairly good to very good arable land depending mainly on drainage and salt concentration. In general the less well drained profiles have the greatest amount of salt. If this salt is of sufficient concentration it will retard growth. In general however no alkali damage was noted excepting in the depressional spots, and damage here appeared to be due in part to excessive moisture. These poorly drained areas are also often quite weedy. Such areas might best be seeded down to a legume grass mixture and used as hay and pasture land.

(c) MALMO LOAM (map symbol M.L.)

Malmo loam and silt loam are fairly well to well drained soils usually found on level to gently undulating topography. The native cover was a parkland vegetation. Most of the Malmo loam occurs in the Wetaskiwin lacustrine plain south

of Battle river, where it makes up well over half the total soil. In all there are 16,000 acres mapped.

The following is a generalized description of a Malmo loam profile: it is a solodic profile.

Inches

5 A_{10}—Black silty loam. Slightly prismatic. pH 6.5.

9 A_{11}—Black silty loam. Prismatic to weakly columnar. pH 6.3.

2 A_2—Grey to grey brown loam. Porous, horizontal cleavage. pH 6.2.

6 B_{20}—Brown clay. Weakly columnar, with nuciform mesostructure. pH 6.4.

14 B_{21}—Brown to yellow brown clay. Larger more irregular nuts than B_{20}. pH 6.9.

Ca & C—at about 36″ to 40″. Sandy clay. Low lime, generally low to medium low salt content. pH 7.6.

The above profile is generally in the well drained position; Navarre loam usually occurs in the lower positions.

Agricultural Use.

Malmo loam can be recognized by the deep black surface horizon, the thin greyish subsurface horizon and the fairly heavy textured uniform, stone-free subsoil.

Malmo silty loam is very good arable land. It has a high native fertility. It will tend, however, to ripen crops later than the nearby Angus Ridge loam. Since much of it is on relatively flat topography, frost is a hazard in some of the higher rainfall years. A considerable percentage of this soil could well be used for hay and coarse grain crops.

3. *Other profiles found in Association with Wetaskiwin, Navarre, and Malmo.*

In the low spots there are meadow soils. These have a deep black silty loam A horizon and a grey B horizon that is strongly mottled with red iron stains. There is also a small percentage of slough podsols; soils that occur in shallow depressions and that appear grey in the plowed field. There are also some marshes that produce meadow hay. All these occur in the lower areas of restricted drainage. They are cold soils and in general not adapted to wheat or oat crops.

A very small percentage of what appears to be a solonetz member also occurs. This profile has a shallow black prismatic A horizon, a black to grey black heavily stained columnar B horizon. Salt and some lime is found at 18 to 24 inches.

C. Soils of Alluvial Lacustrine Deposition

(a) PONOKA LOAM (map symbol Pk.L.)

Ponoka loams are medium textured black soils developed on a sandy loam to clay loam parent material of alluvial-lacustrine deposition over glacial till: the deposition is often

lighter in texture in the lower layers than in the upper portion; that is, immediately above the till contact, there usually is a sandy loam to gravelly loam deposition. The subsequent deposition is generally of a loam to silty loam texture. In spots the till, D horizon, is within two or three feet of the surface. The parent material is low in lime and also low in salt content. It is often found associated with Angus Ridge loam or with Peace Hills sandy loam.

Ponoka loam is a well drained soil usually found on level to gently undulating topography. The native cover is a parkland to light forest vegetation of poplar bluffs with open areas covered by tall grasses and shrubs. It is mapped all along the west portion of the sheet, that is it forms the dominant profile in the level to undulating area that adjoins the Wetaskiwin lacustrine basin. A small acreage of Ponoka loam lies east of the Beaverhills moraine in the sorted soils of the New Norway area (see Plate IV, Fig. 1). In all there are 205,000 acres mapped.

The following is a generalized description of a Ponoka loam profile. It is mildly solodic.

Inches	
9	A_{10}—Black mildly prismatic loam (sandy). pH 6.6.
4	A_{11}—Very dark brown prismatic loam. pH 6.5.
3	A_2—Grey brown to brown loam. Horizontal cleavage: may be weakly platy and porous. pH 6.4.
8	B_2—Brown to reddish brown sandy clay loam. Weakly columnar, may be of a somewhat nuciform mesostructure. pH 6.4.
10-15	B_3—Similar to B_2 but less defined structure. pH 6.5.
	C —Sandy loam to heavy loam, low lime content. pH 7.8.
	D —Glacial till.

The Ponoka profiles that are definitely solodic have a distinct grey A_2 horizon and a fairly pronounced nuciform structure in the B_2 horizon. (See Plate IV, Fig. 3).

In these profiles the D horizon is usually relatively close, that is they approach the Angus Ridge type. In the areas with a more pronounced alluvial deposition the profiles tend to approach, genetically, the prismatic chernozem with less nuciform structure in the B_2 horizon and a brown A_2 horizon. A portion of the area between Bigstone and Pipestone Creeks is characterized by a gravelly lense at the contact of the alluvial deposition and the underlying till. This is outwash gravel. In most of the other places finer alluvial materials cover the till.

Agricultural Use.

Ponoka loam generally can be recognized by a deep black surface horizon, a thin light-colored subsurface horizon and a uniform somewhat sandy subsoil. The areas are usually stone

free although in places there is a concentration of boulders at the contact of the till and the overlying material. The upper portion of the profile looks much like the Angus Ridge profile (see Plate V, Fig. 2) but can be distinguished from the Angus Ridge by the stone-free subsoil.

Ponoka loam is good to very good arable land. What was said regarding the use of Angus Ridge loam (page 38) applies equally well to Ponoka loam with this addition, much of the Ponoka loam has a relatively light textured subsoil as well as being slightly lighter textured throughout. It, therefore, is slightly less drought-resistant than is Angus Ridge loam. One area in tp. 41 ranges 26 and 27 is mapped as Ponoka loam to silt loam. It is somewhat heavier in texture throughout the profile than the typical profile described above.

(b) PENHOLD LOAM AND PENHOLD MEADOW

Only three small areas of Penhold loam occur in the Peace Hills sheet totalling 3,200 acres: much larger areas occur in the Red Deer sheet to the south. Therefore only a brief description will be given in this report. It is a black soil of medium texture developed on alluvial-lacustrine material that is mainly of Paskapoo origin; it is material that has a high lime carbonate content.

Penhold loam is primarily a prismatic chernozem with, in places, very slight solodic development. It is characterized by a deep black A horizon that is mildly prismatic and that tends to tongue into the B horizon, a yellowish brown B horizon, and a light brown high lime subsoil that contains considerable silt and very fine sand. It is good to very good arable land.

Five hundred acres of Penhold meadow Si.L. is also mapped. This soil occurs in the lower spots with poor to fair drainage. It has a deep grey black A horizon that usually has carbonates nearly to the surface.

D. Soils Developed on Alluvial-Aeolian Deposited Material

These soils are developed on water and wind sorted, highly siliceous, sandy material. They are mainly found associated with present or past water courses, and are somewhat related in origin to the adjoining Ponoka soils. The deposition varies from fine to coarse sand and the depth of deposition over the underlying till varies from three or four feet to considerable depths.

(a) PEACE HILLS LOAMY SAND (map symbol Ph.L.S.)

Peace Hills loamy sand is a well to excessively drained soil usually found on undulating to gently rolling dome like topography; that is, most of this soil type is wind sorted and deposited. The native vegetative cover is mainly scrub poplar

on the northern slopes and in the valleys; the southern slopes are grassed. Some willow and occasional spruce are found in the lower positions. Loamy sand areas are mapped, east of Millet, west of Wetaskiwin, east of Menaik, and a large area at Morningside. In all there are 37,000 acres mapped.

The following is a generalized description of a Peace Hills loamy sand profile:

Inches

12 A_1—Black to grey black loamy sand. Some firmness due to organic fibre. pH 6.6.

18 B —Brown to yellow brown loamy sand. Practically structureless with slight evidence of compaction. pH 6.7.

C—at 60″. Yellow brown to brown sand; loose. pH 6.8.

These soils are stone-free. There may or may not be a discernable trace of lime carbonate in the lower horizons. Profiles grading towards the sandy loam and towards the sand occur. Those tending towards the sandy loam usually have a slight indication of an A_2 horizon, and those tending towards the sand have a thinner dark A_1 horizon. The loamy sand occuring in the lower topographic positions have a sandy clay as a D horizon usually within about four feet of the surface.

Agricultural Use.

Peace Hills loamy sand can generally be recognized by the dune-like topography on which it occurs and by the loose sandy texture. A loamy sand soil contains between 75 and 90 percent sand and it, therefore, generally lacks firmness in the profile cut.

These soils usually have a much lower reserve of mineral plant foods than do the medium and heavy textured soils. They are, then, soils that may respond to fertilizer amendments. Sand has a low water-holding capacity, and tends to be droughty. Fibre, however, has a high water-holding capacity, so it is essential that the organic matter content of these soils be maintained at a fairly high level. This will also reduce loss by wind erosion.

The loamy sand on undulating to gently rolling topography is best as pasture land: if cultivated, it should be seeded permanently to grass. That occurring on nearly level topography is fair to fairly good arable land.

(b) PEACE HILLS SANDY LOAMS

(map symbols—Ph.C.S.L., coarse sandy loam; Ph.S.L., sandy loam; Ph.F.S.L., fine sandy loam)

The Peace Hills sandy loams are well to somewhat excessively drained soils mainly on level to undulating topography.

The native cover is a parkland vegetation mainly of aspen poplar, shrubs and the coarser grasses.

These sandy loam soils are mainly developed on material of alluvial deposition and are found scattered throughout the zone. The larger areas are mapped between Wetaskiwin and Millet, west of Wetaskiwin, between Ponoka and Hobbema and around Buffalo Lake. In all there are 223,000 acres mapped. (See Plate IV, Fig. 2).

The Coarse sandy loam contains considerable coarse sand and usually some fine gravel. The area of this mapped south of Millet is uniformly coarse grained throughout the profile. It has a semi-consolidated coal-like lense from 10 to 15 inches in thickness at about the 3 to 4 foot level. Similar coal lenses occur in the sandy areas adjacent to Ponoka. The occurrence of these lenses may indicate that the deposition of this sandy material has occurred in stages over a relatively long period of time.

Fine sandy loam is made up predominantly of fine sand. In general they tend to be slightly heavier in texture than the other sandy loams, and the profiles consequently have more structure. The fine sandy loam soils on this sheet are usually found on level topography and the heavy textured D horizon is often within the average plant feeding range.

The sandy loam soils may be made up predominantly of medium sand or the areas may be mixtures containing coarse, medium and fine sandy loam profiles.

The following is a generalized description of a Peace Hills sandy loam profile. This profile is very slightly solodic.

Inches

14 A_1—Black sandy loam, weakly prismatic, usually firm enough to slightly overhang in the roadcut. pH 6.3.
A_2—From ½″ to 4″ in thickness. From a light brown to dark brown sandy loam, slightly porous. pH 6.1.
B —At least 20″. Loam (sandy), brown to yellow brown. Some organic staining along the vertical cleavage lines in the upper portion of the profile. pH 5.8.
Ca—A low concentration may occur at 40″ or deeper.
C —Yellow brown to brown. Loam to sandy loam. pH 5.9.

In those places where the underlying till is relatively close to the surface the B horizon may be heavier in texture and there is a more pronounced A_2 development.

Agricultural Use.

Peace Hills sandy loams can be distinguished in the field by a deep black sandy surface horizon, a thin lighter colored horizon directly below the black and a fairly loose sandy subsoil. The profiles are stone free.

These soils can be described as being between Ponoka loam and Peace Hills loamy sand in character. They are sufficiently sandy to be vulnerable to wind erosion and to have a relatively low water-holding capacity, yet they have sufficient of the fine soil particles to make them fairly fertile soils. They should remain a fairly fertile soil if the organic matter (fibre) content is maintained at a satisfactory level. This means the inclusion of both grass and clover in the crop rotation. This cannot be over-emphasized because these sandy loam soils can deteriorate very rapidly; or conversely they respond profitably to good management. Deterioration is already noticeable along some of the unprotected ridges.

The sandy loam area lying along the north side of Buffalo lake is quite variable. The area contains many small lakes and slough pockets: some of these sloughs are quite saline. There are also some deep gravel deposits in this area. There is a gravel pit of commercial importance at Bashaw and in some fields deep gravel deposits are found one or two feet below the surface.

The sandy loam areas vary from fair to good arable land depending on depth of black surface, topography and variability.

E. Soils Formed on Coarse Outwash Material

These are coarse textured soils in the black zone developed on gravelly outwash material. The surface is usually of a sandy loam texture. The subsoil may contain thick gravel lenses or may be a deep deposit of gravel and cobble stones.

(a) FERINTOSH SANDY LOAM (map symbol Fth.S.L.)

Ferintosh sandy loam is an excessively drained soil usually found on level lower bench lands. Profiles occur that are transitional in nature between the Ferintosh and the Peace Hills sandy loam. If the gravel deposit is quite deep and practically to the surface the area is simply designated as "gravel." There are 8,500 acres of Ferintosh sandy loam and gravel mapped.

Agricultural Use.

In this group are put those soils with pronounced gravelly subsoils, that is soils in which the subsoil is continuous gravel or where the gravel lenses are thick and extensive enough to seriously affect growth conditions. These soils are droughty soils, since they have a low water-holding capacity. They may also have a low fertility reserve. They range from non-arable to fairly good arable lands depending on topography and the nearness of the gravel to the surface.

F. Soils Developed on Sorted Residual Material

In the Peace Hills sheet there are thin surfaced solonetz-like soils developed primarily on Edmonton parent rock either "in situ" or slightly sorted; the unaltered bed rock can usually be found within a few feet from the surface. The surface texture is generally a loam but the plowed fields may be heavier due to the mixing in of the heavy textured B horizon.

(a) KAVANAGH LOAM (map symbol Kv.L.)

Kavanagh loam is a poorly drained soil usually found on depressional to gently undulating topography. The native cover is mainly of the coarser grasses including some salt resistant varieties. There is some willow growth and some scrub poplar on the higher positions. This soil type occurs mainly adjacent to and west of Kavanagh. In all there are 41,000 acres mapped.

The following is a generalized description of a Kavanagh loam profile. It appears to be between solonetz and thin phase solodized solonetz in character but the difference between the light textured surface and the very heavy subsoil is so great than an A/D profile is suggested.

Inches

5 A_1—Very dark brown loam (sandy). Practically structureless. pH 6.3.

½- 1 A_2—Light grey brown sandy loam. Porous. pH 6.3.

6 B_{20}—Dark brown to black sandy clay. Flat to round topped columns, large nutty mesostructure. pH 5.8.

9 B_{21}—Brown to dark brown. Hard, irregular, blocky. pH 7.5.

Ca—at 25″ to 30″. Very dark brown. Lime and salts, also contains ironstones and pebbles. pH 7.2.

C —at 40″. Brown clay loam to silty clay loam with coal and ironstones. pH 8.9.

The A_1 horizon varies from three to eight inches in depth and from nearly black to brown in color. That is, there appear to be varying degrees of podsolization superimposed on the solodization, particularly on some of the higher land. In these spots there may be only one to two inches of A_0 and A_1 and three to four inches of A_2 that is light brown in color and is strongly platy in structure. If in future surveys sufficient amounts of this podsolized member is found, it may be necessary to map it as a separate type. The most extensive occurrence of this podsolized Kavanagh loam is on the slightly higher land just east of Kavanagh. The area is mapped as predominantly weakly podsolized Cooking Lake loam.

The B and C horizons vary somewhat in color and texture depending upon the character of the particular bed rock lense occurring at the surface.

The depressional spots in this area do not appear to have excessive surface salt concentrations. This may be because

of the relatively impervious nature of the subsoil in the surrounding higher land.

Agricultural Use.

Kavanagh loam can generally be distinguished by the thin surface layer, the very hard dark colored subsurface layer and the presence of exposed bed rock along the road cuts.

This is an inferior soil: there is a relatively shallow dark surface soil; the subsoil is relatively impervious to both water and root penetration; and there are varying quantities of salt present in the subsoil. To cultivate it with any degree of satisfaction, the hard subsurface layer must be rendered more friable. This can be assisted by plowing into this hard layer, and mixing with it the surface soil as well as added organic material, and by sowing such deep rooted crops as sweet clover that will tend to penetrate the hard layer.

THIN BLACK SOILS

The thin black soils in Alberta lie in a narrow transition belt between the black soil zone and the dark brown soil zone; the eastern quarter of the Peace Hills sheet is in this belt. The average rainfall in the area is between 15 and 16 inches and the average annual temperature about 34°F. Thin black soils, in general, have from three to six inches of black top soil, and the lime concentration horizon is found at about twenty-four to thirty-six inches from the surface. The nitrogen content of the surface foot is about 0.25 to 0.30 percent.

Thin black soils are on the average, relatively well supplied with the plant food elements; some have, after a few years of cropping, become deficient in available phosphorus. Rainfall or lack of rainfall is a much greater limiting factor to crop production on these soils than on the soils of the black zone and as a result, therefore, a smaller range of crops can be satisfactorily grown on these soils than on the black soils. The thin black soils have been used primarily to produce wheat.

A. Thin Black Soils Developed on Glacial Till

The soils in the group are medium textured thin black soils developed on glacial till that is mainly of Edmonton formation origin; some Bearpaw shale is mixed with this till, mainly towards the eastern side of the sheet. These soils are, in general, the thin black counterpart of the black soils developed on glacial till described earlier in the report. The main area of these soils occurs partly on the relatively level ground moraine east of Camrose, and partly on the rougher Beaverhills moraine. The parent till is a dark grey brown color and of a sandy clay texture. It contains erratics of

Precambrian rock, iron and coal flecks, salt inclusions and some small bits of shale.

As indicated above, the soils of this group occur over two landscape patterns. There is, therefore, a difference in the percentage distribution of the soil types between the two landscapes. On the level ground moraine area east of Camrose, Killam loam is the dominant profile type, the remainder being made up primarily of Daysland loam: minor percentages of Elnora loam and slough podsols occur. There is also a small percentage of a soil with profile characteristics similar to Daysland loam, but that occurs on till that is very well sorted.

In the rougher morainal area south of Donalda, Elnora loam and Daysland loam occur much more frequently than does Killam loam. There appears to be a little less of the Bearpaw shale mixed in the till in this area than in the ground moraine area to the east.

(a) KILLAM LOAM (map symbol Ki.L.)

Killam loam is a poor to fairly well drained soil usually found on depressional to gently undulating topography. The native cover is an open parkland vegetation with aspen poplar and willow bluffs covering a much smaller percentage of the area than do the medium to short grasses. This soil type forms well over 50 percent of the thin black soil in the Peace Hills sheet, and in much of the area forms about 70 percent of the total. In all there are 266,000 acres mapped.

The following is a generalized description of a Killam loam profile. It is the solodized solonetz profile type.

Inches	
6	A_1—Black loam grading to dark brown at the base; weakly prismatic. pH 5.9.
1- 2	A_2—Light brown to light grey brown sandy loam; weakly platy; crushes to a fine powder. pH 6.7.
7	B_2—Very dark brown clay loam to clay. Columnar with rounded tops. Heavily stained on the cleavage faces. Medium blocky mesostructure. pH 8.5.
	B_3—Brown to light brown clay—massive to weakly blocky. pH 8.1.
	Ca & SO_4—At about 24″ to 30″—low to medium concentration.
	C —Dark brown clay loam to clay. Contains lime, salt, iron and coal flecks and shale fragments. pH 7.7.

This profile in general occupies the moderately to fairly well drained positions found on gently undulating slopes. A thinner phase, that is, one with three or four inches of dark A, may occur in some of the lower positions. It is less well drained and may have a higher salt content in the subsoil

than the deeper phase. Where this shallow phase Killam loam occurred in areas extensive enough to show on the map, these have been delineated: in all 15,000 acres of such have been mapped. In these areas there is about 10 percent of eroded pits; that is, pits in which the surface or A horizon has been eroded off. A small percentage of eroded pits, mainly grassed over, occurs in the general Killam loam area. About 1,000 acres of stony phase Killam Loam is mapped along Battle river in Range 16.

Agricultural Use.

Killam loam can be distinguished in the field by the thin black surface soil and the hard dark brown columnar subsurface horizon, and also by the light-colored rounded caps of the subsurface horizon. (See Plate VII, Fig. 2).

Two characteristics of this soil have a pronounced influence on its agricultural use, namely, the hard, tight subsurface horizon and the salt content of the subsoil. These two factors are discussed in the Agricultural Use section of Camrose Loam, page 41. These solonetzic soils absorb water very slowly and, therefore, their objectionable characteristics are more apparent in the more arid soil moisture conditions. In these thin black soils however, the hard subsurface horizon is usually found within six or eight inches from the top and, therefore, can be reached by deep plowing; that is, it is possible to break into this hard layer and to mix it with the friable top soil. In general this soil type is fairly good arable land.

For a description of the agricultural use of the depressional spots in this area, the reader is referred to the description of slough podsols on page 42.

(b) DAYSLAND LOAM (map symbol Dl.L.)

Daysland loam is a well drained soil usually found on gently undulating topography. The native cover is quite similar to that on Killam loam excepting that there is a slightly higher percentage of tree growth in the Daysland areas. The areas indicated on the map as dominantly Daysland loam are about 60 to 70 percent of this soil type. These areas are of slightly rougher topography than the surrounding Killam area, and there may be a deeper till mantle covering the bedrock. In general, the Daysland loam profile occupies the higher slopes and Killam loam occurs in the lower positions. In all there are 171,000 acres of Daysland loam mapped; this includes a small area of stony phase in range 16.

The following is a generalized description of a Daysland loam profile. It is the solodic profile type.

Inches

7 A_1—Black loam, becoming dark brown towards the base. Prismatic. pH 6.5.

3 A_2—Brown to light brown loam. Prismatic to columnar, breaking into a somewhat porous nutty mesostructure. The columns continue down into the B_2 horizon. pH 5.9.

12 B_2—Brown to dark brown clay loam. Columnar, fairly easily broken down. pH 6.2.

C —at 36″. Brown to dark brown till. Similar in appearance to Killam parent material but no apparent salt. pH 7.8.

Agricultural Use.

Daysland loam might be described as lying midway between Killam loam and Elnora loam. The presence of a thin, friable light-colored horizon just below the black surface distinguishes it from the Elnora. It can be distinguished from the Killam loam in that it does not have the sharp break between the surface and subsurface and does not have the hard round topped columns at this break. (See Plate VII, Fig. 1). Daysland loam corresponds in horizon arrangement to the Angus Ridge loam of the black soils.

Daysland loam is good arable land and is used mainly for wheat production. Since this soil occurs mostly on slightly sloping land, and since the subsoil is fairly heavy, it is vulnerable to water erosion. There seems no reason why this soil type should not continue to be a wheat growing area providing the organic matter content is maintained and other precautions also taken to prevent both wind and water erosion.

(c) ELNORA LOAM (map symbol El.L.)

Elnora Loam is a well drained soil generally found on undulating to hilly topography. The native cover is an open parkland vegetation. The tree growth, composed mainly of poplar and small flowering shrubs, occupies the northern slopes; the southern slopes are principally grass covered. About 75,000 acres of Elnora loam are mapped, the greatest individual percentage occurring in the moraine south of Donalda.

The following is a generalized description of an Elnora loam profile. It is the prismatic-chernozem profile type.

Inches

5 A_1—Black loam. Wide, easily crushed irregular prisms. pH 7.1.

4- 6 A_3—Dark brown loam. Irregular prismatic. pH 6.9.

11 B_{20}—Brown to yellow brown clay loam. Wide prismatic. Slight staining on the cleavage faces. pH 7.2.

B_{21}—Variable depth; structure similar to B_{20} but no apparent staining.

Ca—at 24″ to 36″. Medium lime.

C —Brown clay loam till. pH 7.8.

Where this profile occurs out on the level plain, the parent material is generally more sandy than in the surrounding areas. In the rougher moraine the parent till is generally of a clay loam to clay texture.

On the steeper slopes a thin phase of this member occurs due to loss of water by run-off and to a relatively high natural erosion. There are from few to some stones in these soil areas.

Agricultural Use.

An Elnora loam profile can be distinguished in the field by its thin black surface, the gradual change to the brown subsoil and the relatively friable nature of the subsoil. This last characteristic distinguishes it from the harder more blocky subsoil of the Daysland and Killam loams. It is found in the higher topographic positions and generally occurs on undulating or rougher topography.

Elnora loam is good arable land if on gently undulating to undulating topography. The rougher phases are less desirable. The prevention of water run-off is an important factor in the utilization of these soils both from the point of view of water conservation and soil conservation. Under natural conditions, hill slopes in the thin black zone are generally drier than the surrounding level land and can be classed as semi-arid. This loss of run-off water can be reduced by keeping the soil in an open receptive condition, by keeping up the fibre content, and by cultivating on the contour. Steep slopes should remain in grass.

B. Thin Black Soils Formed on Material of Glacial Lacustrine Deposition

(a) GADSBY SILT LOAM AND SILTY CLAY LOAM

(map symbol Gd.Si.L. & Gd.Si.C.L.)

Gadsby silt loams consist of medium to medium heavy textured soils developed on glacial lacustrine material. This deposition is often fairly shallow and the underlying glacial till may be within three or four feet of the surface. The parent material is a brown uniform silty clay containing a low to medium lime carbonate content and a medium to medium heavy salt content. The areas occurring on this sheet are relatively small and quite possibly are sortations from the surrounding till areas.

The Gadsby silt loams are fairly well drained soils usually found on relatively level topography in an area that is generally slightly lower than the surrounding land. The native cover is made up of small poplar and willow bluffs and grasses that are mainly of the coarser varieties. There are 11,500 acres mapped.

The following is a generalized description of a Gadsby silt loam profile. It is a solodized-solonetz profile.

Inches

4- 6—A_{10}—Black silt loam. Weakly prismatic; crushes to a fine grain microstructure. pH 6.0.

2- 3 A_{11}—Dark brown silt loam. Structure similar to above.

1- 2 A_2—Grey brown very fine sandy loam. Firm, porous. Horizontal cleavage lines. pH 6.1.

6 B_2—Dark grey black clay. Columnar, breaking to medium blocky. Heavily stained along cleavage lines. pH 7.2.

8 B_3—Brown to dark brown silty clay. Massive with some vertical cleavage lines. pH 7.8.

SO_4—at 24″ to 30″. pH 7.2.

C —at 30″ to 40″. Brown silty clay. pH 7.9.

In the depressional spots a fairly deep granular dark grey black clay may occur. In general the silty clay loam areas occur between the silt loam and the clay depressional spots. The areas are practically stone free.

Agricultural Use.

Gadsby silt loam is fairly good arable land. It has the same objectionable characteristics as the surrounding Killam loam, namely, the very hard subsurface horizon and a fairly high salt content in the subsoil. In fact the two soils are quite similar but can be distinguished in the field by the fact that the Gadsby loams generally occur in basin-like areas; they are stone free, and the subsoil is a uniform brown clay: the subsoil of a Killam loam is variable and contains stones, small iron-stones and bits of coal.

C. Thin Black Soils Formed on Alluvial Aeolian Deposits

(a) IRMA SANDY LOAMS (map symbol I.S.L. and I.F.S.L.)

The Irma soils are light textured and are developed on mixed wind and water transported deposits; that is, they are on reworked materials from the surrounding and underlying drift sheet. The main area of these soil types is south of Meeting Creek adjacent to Willow and Big Knife creeks; small areas occur throughout the thin black zone. The parent material is a uniform brown to light brown loam to sandy loam, low in lime carbonate and relatively free from salts. The areas are practically stone free.

Irma sandy loam and fine sandy loam is a well to excessively drained soil usually found on gently undulating topography. The native cover is mixed grassland and bluffs of small poplar. In all there are 10,000 acres mapped.

The following is a generalized description of an Irma fine sandy loam profile. It is a slightly solodic profile.

Inches

3 A_{10}—Black sandy loam. Wide prismatic; firm. pH 6.0.

7 A_{11}—Dark brown sandy loam. Wide prismatic.

3 A_2—Brown to light brown loamy sand. Prismatic to wide columnar. This varies from relatively indistinct to fairly pronounced. pH 6.3.

11 B —Brown loam. Wide columnar; firm to hard when dry; some slight staining. pH 6.4.

C —L(sandy) to light Si.L. Brown, loose to slightly massive depending upon the texture. pH 6.9.

In the depressional areas the depth of black color increases and the A_2 becomes more distinct. The excessively drained areas have a relatively shallow profile and are lighter in colour.

Agricultural Use.

The Irma sandy loam and fine sandy loam are fairly good arable lands. These soils, however, have a low water-holding capacity excepting where the till is relatively close to the surface. Soil drifting can be a problem in these soils. By increasing the organic matter content, wind erosion is lessened, the water-holding capacity of the soil is increased and the amount of available plant food tends to increase. That is, a continuous wheat-fallow rotation is not recommended, but rather a rotation including grasses and legumes.

D. Soils Developed on Sorted Residual Parent Material

(a) TORLEA LOAM (map symbol Tl.L.)

In the Peace Hills sheet these are medium textured, solonetz-like soils formed on residual material that may be somewhat disturbed and sorted. This residual material is mainly a sandy shale that occurs near the contact of the Bearpaw and Edmonton formations. Although these soils are well within the thin black zone, the depth of black as well as of the A horizon is much less than in the surrounding "normal" soil. The undisturbed residual bedrock is generally fairly close and often within a foot or two of the surface.

The areas occurring in this sheet are relatively small and confined to the north-east corner and along the Battle River and Meeting Creek. In all there are 8,500 acres mapped.

The Torlea loams are poorly drained to fairly well drained soils and are found on level to depressional topography. There is a fair cover of native grasses, the marshy flats producing some native hay. Small bluffs of willow and poplar occur particularly on the edges of the depressions. The native grasses are mainly alkali tolerant species.

The following is a generalized description of a Torlea loam profile: It is a solonetz-like profile.

Inches
3 A_1—Loam: 1″ to 2″ black, grading to a brown. pH 5.9.
2 A_2—Grey brown loam. Ashy; lighter in texture than A_1.
9 B_2—Waxy, clay round tops; very dark brown. Columnar; breaking into hard medium blocks. pH 6.9.
B_{ca} & B_{so4}—at 14″ to 22″. Medium concentrations. pH 7.8.
C —at 22″. Partially weathered sandy shale bedrock.

Agricultural Use.

Torlea loam areas are characterized by the shallow surface horizon, the hard round topped subsurface horizon and the level to depressional nature of the topography. Bedrock exposures can often be seen in the road-cuts.

Torlea loam is marginal arable land. Numerous marshes and large marshy flats occur throughout the area from which some hay is obtained. Its value depends to a great extent upon the depth of the profile over the parent bedrock. In wet years there is a danger from flooding as the water has great difficulty penetrating through the compact subsurface horizons. The high salt content of the parent material combined with poor drainage presents the greatest problem. Crop production in this soil area should be restricted mainly to the growing of legumes and cultivated grasses.

MISCELLANEOUS SOILS

ALLUVIUM (map symbol Av.)

Alluvium or recent river deposit is found mainly in the valley of Battle River, although in the Meeting Creek valley it is found mixed with Kavanagh loam and Torlea loam. In general the soil profile has very little development (it is immature) and is usually dark brown to grey brown in color with little evidence of horizon differentiation. The texture varies from light loam to light silt loam. These flats are badly cut up by oxbows and old stream courses, so rarely do large fields occur. They are mapped as fairly good to good arable land and are usually utilized for the growing of coarse grains and hay crops. In all there are 25,000 acres mapped.

SANDS (map symbol S)

Dune sand areas are found mainly in association with Peace Hills soils. The only area mapped as sand is east of Millet and north of Pipestone Creek. These appear to be of alluvial origin subsequently piled into dunes by wind action. The soil profile is very shallow with one or two inches of dark brown A_1 loamy sand to sand overlying medium sand. Darker profiles occur in the valleys between the dunes. The dunes are fairly well stabilized by a scrub poplar cover.

The duned portions have no arable value and very little pasture value, since any breaking of the protective cover

would allow them to again move with the wind. The level areas between the dunes are of pasture value and some could be seeded to cultivated grasses. There are 4,000 acres mapped as sand.

ORGANIC SOILS (map symbol Sd. or MxP.)

These soils consist of sedge, and mixed sedge and sphagnum peats. They are found in the far western portion of the sheet in low, poorly drained areas. Some hay is cut from some of the areas but as yet very little use is made of them. Peats will have to be properly drained before they become of agricultural value. (See Plate III, Fig. 2). The sedge peats are generally much superior agriculturally to the sphagnum peat; very little of the latter was seen in this area. Those that are over approximately two feet in thickness should be left undisturbed since they may be of value in maintaining ground water supplies. There are only 2,000 acres of organic soils mapped.

ERODED LAND (map symbol Er)

Steeply sloping land, particularly river banks, is mapped as eroded land. That is, this category refers to geological erosion and not to recent erosion on cultivated land. These creek banks have at one time been subjected to severe erosion, but most of them in this area are now fairly well stabilized by grass and tree cover. (See Plate VIII, Fig. 3). Most of the areas in the black and grey wooded zones are so covered and are of value as pasture and wood lot. As such they serve a useful purpose and overgrazing, indiscriminate cutting of the trees or cultivation should never be practised on these slopes. Battle river and Meeting creek in the thin black zone has cut deeply into the underlying bedrock formations, so that a sizable percentage of the slopes in this section are bare bedrock exposures. There are 50,000 acres of eroded land mapped.

CHEMICAL COMPOSITION OF SOILS

PLANT FOOD ELEMENTS.

Nitrogen, phosphorus, calcium, magnesium and soil acidity analyses were made on type profiles from the Peace Hills sheet. A number of these are reported in table 8.

The nitrogen content, which is directly related to the organic matter content varies somewhat across the area. The average nitrogen content in the surface foot of the analysed soils of the thin black soil zone was 0.31 percent, of the black soil zone 0.39 percent, of the grey-black soils 0.20 percent, and of the grey wooded soils 0.16 percent.

There is also considerable variation between the soil types within any one zone. In the thin black zone the variation as determined was from 0.25 percent for an Irma fine sandy loam

to 0.36 percent for a Gadsby silt loam for the surface foot. In the black soil zone the variation was from 0.18 percent for the average of the members of the Peace Hills soils to 0.50 percent for Navarre silt loam. The very low nitrogen content of the Peace Hills sandy loams may be due to the fact that most of the profiles had been subjected to noticeable solodic degradation, and possibly also to slight podsolic degradation. In practically all the profiles analysed there is a gradual decrease in the nitrogen content from the surface down.

Nitrogen in the soil is retained principally in the form of organic matter that has accumulated in the profile, over a long period of years, from the decay of native vegetation. A continuous grain-fallow rotation, as well as wind and water erosion, gradually reduce this organic matter content. This results in lower fertility, accelerated erosion and poorer physical condition. Every effort should be made to build up and maintain an adequate organic matter content.

Phosphorus is a mineral element and therefore the amount in a soil is directly related to that soil's parent material. Analysis of the parent material from this sheet gave a phosphorus range from about 0.025 to 0.050 percent. There was no indication of any one parent material being distinctly lower or higher than any other. Although not to be considered deficient, this indicates that phosphorus is one of the elements in lower natural supply and suggests that it may be one of the first that should be added artificially.

The phosphorus content of the surface or A_1 horizon varies from about 0.025 to 0.100 percent; the higher content in the surface than in the parent material is due to the accumulation of organic matter in the surface horizon. The phosphorus content of the A_1 horizon varies somewhat between soil groupings. For example, in the black zone the Ponoka soils average 0.042 percent, the Peace Hills soils 0.067 percent, the Wetaskiwin-Navarre-Malmo soils 0.085 percent and the Camrose-Angus Ridge-Beaverhills soils 0.073 percent. No significant average differences were noted in the phosphorus content as between the different zones.

If the above percentages are transferred into pounds per acre, it means that there are about 2,500 pounds of phosphorus in the surface foot of an average soil in this sheet (a thirty bushel crop of wheat requires about 9 lbs of phosphorus). These figures might indicate that we have little to worry about for some time. However, the percentages given refer to total phosphorus in the soil, and only a small percentage of this is, at any one time, in the soluble or usable form. Therefore, although there may be a fairly large amount of total phosphorus in the soil in relation to a single crop's requirement, 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 to insure available plant nutrients. This applies equally well to the other mineral plant foods, such as calcium, magnesium, potassium, etc.

Calcium and magnesium analysis of type profiles from the Peace Hills sheet indicated that for these elements they were slightly below the average for the province. The calcium in the surface horizon averaged about 0.75 percent with a variation from 0.25 percent to 1.00 percent, and the magnesium averaged about 0.30 percent. The parent material averaged about 1.50 percent calcium and about 0.60 percent magnesium. The parent material of the Penhold Loam had about 8 percent calcium, the highest analysed; the Breton loam had second highest with over 3 percent. The C horizon of the Peace Hills sandy loam had less than 0.25 percent calcium. In general no well defined B_{ca} concentration horizons were analysed; that is, there was little difference noted between the B_{ca} horizon and the underlying C horizon. Lime carbonate was found at an average depth of 25 to 30 inches in the thin black soils, at 30 to 40 inches in the black soils and 40 to 60 inches 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 Peace Hills samples. Analyses in other areas throughout the province indicated that potassium and iron are generally present in fairly large quantities. Experimental data indicate that sulphur may be deficient in the Breton loams. Practically all the other soils in this sheet are formed on parent material of Edmonton formation origin, and this material contains varying amounts of gypsum (calcium sulphate).

The pH (soil acidity or alkalinity) of the soil types are given with the profile descriptions. These figures indicate that most of the surface samples are near the neutral point (pH7) and vary from about 6.3 to 7.0. Usually the A_2 (leached) horizon is slightly lower in pH (more acid) than the surface. The parent materials are generally above pH 7.0 and average around 7.8 to 8.5. The highest determined pH was the parent material of the Kavanagh loam at pH 9.0. A pH value above 9.0 is viewed with suspicion and often indicates black alkali. Very few samples were below pH 6.0 and none were below pH 5.5; this is not considered seriously acid.

TABLE 8—CHEMICAL COMPOSITION OF REPRESENTATIVE SOIL PROFILES

Sample No.	Depth in Inches	Horizon	Percent N	N in 1st 12″	P	Ca	Mg	pH
Slough Podsol—Black Zone 22-46-20-4								
2351	0- 2	A_0 & A_1	1.0	.259	.....	1.08	.39	6.3
2352	2- 6	A_2	.116		.....	.24	.29	6.4
2353	6-24	B	.107		.....	.28	.72	6.1
2354	24+	G	.....		.....	.34	.56	6.3
Breton Loam—Grey Wooded Zone N.E. 14-44-28-4								
2355	0- 2	A_0 & A_1	1.034	.161	.110	1.23	.28	7.0
2356	2- 8	A_2	.092		.054	.....	.....	7.0
2357	8-10	A_3	.070		.....	.....	.....	6.8
2358	10-24	B_{20}	.....		.....	.35	.47	6.2
2359	24-36	B_{21}	.....		.....	.33	.46	5.8
2360	36-50	B_3 or C	.....		.....	.36	.51	6.0
Falun Loam—Grey-Black Transition Zone N. 10-46-27-4								
2386	0-10	A_1	.244	.216	.025	.42	.34	6.1
2387	10-14	A_2	.076		.013	.24	.28	5.8
2388	14-30	B_2	.067		.016	.45	.32	6.2
2389	at 40	C	.....		.....	.80	.54	7.7
Irma F.S.L.—Thin Black Zone S. 14-41-18-4								
2390	0-10	A_1	.290	.258	.056	.....	.....	5.7
2391	10-13	A_2	.098		.....	.....	.....	6.3
2392	13-24	B_2	.....		.....	.....	.....	6.4
2393	24+	C	.....		.....	.37	.46	6.9
Killam Loam—Thin Black Zone NE. 5-48-15-4								
2401	0- 5	A_1	.503	.340	.085	.34	.18	5.9
2402	5- 7	A_2	.....		.....	.....	.....	6.7
2403	7-14	B_2	.177		.....	.....	.....	8.5
2404	at 24	B_{ca}	.....		.....	1.73	.71	8.1
2405	at 48	C	.....		.....	.79	.77	7.7
Elnora Loam—Thin Black Zone S.E. 2-47-16-4								
2414	0- 5	A_1	.317	.253	.047	.....	.....	7.1
2415	5-11	A_3	.207		.....	.....	.....	6.9
2416	11-22	B_2	.....		.....	.....	.....	7.2
2417	22+	Ca & C	.....		.....	2.28	.46	7.8
Peace Hills Fine Sandy Loam—Black Zone NE. 14-46-26-4								
2226	0-22	A_1	.187	.187	.042	.36	.22	6.3
2227	22-26	A_2	.079		.032	.20	.25	6.1
2228	26-30	B_{20}	.057		.012	.34	.53	5.8
2229	30-45	B_{21}	.020		.020	.10	.21	5.9
Ponoka Loam—Black Zone SW. 22-47-23-4								
2436	0- 8	A_{10}	.509	.469	.059	.80	.39	6.2
2437	8-20	A_{11}	.390		.040	.....	.....	6.2
2438	20-26	A_2	.122		.....	.46	.41	6.3
2439	26-32	B_{20}	.....		.....	.51	.58	6.2
2440	32-50	B_{21}	.....		.....	.45	.33	6.5
2441	50-76	B^{ca} & C	.....		.....	1.13	.61	7.8

Sample No.	Depth in Inches	Horizon	Percent N	N in 1st 12″	P	Ca	Mg	pH
Navarre Loam—Black Zone NE. 3-46-24-4								
2442	0- 8	A_{10}	.726	.615	.082	1.03	.43	.....
2443	8-20	A_{11}	.393		.....	.77	.47	.....
2444	20-35	B_{20}	.....		.....	.50	.62	.....
2445	32-48	B_{21}	.....		.....	.53	.63	.....
Wetaskiwin Loam—Black Zone NW. 12-46-24-4								
2197	0- 9	A_1	.586	.503	.090	.64	.28	5.9
2198	9-11	A_{20}	.320		.079	.56	.31	5.7
2199	11-13	A_{21}	.119		.026	.14	.21	6.4
2200	13-19	B_{20}	.088		.018	.24	.41	7.6
2201	19-23	B_{21}	.048		.025	.10	.53	7.9
2202	23-30	B_3	.020		.033	1.52	.49	7.8
2203	30-36	B^{ca}	.040		.042	2.98	.91	8.5
2204	at 48	C	.048		.063	1.84	1.03	8.1
Angus Ridge Loam—Black Zone NE. 21-45-23-4								
2215	0- 7	A_{10}	.555	.470	.077	.50	.39	7.0
2216	7-14	A_{11}	.351		.061	.52	.33	5.9
2217	14-16	A_2	.133		.036	.38	.34	5.5
2218	16-23	B_2	.068		.016	.32	.42	5.7
2219	23-40	B_3	.028		.019	.46	.43	6.5
2220	at 50	C	.045		.023	1.24	.69	7.7

ALKALI SALT

Water soluble salt analyses were made of a number of samples from the Peace Hills sheet; some of these are reported in table 9. Analysis and observation indicate that over most of the area there does not appear to be any serious alkali problem. Some alkali salt, however, does occur in the soil areas of the Camrose and the Wetaskiwin plain, that is, in areas with a high percentage of solodized-solonetz soils.

Alkali salts originally come from the weathering or decomposition of parent rock material. In the sections of higher rainfall these salts tend to wash or leach out of the soil as they are formed, excepting in the areas of restricted drainage. In the more arid sections there is much less movement of water through the soil and therefore a greater tendency for the salt to accumulate.

The alkali salts are commonly classed as brown, black or white. Brown alkali consists chiefly of the nitrates. Black alkali includes mostly the carbonate and bicarbonate of sodium. White alkali consists chiefly of the neutral salts such as sodium or magnesium chloride, or sodium, calcium or magnesium sulphate. Black alkali is the most toxic, and when present in quantities exceeding about 0.1 percent in the surface soil, it is often detrimental to plant growth. However,

practically no black alkali or brown alkali was found in this sheet. The white alkali is the least toxic and seldom causes excessive injury unless present in excess of about 0.5 percent in the surface soil. Most Alberta soils contain less than 0.1 percent of water-soluble salts in the surface horizons, and in most of these soils there is less than 1 percent salt, mostly white alkali, in the subsoil. In such cases the injury due to alkali is relatively light. This is particularly true if the salt present is calcium sulphate or gypsum, since this salt ameliorates the toxic effect of other alkali salts.

In table 9 the salt content of the C horizons of some soil types is reported. This indicates the higher salt content of the solonetz soils, for example the Camrose, Killam and Gadsby soils. The much lower salt content of the Beaverhills loam and the Daysland loam may indicate the much better drainage in these soil types since these soils are formed on the same parent till as the Camrose and Killam loams.

The slightly higher salt content of the A horizon over the B horizon in the Navarre loam is fairly typical. However in general, there is not a sufficiently high concentration to materially affect crop growth.

The salt content of the C horizons of the grey wooded soils, Cooking Lake and Breton loam, is relatively low. The difference between the two is not considered significant. A few samples from greater depth indicated that the parent material of the Cooking Lake loams may be somewhat higher in salt content.

It is noted that the principal salt present in this sheet is calcium sulphate (gypsum) with sodium sulphate next in importance. The salt from the shore of Bittern lake is primarily sodium sulphate—this salt is much more soluble than gypsum.

TABLE 9.—WATER SOLUBLE OR ALKALI SALTS OF THE PEACE HILLS SHEET

Sample No.	Horizon	Remarks	N.V.S.	CO_3	SO_4	Ca	Mg	Na
2338	C	Beaverhills loam	0.012	.....	.....	.....	.....	.....
2343	C	Camrose loam	0.285	.....	0.148	0.032	0.011	.....
2344	C	Camrose loam	1.870	.....	1.406	0.222	0.171	.....
2254	C	Malmo silt loam	0.165	.....	0.104	0.034	.....	.....
2443	A_{11}	Navarre loam	0.03	.....	.....	.....	.....	.....
2444	B_2	Navarre loam	0.015	.....	.....	.....	.....	.....
2435	Salt Crust	Shore of Bittern Lake in Beaverhills moraine	5.588	0.591	3.484	0.010	0.053	1.450
2409	C	Daysland loam	0.159	.....	0.100	0.018	0.002	0.025
2413	C	Killam loam	1.539	.....	1.144	0.224	0.128	.....
2398	B_{ca}	Gadsby Silt loam	1.145	.....	0.846	0.261	0.095	.....
2399	C	Gadsby Silt Loam	0.387	.....	0.290	0.056	0.079	.....
Composite	C	Cooking lake loam	0.031	.....	.....	.....	.....	.....
Composite	C	Breton loam	0.025	.....	.....	.....	.....	.....
2420	B	Slough Podsol in Killam area	0.040	.....	.....	.....	.....	.....
1961	C	Torlea heavy loam	0.830	0.037	0.534	0.058	0.020	0.166

SOIL RATING MAP

Accompanying this report is a soil rating map of the Peace Hills sheet on the scale of six miles to the inch. This map divides the area into 8 land classes: three pasture and five arable. No attempt has been made to state the type of crop that should be produced on the arable land. The map is applicable only under dry land conditions.

The data on this map are based mainly on the physical characteristics of the area. In making the map, such physical data as soil type, degree of stoniness, topography, rainfall, and rainfall variability were all taken into consideration. The groups carry a number and a legend on the map: group 1 is poor to fair pasture, group 2 is fair to good pasture, group 3 is good to excellent pasture, group 4 is poor to fair arable land, group 5 is fair to fairly good arable land, group 6 is fairly good to good arable land, group 7 is good to very good arable land, and group 8 is very good to excellent arable land. It is realized that this grouping is based on past performance under existing farm practices.

The introduction of new varieties of farm crops, the introduction of improved farming methods as well as a change in economic requirements might, for example, shift the dividing line between pasture and arable land. It must also be noted that the number of quarter sections of land necessary to constitute a self-sustaining unit varies from class to class.

It is practically impossible to set any definite productivity limits for these groups. The following tentative limits, however, are suggested to give an approximate idea of the productive capacity of the various groups. Group 1 areas would take over 40 acres to pasture one head of cattle, group 2 areas would require between 20 and 40 acres per head and group 3 areas would require less than 20 acres per head. Group 5 soils over a long term of years have produced from 12 to 15 bushels of wheat per seeded acre, and group 6 soils have produced from 15 to 20 bushels of wheat per seeded acre. Group 7 soils have produced from 20 to 25 bushels per seeded acre and group 8 soils have produced over 25 bushels. Group 4 soils in general have produced less than 10 to 12 bushels. Some farmers in this area have exceeded these yields. In some instances it has been possible to make some subdivisions within each rating group. This is taken care of in the description of each soil type. For example, two areas may appear on the rating map as group 6, that is fairly good to good arable land. However, in the description one may be listed as fairly good, that is near the bottom of the group, and the other be listed as good, that is near the top of this class.

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 granule or crumb, etc.
Alluvium	a group of soils developed from water transported, recently deposited, material and characterized by a weak (or no) modification of the original material by soil forming processes.
Available plant nutrients	plant nutrients in a soluble form, readily available to the plant roots.
Calcareous material	material having a high percentage of lime carbonate.
Cleavage	the capacity of the soil on shrinkage to separate along certain planes more easily than on others.
Complex	an intimate mixture of soil associations, types, or phases which cannot be indicated separately upon maps of the scale in use.
Drift	an accumulation of earth, stones, etc., carried and finally deposited by a glacier.
Erratic (glacial)	boulders or rocks transported and deposited by glaciers and isolated from any others of the same kind.
Erosion	the wearing away of the land surface by running water, wind and other geological agents.
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.
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 very compact and sticky.
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.
In situ	refers to bedrock that is in its original position and is undisturbed.
Impervious materials	materials which resist the passage of drainage water and plant roots.

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

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

Moraine ..... is formed when the glacier deposits material it is unable to carry any farther or leaves as it retreats

Terminal moraine ..... is formed when the ice melts away at the terminus of the glacier dropping the materials carried by it. The surface is usually gently rolling to hilly.

Ground moraine ..... when a glacier recedes, its debris, instead of being concentrated in a terminal moraine, is scattered over the surface left by the retreating ice, and is more or less stratified. The topography is usually level to gently rolling.

Phase (soil) ..... is defined on the basis of characteristics of the land or of the landscape, of which the soil is a part, that are of importance in land use, but are not differentiating characteristics of the soil profile. Separation of phases is based on external physical characteristics, such as stoniness.

pH ..... is a measurement of the relative acidity or alkalinity of a soil or other materials. (Read the paragraph immediately above Table 8, page 63.

Podsolization ..... the genetic process by which grey wooded soils are formed, specifically a process by which iron and alumina are removed (leached) from the upper part of the profile more rapidly than is the silica. This results in the development of a light colored surface horizon. Podsol is from the Russian for "ashy".

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.

Silicious material ..... materials having a high percentage of silica such as quartz.

Soil Type ..... the named soil that formed the mapping unit in the Peace Hills sheet. These soils are also given a general profile type name. In the report the soil types are reported under their respective parent material groupings. This larger grouping may be called the soil association.

Solonetzic group ..... a group of soils usually developed on somewhat saline parent material under poor drainage conditions.

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

Stones ..... in this report stones refer mainly to granitic and sandstone erratics that hinder cultivation. The following broad classification of numbers is used:

- Stones few ..... indicates that the stones are only sparsely scattered over the fields, possibly less than a load to the acre.
- Stones some ..... indicates numbers in sufficient amount that they must be removed, possibly three to five loads per acre.
- Stones many ..... indicates fairly stony land, possibly ten or more loads per acre.
- Very stony ..... indicates land on which it may be unprofitable to clear the stones.

Structure (soil) ..... the aggregates into which the individual soil particles are arranged. Often one type of aggregation occurs within another. For example, the columnar structure of the solonetz soils will break down into smaller blocky aggregates. Where this occurs, macrostructure may be used for the larger columnar structure and mesostructure for the smaller blocks. It is possible at times to break the mesostructure into still finer divisions and these divisions can be referred to as the microstructure. The following structures are recognized in this report.

- Blocky ..... block-like aggregates with sharp angular corners.
- Granular ..... soil aggregates more or less rounded with an absence of smooth faces and edges, relatively non-porous.
- Fragmental ..... firm aggregates with irregular cleavage lines and more or less sharp corners and edges often wedge-shaped.
- 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 well defined and regular edges and surfaces. The tops may be rounded. Is usually found in the subsurface or B_2 horizon.
- Nuciform ..... nut-like aggregates with more or less clearly defined edges and faces.
- 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 uniform and cohesive masses of soil, almost amorphous or structureless with irregular cleavage faces.

Texture ..... this refers to the size of particles in the soil, that is the relative percentage of sand, silt, and clay.

Till	an unstratified heterogeneous deposit of clay, silt, sand, gravel and boulders transported by glaciers.
Varving	a succession of thin seasonal sedimentary beds each grading from coarse grained at the base to fine grained at the top.
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. Sometimes referred to as a "normal" soil for one climatic zone.

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