RECONNAISSANCE

Soil Survey of the Beaverlodge and Blueberry Mountain Sheets

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RECONNAISSANCE

Soil Survey of the Beaverlodge and Blueberry Mountain Sheets

BY

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(With Appendix 1 by A. C. CARDER)

Soils Division, Research Council of Alberta
in cooperation with
Research Branch, Canada Department of Agriculture
and the
Soil Science Department, University of Alberta

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COVER: Gently rolling area near the Saddle hills northeast of Buffalo Lake

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The Research Council of Alberta supplied the funds for the field work, for drawing and printing the soil map, and part of the funds for the laboratory work. The Research Branch, Canada Department of Agriculture, supplied part of the funds for the laboratory work and provided the aerial photographs of this area. The University of Alberta provided the office and laboratory accommodation and supplied funds for printing the report.

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

INTRODUCTION

The Peace River District contains the largest area of potentially arable land in Canada. To assist in the agricultural development of this region a reconnaissance soil survey programme was initiated in 1944. As a result of this continuing effort this is the fourth of a series of reconnaissance soil survey reports describing portions of that region. The preceding reports include the Rycroft-Watino sheets published in 1950, the High Prairie-McLennan sheets published in 1952, and the Grande Prairie-Sturgeon Lake sheets published in 1956.

The field and laboratory work required in the preparation of this publication was started in 1954 and completed in 1958. The report and the accompanying maps are supplementary to each other and both should be referred to in seeking information regarding the soils of the mapped area.

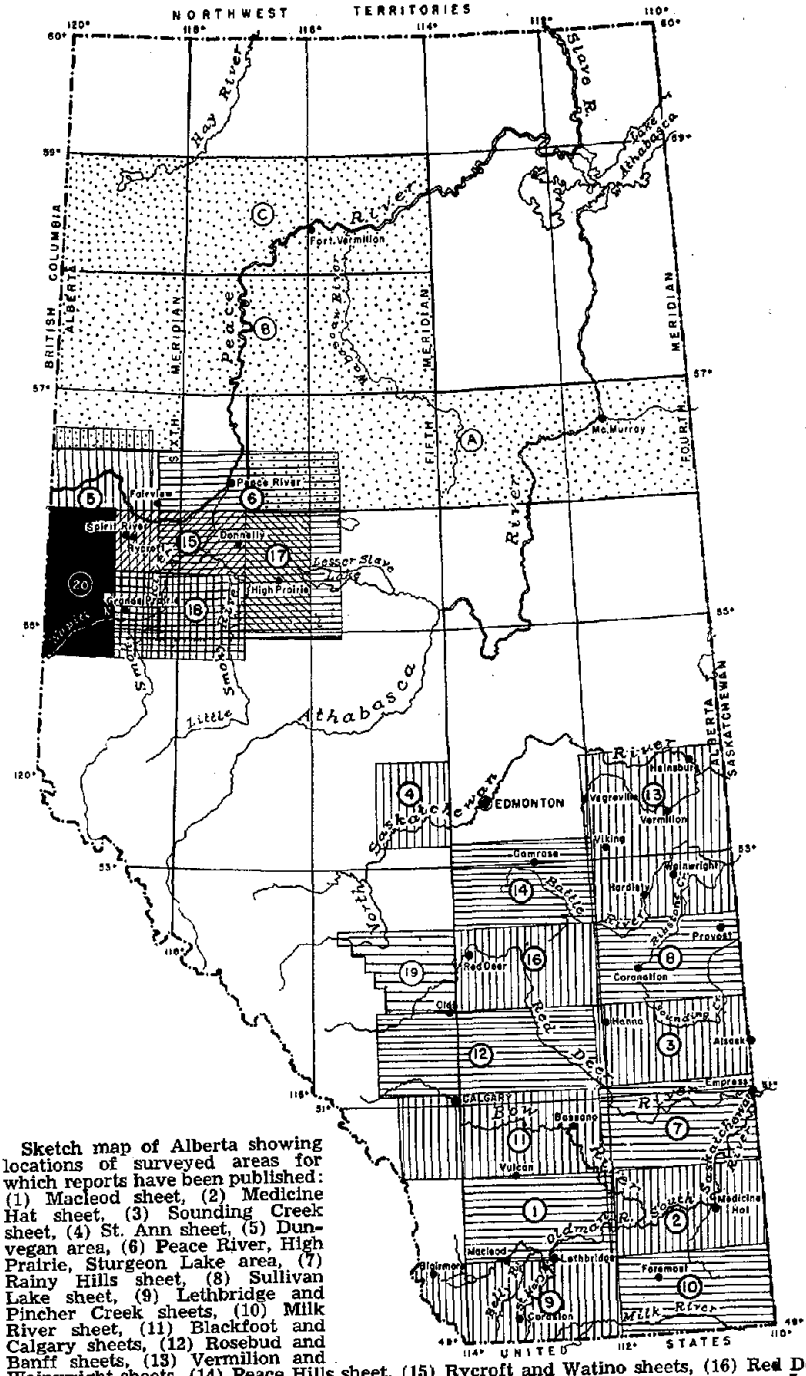
The **report** is divided into a number of sections and the topics dealt with in each area are listed in the table of contents. Included in this report are sections dealing with the topography, drainage, climate, vegetation, parent material and other factors that have a bearing on soil development, settlement,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

The **soil map**, printed on the scale of three miles to the inch, shows the towns, railroads, post offices, lakes, rivers, and the location and extent of the different soil areas. The designated soil areas are separated by either solid or broken boundary lines and identified by the use of differing colors, letter combinations and symbols which are defined in the map legend. Topography is indicated by means of hatchuring. The topographical separations are described in the report and the method used to indicate the separations is also referred to in the map legend. The township and range numbers are shown at the margins of the map and a diagram of a township is included to show how sections are numbered.

Three other maps accompany this report: They are small scale maps that are published in black and white and provide information supplementing that given on the soil map. The tree cover map distinguishes areas on the basis of the extent to which tree cover may be an impediment to land improvement. The cultivation map indicates the extent of agricultural development in the area. The soil rating map distinguishes the better land from the poorer land and serves as a guide to the possible utilization of the area.

The rating and classification indicated on the maps should be regarded as average for the areas rather than specific for individual land parcels. The information of the survey is not given in sufficient detail to show all soil variations in individual farm units. However, the maps and reports can furnish information of valuable assistance in determining the characteristics of the soils encountered in the various portions of this area. As pointed out, in the following pages, many different soils are encountered in this area, and a recognition of their characteristics will aid in planning land use practices that are essential in establishing a profitable and permanent agriculture.

Figure 1—Location Map



Sketch map of Alberta showing locations of surveyed areas for which reports have been published: (1) Macleod sheet, (2) Medicine Hat sheet, (3) Sounding Creek sheet, (4) St. Ann sheet, (5) Dunvegan area, (6) Peace River, High Prairie, Sturgeon Lake area, (7) Rainy Hills sheet, (8) Sullivan Lake sheet, (9) Lethbridge and Pincher Creek sheets, (10) Milk River sheet, (11) Blackfoot and Calgary sheets, (12) Rosebud and Banff sheets, (13) Vermilion and Wainwright sheets, (14) Peace Hills sheet, (15) Rycroft and Watino sheets, (16) Red Deer sheet, (17) High Prairie and McLennan sheets, (18) Grande Prairie and Sturgeon Lake sheets, (19) Rocky Mountain House sheet, (A) Preliminary 58-1, (B) Preliminary 59-1, (C) Preliminary 60-1, (20)(In Black) Beaverlodge and Blueberry Mountain sheets.

NOTE: Reports for areas 1 to 9 inclusive are out of print, but may be obtained on loan from the University Extension Library, University of Alberta, Edmonton.

Soil Survey of the Beaverlodge and Blueberry Mountain Sheets

GENERAL DESCRIPTION OF THE AREA

LOCATION AND EXTENT

The Beaverlodge and Blueberry Mountain sheets are in the western portion of the Peace River district. They include portions of the former Dunvegan and Wapiti sheets and consist of all or portions of townships 69 to 80 in ranges 7 to 14 west of the 6th meridian. A more precise indication of the boundaries is as follows: east boundary—119°00′ west longitude; west boundary—120°00′ west longitude (Alberta and British Columbia boundary); south boundary—55°00′ north latitude; north boundary—56°00′ north latitude.

Included in the mapped area for this report is an additional extension south of the previously indicated area that consists of the remaining portion of township 69 and all of townships 68 and 67. The total mapped area therefore consists of an area extending approximately 39 miles east and west and 85 miles north and south. It extends from Dimsdale (about 8 miles west of Grande Prairie) to the Alberta-British Columbia boundary and includes the areas adjacent to Wembley, Beaverlodge, Hythe, Bonanza, Gordondale, and Blueberry Mountain. There are approximately 2,100,000 acres in the mapped area whose general location is indicated on the sketch map in Figure 1.

SETTLEMENT AND AGRICULTURAL DEVELOPMENT

The first settlement and agricultural development in this area occurred adjacent to the missions and fur trading posts. Many of the travellers en route to the Klondike during the gold rush, forsook their objective to undertake other occupations. In 1900, a group including Alex. Monkman started a settlement in the vicinity of the Hudson's Bay Company trading post near Lake Saskatoon. By 1911, according to the Canada Census, there was a total population of 403 in the mapped area. There was a marked increase in settlement after the opening of the Edson Trail in 1914. The 1916 Census show that there was a total population of 1,324 concentrated principally in the Beaverlodge-Dimsdale portion of the area. The completion of railroad construction to Grande Prairie in 1918 served as an impetus to settlement in this area. The total population indicated in the 1921 Census was 3,268. The railroad was extended to Wembley in 1924, to Hythe in 1929 and to Dawson Creek, British Columbia in 1930. The major portion of the agricultural develop-

ment in this area has taken place since the completion of the railroad. The Canada Census shows that in 1931 the total population in the mapped area had risen to 8,569 and by 1941 it had increased to 9,145. Since then there has been a progressive decrease in the total population of this area. The 1951 Census shows a total population of 8,481, while the 1956 report indicates a total population of 7,796 which includes the urban population found in the villages of the area. However, it is noteworthy that the urban population of this area has been increasing. A comparison of the 1941 and 1956 reports shows an increase from 331 to 768 at Beaverlodge, from 247 to 481 at Hythe, and from 188 to 271 at Wembley.

Table 1 gives, in summary, the number of farms, the occupied and the improved acreage in the surveyed area for each of the Census years from 1916 to 1956. The data, compiled from the Canada Census, shows a marked increase in the number of farms from 1926 to 1931. However, there has been a progressive decrease in the number of farms since 1931. This indicates a period of consolidation in which the farmers remaining in the area have gradually increased the size of their farm holdings and their acreage of improved land. The percent of land improved has increased from 22 in 1916 to 58 in 1956.

The cultivation map (Figure 4) shows the distribution of those farms on which cultivation was observed at the time of survey.

Figure 2—Monkman road in township 69 range 13 extends about 50 miles into British Columbia. Following a trail blazed by Alex. Monkman a road was cleared by 1938 to provide a short route to Vancouver.

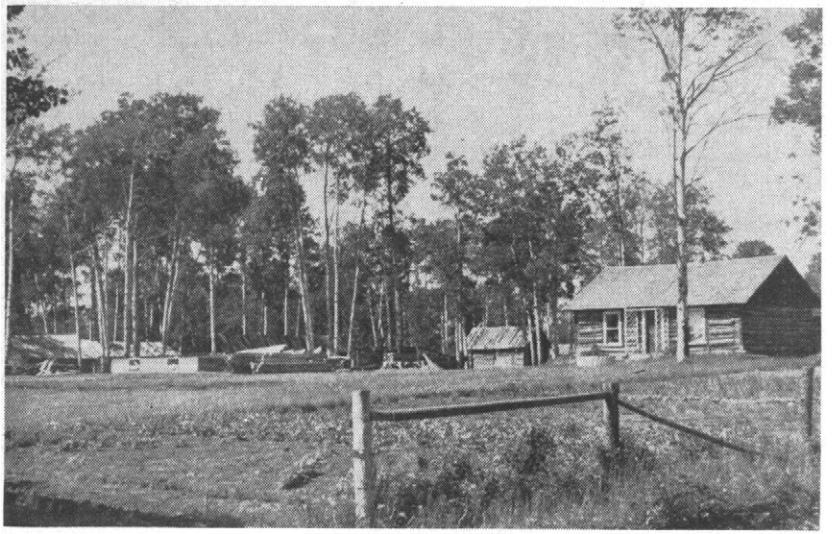


Figure 3—Farmstead typical of the sparsely settled portions of the mapped area.

The greatest portion of the cultivated acreage is in the southern half of the mapped area, east of Brainard. Smaller concentrations are located in the northern portion of the area, in the vicinities of Bonanza, Gordondale and Blueberry Mountain.

TABLE 1—Number of Farms, Acres Occupied and Acres Improved in the Beaverlodge and Blueberry Mountain Sheets, 1916-1956

Year	Number of Farms	Acres Occupied	Acres per Farm	Acres Improved	Percent of Land Improved
1916	341	90,728	266	19,678	22
1921	1,319	312,482	237	72,938	23
1926	930	257,408	277	83,991	33
1931	2,705	588,004	217	218,861	37
1936	2,393	663,587	277	269,019	41
1941	2,338	703,610	301	324,697	46
1946	2,067	694,093	336	350,083	50
1951	1,940	714,038	368	401,123	56
1956	1,747	717,279	411	413,684	58

The acreage sown to field crops increased correspondingly as more land was improved. Grain farming is now the prevalent type of farming in the mapped area. As indicated in Table 2, wheat, oats and barley crops occupy the largest portion of the cultivated land. The acreage sown to oats usually exceeds that sown to wheat. The acreage sown to hay crops has shown a very marked increase since 1931, and particularly noticeable are the increases indicated in the 1951 and 1956 Census years. This trend is considered very desirable in this region.

Records, obtained from the Canada Experimental Farm at Beaverlodge, show that the average crop yields in the mapped area were as follows: wheat—20 bushels per acre, barley—25 bushels per acre, oats—38 bushels per acre, rye—17 bushels per acre, flax—10 bushels per acre, sweet clover seed—400 pounds per acre, alsike

clover seed—250 pounds per acre, alfalfa seed—100 pounds per acre, brome grass seed—250 pounds per acre, and creeping red fescue grass seed—200 pounds per acre. These include yields produced on many soil types and under differing farming practices. Some of the better soils produced higher yields and many individual farmers obtained yields exceeding these averages by considerable margins.

TABLE 2—Total Acreage Cropped, and Acreage by Principal Crops in the Beaverlodge and Blueberry Mountain Sheets, 1916-1956

Year	Total Field Crops ac.	Wheat ac.	Barley ac.	Oats ac.	Rye ac.	Flax ac.	Hay* ac.
1916	12,687	4,143	1,020	6,683	.....	43	594
1921	44,581	11,358	3,242	26,309	726	15	1,478
1926	54,963	25,177	1,157	24,107	674	11	3,040
1931	156,712	81,091	2,875	62,139	550	125	3,133
1936	180,969	76,893	4,250	88,410	184	35	7,238
1941	206,671	83,392	8,344	96,448	554	1,761	12,319
1946	232,064	88,188	7,180	109,914	357	990	22,117
1951	293,452	78,058	24,339	104,846	5,780	5,375	66,944
1956	282,661	48,998	71,550	77,100	787	14,763	68,413

*Includes clover, alfalfa and cultivated grasses.

The Census show that the livestock population in the mapped area bears little relation to the amount of land improved. In Table 3 it will be noted that the livestock population is comparatively small and varies considerably. The variations are most pronounced in the swine and poultry population.

TABLE 3—Livestock Population in the Beaverlodge and Blueberry Mountain Sheets, 1916-1956

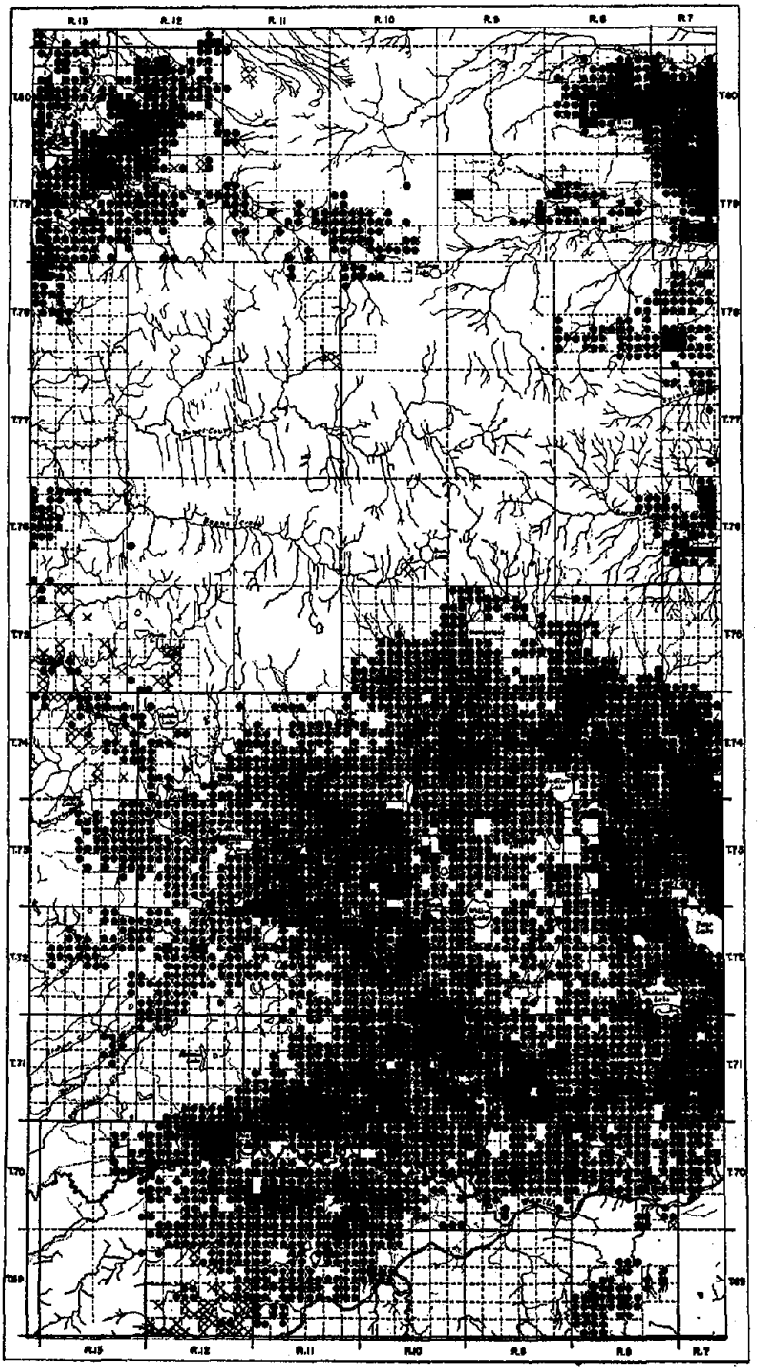
Year	Horses	Cattle	Sheep	Swine	Poultry
1916	1,935	2,063	24	3,488	.....
1921		——	not reported	——	
1926		——	not reported	——	
1931	11,231	10,881	1,397	13,066	115,619
1936	12,185	19,659	2,040	11,965	84,333
1941	14,410	13,694	2,706	23,740	116,795
1946	10,351	13,646	3,944	10,148	212,534
1951	6,072	12,697	2,071	9,751	99,248
1956	3,231	19,496	2,931	16,441	107,557

TRANSPORTATION

The main line of the Northern Alberta Railway traverses the southern portion of the mapped area. It enters the area in township 71 range 7 and then proceeds in a northwesterly direction to Wembley, Beaverlodge, Hythe and Demmitt. It leaves the area northwest of Demmitt in township 75 range 13 en route to Dawson Creek, British Columbia. The shipping distance from Beaverlodge to Edmonton is 436 miles.

Two highways traverse the mapped area. In the southern portion, the main highway parallels the railroad. It is hard surfaced to the British Columbia boundary. Using the new Valleyview highway, the distance from Beaverlodge to Edmonton is 314 miles. The other main highway traverses the northern portion of the mapped area. From Spirit River it enters the area in township 78 range 7 and proceeds in a westerly direction, also en route to Dawson Creek, leaving the area in township 78 range 13. It is gravel surfaced and provides a shorter route from many of the adjacent areas to British Columbia. At Gordondale the distance by highway to Edmonton is 358 miles.

Figure 4—Map Showing Present Cultivated, Abandoned and Virgin Lands in the Mapped Area.



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

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

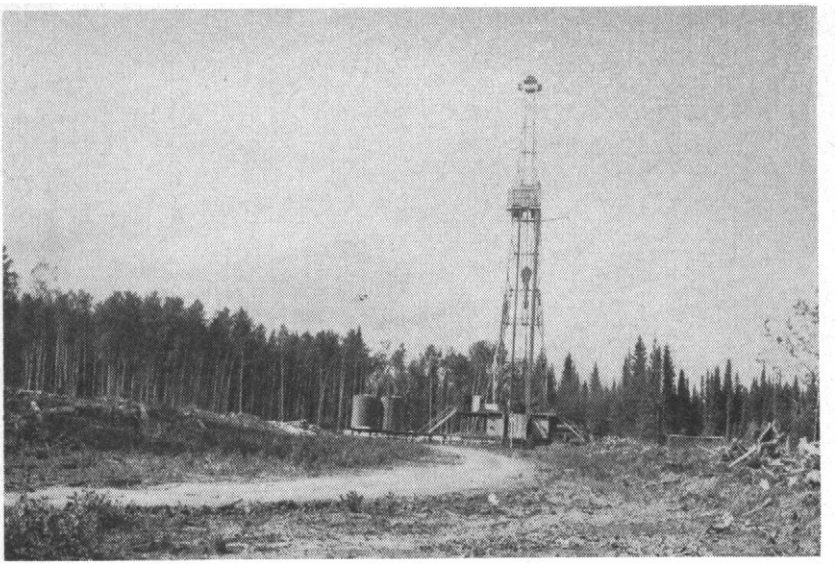


Figure 5—Oil exploration near the Saddle hills. Such activities have provided new trails and roads which will assist in the agricultural development of the fringe areas.

Figure 6—Hard surfaced highway near Demmitt. This highway traverses the central portion of the mapped area and is part of the main highway from Grande Prairie to Dawson Creek, British Columbia.

The heavily settled portions of the mapped area are well supplied with market roads. In most of the sparsely settled portions there are very few roads and in many cases the areas are accessible only by wagon or pack trails. Many trails and some well graded roads have been built during the last few years in connection with the

activities of numerous oil companies. Such roads have provided access to many of the remote southern portions, to the Saddle hills area in the central portion, and to the recently settled areas in the northern portion.

Bridges span the rivers and streams along the routes of the main highways and most of the secondary roads. South of Wembley, the Wapiti river can be crossed by a ferry in section 11, township 70, range 8.

PHYSIOGRAPHIC DIVISIONS

The surveyed area consists mainly of the remnants of a former till plain and of lower lying lake basins, some of which have undergone considerable alteration adjacent to the main drainage channels.

Till plain remnants are found in the northern, central, and southern portions of the mapped area at elevations of 2,500 feet to about 3,000 feet above sea level. The highest remnants with elevations of 3,000 feet are found in the northern portion of township 77 range 8 (White mountain), in the southwest portion of township 76 range 8 and the southeast portion of township 76 range 9, in the central portion of township 72 range 9 (Saskatoon mountain), in township 67 range 7, and in townships 67 and 68 in ranges 12 and 13. Many of these high till plain remnants are closely underlain by bedrock. Occasional variable benches, low ridges and knolls are characteristic of this otherwise relatively level till plain. The slopes from the till plain to the lower lying basin valleys are generally long and fairly uniform. In the southwestern portion of the mapped area, particularly south of Demmitt and Brainard there are numerous ridges that have a northeast-southwest bearing. They are often gravelly or stony, frequently parallel, and separated by long, narrow boggy areas.

The lake basins occupy much of the south-central, east-central, and northern portions of the mapped area. Adjacent to the Wapiti river the basin increases in elevation from 2,200 feet in the northeastern portion to about 2,500 feet in the western and central portions near Hythe and Rio Grande. In the northern portion, north of the Saddle hills, the basin increases in elevation from 2,000 feet near Pouce Coupe river and Hamelin creek to elevations of approximately 2,500 feet in the vicinity of Gordondale.

Considerable alteration has taken place in some of the laking basins. In the southern portion, south of the Wapiti river, and in the northwestern portion adjacent to the Pouce Coupe river, there are areas in which the relief is characterized by numerous, low, steep sided knolls whose crowns frequently have doughnut shaped depressions. In the southern area, near the Wapiti river, the sand areas are often characterized by longitudinal dunes or ridges or occasionally by U-shaped dunes similar to those described and illustrated in the Grande Prairie and Sturgeon Lake Soil Survey Report.

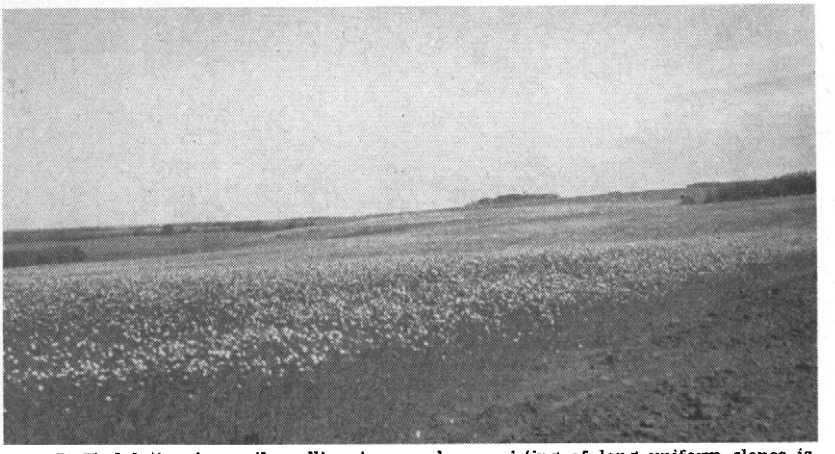


Figure 7—Undulating to gently rolling topography consisting of long uniform slopes is typical of the Hythe-Beaverlodge area.

Figure 8—Rolling to hilly topography is typical of portions of the Saddle hills and the southern part of the mapped area.

DRAINAGE

Drainage of the mapped area is provided by numerous streams and rivers that form part of the Peace river drainage system.

The southern part of the area is drained by the Wapiti river and its tributaries, the chief of which are the Red Willow and Beaverlodge rivers and the Pinto and Nose creeks. The Wapiti river flows east to join the Smoky river about 30 miles east of

this map area. These rivers and creeks are permanent in character while some of their tributary streams are seasonal, reaching a maximum flow during the spring run-off and often become dry during the late summer months.

The Pouce Coupe river and its main tributary, Henderson creek, drain the northwestern part of the mapped area. They are permanent streams. The northeastern portion is drained by the Hamelin and Howard creeks, and the Ksituan river. These are seasonal streams that are often dry during the late summer months.

There are numerous lakes of various sizes in the mapped area. The greatest concentration of lakes is in the west central portion of the area where Sinclair, Whitman, Updike, Preston, Albright, and Kamisak lakes occur. In the eastern portion, the principal lakes are La Glace, Bear, Saskatoon, and Cutbank. There are no lakes of significant size in the area north of the Saddle hills. Most of the lakes are fed by seasonal streams or replenished by run-off. Many are therefore stagnant during much of the year. While they provide sanctuary for water fowl they do not appear suitable for fish production.

Local drainage conditions vary greatly throughout the mapped area. The most satisfactory drainage conditions, from the standpoint of agriculture, are found in those areas that have long, very gentle slopes. Much of the rolling and hilly land is excessively drained through loss of moisture by surface run-off. Low lying flats and depressions are characterized by varying degrees of flooding as the result of restricted drainage.

CLIMATE

Meteorological records, for the mapped area, are available for Beaverlodge. The data assembled at the Canada Experimental Farm provide information that should be applicable to a large portion of this area. However, it must be expected that the weather records of areas farther removed from Beaverlodge might show differences significant to crop production. For example, areas south of the Wapiti river, those near Demmitt, or those in the Saddle hills have higher elevations, while some of the areas south and east of Beaverlodge and portions of the area north of the Saddle hills have lower elevations. Such differences may affect the precipitation, the moisture distribution, the frost-free periods, and other factors which may result in records significantly different to those of Beaverlodge.

Features of the climate at Beaverlodge are described by A. C. Carder in Appendix I. Comparisons are made with similar data assembled at Lacombe in central Alberta and with those at Lethbridge in southern Alberta. The indicated differences are reflected in the native vegetation and must be considered in the agricultural development of the mapped area.

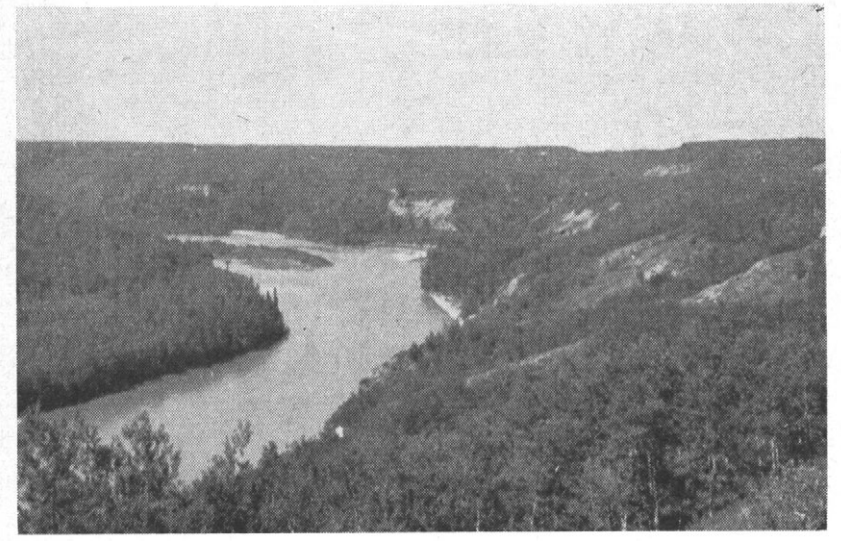


Figure 9 –Wapiti river in township 69 range 10. Steep, rough banks are commonly associated with the stream courses in the mapped area.

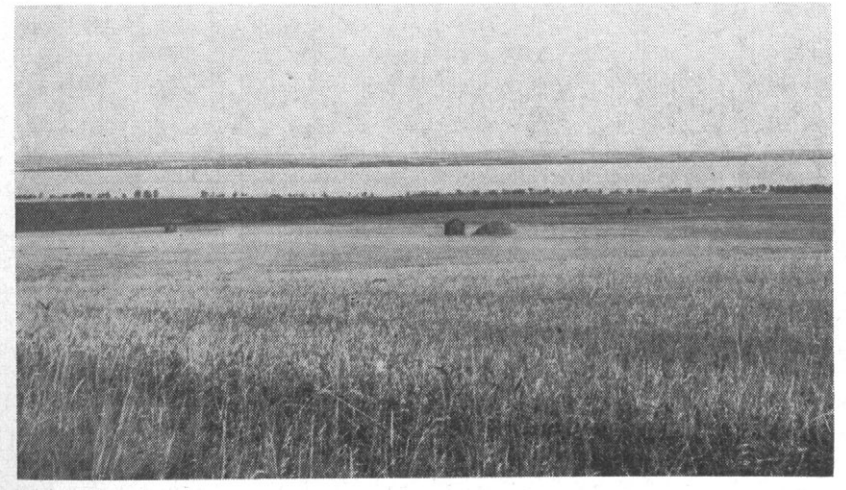


Figure 10—Bear lake in township 72 range 7. The numerous lakes in this region are not suitable for fish but do provide a haven for a variety of water fowl.

Figure 11—Light to medium tree cover in areas that are being cleared for agricultural use. (See Fig. 13.)

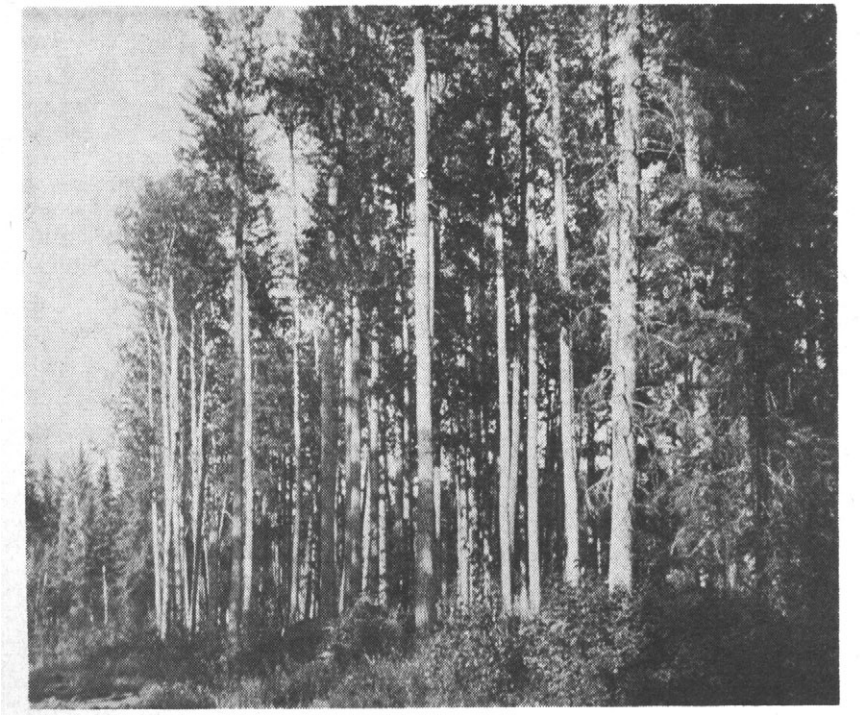


Figure 12—Heavy cover, some of which is of commercial importance, is found in some of the northern and southern portions of the mapped area. (See Fig. 13.)

VEGETATION

The dominant native vegetation of the mapped area consists of a mixed tree cover in which aspen poplar is usually predominant. Balsam poplar, white spruce, pine, birch, willow, and alder occur either in mixtures or as the dominant cover of local areas. Such shrubs as the rose, gooseberry, raspberry, cranberry, chokecherry, saskatoon, and hazelnut occur in mixtures, particularly in the more open portions of the area. Black spruce, tamarack, dwarf birch, labrador tea, sedges, rushes, reeds, coarse grasses, and mosses occur in the low-lying, poorly drained portions of the area. Fir is found in the understory of some of the mature stands of spruce, particularly in the southern portion of the area.

Much of the native cover has been destroyed as the result of land improvement and forest fires. The relative distribution of tree cover, at the time of survey, is shown in Figure 13. Marketable stands of spruce and pine occur in the southern, western and northern portions of the mapped area. Lumbering is a significant industry in the southern portion, south of the Wapiti river.

In addition to the wooded areas, there are fairly extensive parkland areas that consist of wooded bluffs, low shrub cover, and varying areas of open grassland. Such parkland conditions appear to have prevailed in many of the settled areas adjacent to Hythe, Beaverlodge, Wembley, Halcourt, La Glace, Valhalla, Bonanza, and Blueberry Mountain.

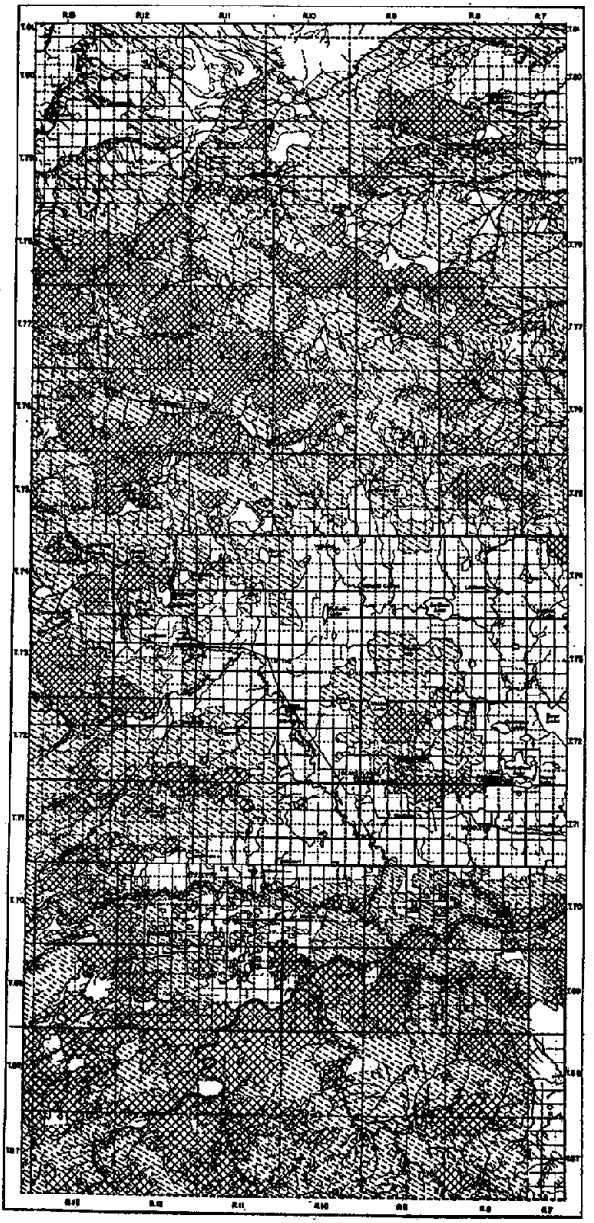
The existence of these and other parkland areas within the wooded Peace River region has been a source of major interest for a long time. Early settlers, traders and explorers referred to these areas and attributed their existence to repeated forest fires. Investigations by E. H. Moss reported in "The Botanical Review" 21-9-1955, indicate that the native vegetation of these northern parklands is similar in many respects to that of the foothills and some of the other parklands of Alberta, but that it lacks some of the leading grass species of the latter areas. Further studies will be required to determine the species native to the northern parklands and their relationship to the soils in these areas. It is noteworthy that many of these parklands are found on soils developed on fine textured, somewhat saline parent materials, and are characterized by a relatively impermeable clay pan. Such clay pans might tend to be unfavorable to the development of a good tree growth and it is suggested that, as a result, trees never did become well established in such areas.

THE SOILS' PARENT MATERIAL

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

The surface deposits and the surface features of the mapped area are the result of deposition and erosion during pre-glacial,

Figure 13—Map Showing the Relative Distribution of Tree Cover in the Beaverlodge and Beaverlodge and Blueberry Mountain Sheets



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

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

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

glacial, and post-glacial times. The general effect of pre-glacial erosion was to remove any beds that might have been deposited subsequently to the Late Cretaceous epoch. Maps and reports published by the Geological Survey, Research Council of Alberta, show that north from a line extending from section 36 township 78 range 8 to the vicinity of Bay Tree, the area is underlain by the Kaskapau member—the lower shale of the Smoky River formation. The intervening area to a line extending from section 12 township 78 range 8 to the vicinity of Lymburn is underlain by the upper shale of the Smoky River formation. South of this line the area is underlain by the Wapiti formation.

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

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

"Lithologically the Wapiti formation consists of sandstones and shales of fresh water deposition . . . Light grey to buff are the prevailing colors, and on the whole, fine grained textures are most common . . . The shales are poorly stratified, a characteristic common to shales of fresh water deposition." (Rutherford, R. L., Research Council of Alberta Report No. 21). The Wapiti formation is over 1,100 feet thick and includes all the beds of the Upper Cretaceous series that lie above the upper part of the Smoky River formation. Further investigations lead Allan and Rutherford (Research Council of Alberta Report No. 30) to suggest a separation of the Wapiti into the Belly River and Edmonton formations. "In the Peace River districts of Alberta and eastern British Columbia, the top of the Belly River has been placed at a horizon within the upper part of the Wapiti formation where a lithological change occurs . . . The Edmonton formation is composed of light to dark colored shales, bentonitic clays and sandstones, coal seams and carbonaceous bands, and frequent layers of clay-ironstone nodules . . . The Edmonton formation is extended west across the Smoky through the Grande Prairie district where the upper part of the Wapiti is correlated with the Edmonton on a lithological basis." In the mapped area sections of the Wapiti formation can be observed in a road-cut exposure about 2 miles southeast of Hythe while sections of strata of the Smoky River formation can be observed in the northern portion of the area. A section of Baytree conglomerate is exposed in section 27 township 78 range 13 while in the northeast quarter of section 15 township 80 range 8 the Bad Heart sandstone occurs at or near the surface. The Bad Heart sandstone is the thin lithological unit that separates the upper and lower shale members of the Smoky River

formation, while the Baytree conglomerate lies within the Kaskapau members.

During the Pleistocene epoch this region was overridden by the Laurentide ice sheet advancing from the northeast part of the continent. In passing over the area, the ice sheet mixed the materials accumulated from the underlying bedrock and produced large areas with a relatively flat surface by filling in the depressions left as a result of pre-glacial erosion. However, some of the ridges and hilly portions of the area are closely underlain by bedrock and reflect some of the pre-glacial topography. The materials from the underlying bedrock make up the greater proportion of the drift in this area.

Three different glacial deposits were recognized in the mapped area. The first consists of a greyish brown to yellowish brown, sandy clay loam to clay till, that is somewhat stony, has numerous coal flecks and may be largely derived from both the Smoky River and Wapiti formations. This till underlies many of the subsequent deposits in the mapped area and is exposed most extensively in the southeastern, east-central and northern portions of the area. It forms the parent material of Hillburn, Braeburn, Saddle, and Sexsmith soils.

Figure 14—Baytree Conglomerate (reported by C. R. Stelck in the Canadian Mining and Metallurgical Bulletin, May, 1955) is a significant member of the Smoky River formation and is exposed in section 27 township 78 range 13.

The second glacial deposit, frequently lying immediately above the preceding one, consists of a well sorted, grey to dark greyish brown clay that has few stones, numerous gypsum crystals and may be derived largely from the products of the Smoky River shales. This deposit is remarkably uniform and may have been laid down in a glacial lake. Pending further investigations to determine its origin, the term "lacustro-till" is used in this report in reference to this deposit. It forms the parent material of the Donnelly, Esher, and Landry soils and occurs on the lower slopes of the till plain remnants at elevations rarely exceeding about 2,500 feet. At elevations of about 2,500 feet and up to about 2,600 feet, particularly in the west-central portion of the area, this deposition becomes more variable. The dark colored beds of clay, often about 12 inches in thickness, are separated by bands of yellowish brown, sandy, often gravelly or stony, till-like material that may vary in thickness from 4 to 12 inches, or may be a part of a sequence of thinner beds or strata of dark grey clay and brown, sandy till. This material, that may be typical of the marginal portions of the "lacustro-till" areas, forms the parent material for the Hazelmere and Albright soils.

Figure 15—Till overlying lacustro-till in section 3 township 73 range 12. Note the pebble layer at the contact.

The third glacial deposit, frequently lying above the preceding one, is a yellowish brown, sandy, gravelly or stony till. The stones are predominantly quartzites and there may be occasional fragments of sandstone. This material is often found in slight ridges that appear to have a parallel alignment with a northeast and southwest bearing. This stony deposit appears to be relatively thin and is of common occurrence in the west-central portion of the mapped area. It is suggested that this deposit may be of western origin transported by the Cordilleran ice sheet. It forms the parent material of the Demmitt and Hythe soils.

In the lower basins, at elevations usually below 2,200 feet, much of the soils' parent material appears to be of post-glacial origin. Lacustrine, grey to dark grey clays are found adjacent to the Hamelin creek in the northeastern portion, adjacent to the Pouce Coupe river in the northwestern portion, and adjacent to Bear lake in the east-central portion of the mapped area. They are stone-free, very firm, unctuous clays that exhibit characteristics of the Smoky River shales. Except for the fact that these clays are stone-free, somewhat more uniform and generally darker colored, they differ very little from the "lacustro-till" clays. Nampa, Falher, Rycroft, and Kleskun soils are developed on this dark colored, somewhat saline lacustrine material.

Adjacent to some of the major stream courses, the parent materials are brownish colored and appear to be of alluvial origin. The more recent of these deposits are found on the lower terraces and flood plains. They form the parent material of the High Prairie soils that are found on the flood plain adjacent to the Beaverlodge river. Older alluvial deposits, adjacent to the Wapiti river in the southeastern portion and those adjacent to the Pouce Coupe river in the northwestern portion of the area, consist of sandy and silty materials that in many cases appear to have been worked by wind. Toad, Davis, Kathleen, Judah, and Tangent soils are formed on these silty materials and are often characterized by a humpy topography that may be the result of frost action. Sundance, Culp, Leith and Heart soils are formed on the sandy materials. Adjacent to the Wapiti river these sandy materials have been worked by wind with the result that some of this area has characteristic U-shaped and longitudinal shaped dune topography.

In addition to the foregoing, there are other types of parent material that are of local importance in various portions of the mapped area. These are the gravelly outwash and beach materials that are often found in association with some of the till and lacustro-till areas, the materials developed on or in very close association with the underlying bedrock, other alluvial or wind blown materials deposited as relatively thin beds overlying other deposits, and the recent alluvium deposited on the river flats.

SOILS

SOIL DEVELOPMENT

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

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

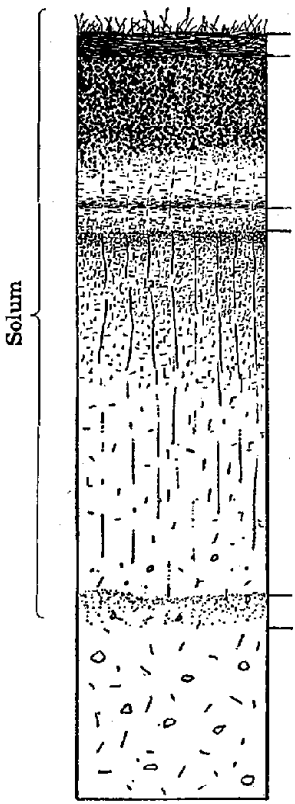
The characteristics that a soil acquires, as a result of the interaction of the various soil-forming factors, are reflected in the development of more or less distinct layers or horizons. A cross section of these horizons from the surface to the relatively unaltered parent material is known as a soil profile. (See Fig. 16). The A horizon is the portion of the profile from which materials are leached by the percolating rain water and in which, in most soil profiles, the organic matter accumulates. The B horizon is the portion in which some of the materials carried down from the A horizon are deposited. As a result of this accumulation, the B horizon may be somewhat finer textured and more compact than the A horizon. Taken together, the A and B horizons form the solum, which represents the true soil formed by the soil building agencies. The C horizon is the relatively unaltered parent material. Soil profiles developed under the influence of excessive moistening may have a greyish, more or less sticky, gleyed horizon in the lower part of the solum.

The degree of profile development is dependent on the intensity of the activity of the different soil forming factors, on the length of time they have been active, and on the nature of the materials from which the soils have developed. Characteristic horizons are not the result of chance. Mature soils, developed on similar parent material under the influence of similar conditions of climate, vege-

tation and relief, will have horizons of similar thickness possessing similar characteristics. Soils developed from similar materials that have been acted upon by environmental factors that are different in kind or intensity will have different profiles.

The National Soil Survey Committee, in their 1960 proceedings, authorized a revision in the classification and nomenclature of the soils in Canada. Thus, throughout this report, an effort will be made where possible to incorporate the revisions and to indicate, in brackets, their relation to formerly used terms.

Some of the revisions are indicated in the following diagrams and in the summary which relates some of the soil forming factors to the major profile types found in the mapped area.



L-H—Organic horizon that may be subdivided into L (raw organic matter), F (partially decomposed), and H (decomposed organic matter).

A —Mineral horizons at or near the surface which includes horizons in which there is an enrichment of humus (Ah) and those that have been eluviated of clay, iron, aluminus and/or organic matter (Ae).

AB —Transition horizon.

B —Mineral horizon that may have an enrichment of clay (Bt), iron (Bf), or organic matter (Bh). It may be characterized by an enrichment of exchangeable sodium (Bn) or by a concentration of weathered products formed in situ. Usually there is a removal of dolomite and soluble salts.

BC —Transition horizon.

C —Mineral horizon comparatively unaffected by the soil forming processes operative in the A and B horizons except for the process of gleying and the accumulation of dolomite (Ck) and soluble salts (Cs).

Figure 16—Diagram of a soil profile showing various horizons. Further separations may be made by the use of suffixes. Definitions of the descriptive lower case suffixes are given in Appendix III.

A. Vegetation and Relief

1. Well drained to moderately well drained topographic positions.

(a) *Black Soil Profiles:* Developed on non-saline parent materials in areas characterized by a long continued absence of tree cover. The profiles have a very dark brown to black A horizon and a prismatic or granular structure in the B horizon. The lower portion of the profile has an accumulation of calcium carbonate. (See Fig. 17.) Such profiles are of infrequent occurrence in the mapped area.

(b) *Dark Grey Wooded (Degraded Black) Soil Profiles:* Developed in areas in which the woodland vegetation has not been as dense nor as well established as that in the Grey Wooded soil areas. The woodland may be a comparatively recent development on former grassland areas. The profiles have a dark grey to brown Ah horizon that is well developed and usually several inches thick. The underlying Ae horizon is grey to greyish brown in color, and rarely exceeds a thickness of six inches in this area. The B horizon generally has a nuciform structure, and calcium carbonate is usually present in the lower part of this profile. (See Fig. 17.)

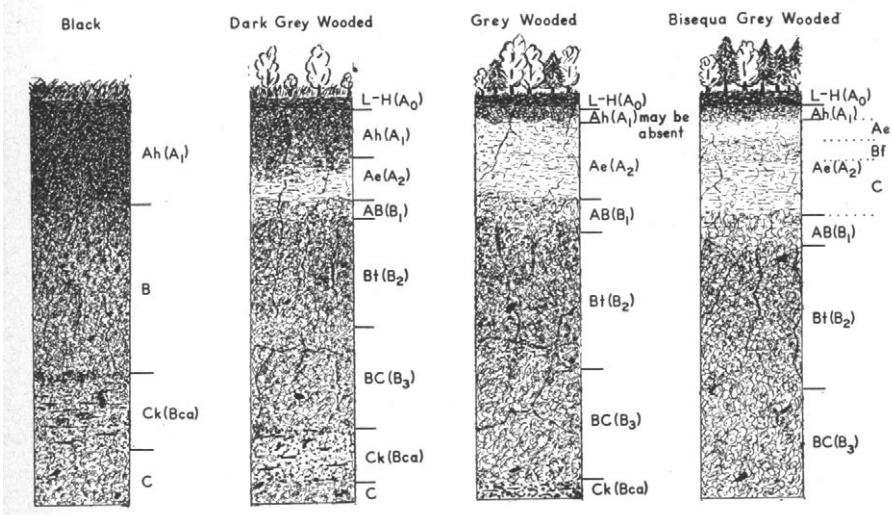


Figure 17—Sketch showing the characteristics of some of the principal profiles found in the mapped area.

(c) *Grey Wooded Soil Profiles:* Developed under a mixed deciduous and evergreen woodland vegetation on calcareous parent materials. The profiles have a thin or almost imperceptible Ah horizon, a thick, ashy, grey to very pale brown Ae horizon, and a well developed textural B horizon (Bt). Lime is usually present in the C horizon and may occur in the lower portion of the B horizon. (See Fig. 17.)

(d) *Bisequa Grey Wooded (Podzolized Grey Wooded) Soil Profiles:* These profiles are characterized by the development of what appears to be a secondary Podzol-like profile in the A horizons of soils that otherwise resemble Grey Wooded soils. The secondary profile is readily distinguished by its white to pinkish white Ae horizon that is usually thin and much lighter colored than the remainder of the Ae horizon of the primary profile. There is a brown to reddish brown B horizon which is underlain by the grey to very pale brown remnants of the former Grey Wooded Ae horizon. (See Fig. 17.) The B horizon of the primary profile usually undergoes some alteration with a resultant deterioration of its pronounced textural characteristics. Such profiles are found mainly in some of the more sandy portions of the southern area and in some parts of the Saddle hills.

2. Moderately well drained to poorly drained topographic positions.

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

(b) *Low Humic Eluviated Gleysol (Depression Podzol) Soil Profiles:* These profiles are distinguished by their thick, grey Ae horizon underlain by a fine textured "sticky" B horizon (Btg). Rusty streaks and mottling are found in the B horizon and often in the Ae horizon. Frequently the uppermost horizon consists of a fairly thin, dark colored accumulation of peat.

(c) *Organic Soil Profiles:* These profiles have an accumulation of organic material (peat), exceeding 12 inches, overlying a mottled and often rusty streaked mineral subsoil. They are identified by the nature of the peat accumulation. Depending on the kind of organic material in the accumulation, they are referred to in this report as Fibrous Peat (*Sedge Peat*) or Sphagnum Peat (*Moss Peat*) soil profiles.

B. Influence of Parent Material

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

(a) *Solonetz Soil Profiles:* May occur as the dominant soil profiles of fairly large areas or in association with other Dark Grey or Black Soils. These profiles have a dark grey to greyish brown Ah horizon and sometimes a thin grey Ae horizon. The upper part of the B horizon is very hard and compact and has a distinct columnar top that is capped with a grey, dense, very hard layer. Dark colored organic staining is common in the upper part of the B horizon, while lime and salts are usually present in the lower part of the B horizon and the upper part of the C horizon.

(b) *Solodized Solonetz Soil Profiles:* Similar to the previously described profiles, except that the upper part of the B horizon is

not as hard nor as dark colored, and there is usually a thick grey Ae horizon. The lower B horizons are often much more friable than the upper B horizons. Depending on the characteristics of their Ah horizon, they are further designated as Black, Dark Grey or Grey Wooded Solodized Solonetz profiles.

(c) *Solod Soil Profiles:* Appear to be remnants of Solodized Solonetz profiles. They generally have a fairly thick A horizon of which the grey, platy Ae horizon is usually well developed. There is an AB horizon that consists of fairly loose, blocky to nuciform aggregates. The B horizon does not have the pronounced columnar characteristics of the former profiles but is more friable and has a blocky to nuciform structure. While the distinguishing features of Solod soil profiles are not as apparent as those of the two preceding profiles, there is usually a fairly abrupt break between the A and B horizons. Depending on the characteristics of their Ah horizons, they are referred to as Black, Dark Grey or Grey Wooded Solod soil profiles. Such profiles are of extensive occurrence in the mapped area.

SURVEY METHODS, CLASSIFICATION AND MAPPING

Survey Methods

The soil survey of the Beaverlodge and Blueberry Mountain sheets was essentially a reconnaissance survey carried out by making traverses at intervals of one mile wherever possible. Traverses were made by car, on foot and, where necessary, by saddle horse. In the latter case, both the traverse interval and the route was very irregular and the information thus obtained was of an exploratory nature. The boundary lines between different soil areas were determined along the lines of traverse and then projected between the lines of traverse. In many cases, boundary lines were projected with the aid of aerial photographs. Further inspection should be made if information of a more detailed nature is required.

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

Classification

The soils of the Beaverlodge and Blueberry Mountain sheets were classified and grouped according to the scheme outlined in Table 4. Soils developed from similar parent material and having similar profile characteristics received a *soil series* name. Names

were taken from the locality in which those soils were found, and include the names of rivers, lakes, towns and districts. Features that were believed of importance to the growth of native or crop plants formed the principal basis of soil series separation. Those which affected mainly the external characteristics of the soil, but not the principal profile characteristics, were separated as *phases*. Thus, soils belonging to the Braeburn series, for example, are assumed to have similar characteristics relative to crop production. If some of them are excessively stony or gravelly, or have a significantly different topography, they may be indicated or outlined on the soil map as appropriate phases of the Braeburn series. Further separations based on the texture of the surface soil or A horizon were not made in this area. Soils developed on similar parent material usually have a narrow range of texture, and beyond indicating the range common to each series, further separations into soil classes were believed unnecessary. Moreover, in leached soils, the most significant textural references are those of the B and C horizons.

The various soil series in Table 4 are grouped according to the type of parent material on which they have developed. Such groups of soils, whose different characteristics are believed to be due to differences in relief and drainage, are called *catenas*. The classification proposed in Table 4 might therefore be considered as essentially a catenary classification. It will be noted that in some cases, soils of the same series are included in two or more catenas. Soils formed in poorly drained areas acquire profile characteristics that show little difference over a fairly wide range of parent materials. In the descriptions to follow and in the map legend, such soils are assigned specific parent materials merely for convenience of reference.

TABLE 4—Classification of Soils in the Beaverlodge and Blueberry Mountain Sheets

A. Soils Developed on Glacial Till

1. Yellowish brown and greyish brown, slightly calcareous, loam and clay loam.
   - (a) **Hillburn**—Orthic Grey Wooded, loam and clay loam.
   - (b) **Braeburn**—Orthic Grey Wooded, loam and clay loam.
   - (c) **Saddle**—Dark Grey Wooded (Degraded Black Solodic), loam and clay loam.
   - (d) **Sexsmith**—Eluviated Black (Black Solodic), loam and clay loam.
   - (e) **Snipe**—Low Humic Eluviated Gleysol (Depression Podzol), loam and clay loam.
   - (f) **Goose**—Orthic Meadow, silty clay loam and clay.
   - (g) **Prestville**—Peaty Meadow (Thin Peat), silty clay loam and clay.
2. Yellowish brown, slightly calcareous, usually gravelly or stony, sandy loam and clay loam.
   - (a) **Demmitt**—Orthic Grey Wooded, sandy loam and loam.
   - (b) **Hythe**—Dark Grey Wooded (Degraded Black), sandy loam and loam.
   - (c) **Snipe**—Low Humic Eluviated Gleysol (Depression Podzol), loam and clay loam.

(d) **Goose**—Orthic Meadow, silty clay loam and clay.
(e) **Prestville**—Peaty Meadow (Thin Peat), silty clay loam and clay.

B. Soils Developed on Lacustro-till or Glacial-lacustrine Materials

1. Grey and dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam and clay.
   (a) **Donnelly**—Grey Wooded Solod (Solod to Solodized Solonetz), loam and clay loam.
   (b) **Esher**—Dark Grey Solod (Degraded Black Solod to Solodized Solonetz), loam and clay loam.
   (c) **Landry**—Black Solod (Solod to Solodized Solonetz), loam and clay loam.
   (d) **Snipe**—Low Humic Eluviated Gleysol (Depression Podzol), loam and clay loam.
   (e) **Goose**—Orthic Meadow, silty clay loam and clay.
   (f) **Prestville**—Peaty Meadow (Thin Peat), silty clay loam and clay.
2. Strata of grey and dark greyish brown clay loam and clay alternating with strata of yellowish brown sandy loam and clay loam that may be gravelly or stony.
   (a) **Hazelmere**—Grey Wooded Solod, loam and clay loam.
   (b) **Albright**—Dark Grey Solod, loam and clay loam.
   (c) **Snipe**—Low Humic Eluviated Gleysol (Depression Podzol), loam and clay loam.
   (d) **Goose**—Orthic Meadow, silty clay loam and clay.
   (e) **Prestville**—Peaty Meadow (Thin Peat), silty clay loam and clay.

C. Soils Developed on Lacustrine Materials

1. Grey and dark grey, slightly to moderately calcareous, somewhat saline, clay.
   (a) **Nampa**—Grey Wooded Solod (Solod to Solodized Solonetz), clay loam and clay.
   (b) **Falher**—Dark Grey Solod (Degraded Black Solodized Solonetz), clay loam and clay.
   (c) **Rycroft**—Black Solodized Solonetz, clay loam and clay.
   (d) **Kleskun**—Black Solonetz, clay loam and clay.
   (e) **Goose**—Orthic Meadow, silty clay loam and clay.
   (f) **Prestville**—Peaty Meadow (Thin Peat), silty clay loam and clay.
2. Brown, moderately calcareous, friable, silty clay loam and silty clay.
   (a) **Kathleen**—Orthic Grey Wooded, silt loam and silty clay loam.
   (b) **Judah**—Dark Grey Wooded (Degraded Black), silty clay loam and silty clay.
   (c) **Bronco**—Orthic Black, silt loam and silty clay loam.

D. Soils Developed on Alluvial and Aeolian Materials

1. Brown and yellowish brown, very calcareous, variable, silty materials.
   (a) **Toad**—Bisequa Grey Wooded, sandy loam and silt loam.
   (b) **Davis**—Orthic Grey Wooded, loam and silt loam.
   (c) **Tangent**—Dark Grey Wooded (Degraded Black), loam and silt loam.
   (d) **Codner**—Orthic Meadow, sandy loam and silt loam.
2. Brown and yellowish brown, moderately calcareous, variable, sandy materials.
   (a) **Sundance**—Bisequa Grey Wooded, loamy sand and sandy loam.

(b) **Culp**—Orthic Grey Wooded, loamy sand and sandy loam.
(c) **Leith**—Dark Grey Wooded (Degraded Black), loamy sand and sandy loam.
(d) **Codner**—Orthic Meadow, sandy loam and silt loam.

3. Brown and yellowish brown, slightly to moderately calcareous, fairly loose, sand.
   (a) **Heart**—Podzolic and Brunisolic loamy sand and sand.

4. Brown and pale brown, slightly calcareous, comparatively recent river flood plain materials.
   (a) **High Prairie**—Gleyed Black and Gleyed Dark Grey, sandy loam and clay loam.
   (b) **Enilda**—Orthic Meadow, sandy loam and clay loam.
   (c) **Alluvium**—Undifferentiated profiles occurring on the river flats and river benches.

5. Brown and pale brown, slightly calcareous, coarse and medium textured material that occurs as a mantle (not exceeding 30 inches), overlying other finer textured materials.
   (a) **Pinto**—Bisequa Grey Wooded, loamy sand and silt loam.
   (b) **Codesa**—Orthic Grey Wooded, loamy sand and silt loam.
   (c) **Belloy**—Dark Grey Wooded (Degraded Black to Black), sandy loam and loam.
   (d) **Peoria**—Eluviated Black (Black to Degraded Black), sandy loam and silt loam.
   (e) **Codner**—Orthic Meadow, sandy loam and silt loam.

E. Soils Devoloped on Coarse Outwash and Beach Materials

1. Brown and pale brown, gravelly or stony loamy sand and sandy loam.
   (a) **Nose**—Bisequa Grey Wooded, gravelly or stony loamy sand and sandy loam.
   (b) **Clouston**—Orthic Grey Wooded, gravelly or stony loamy sand and sandy loam.
   (c) **Codner**—Orthic Meadow, sandy loam and silt loam.

F. Soils Developed on Residual and Modified Residual Materials

1. Mainly brown and yellowish brown sandstone.
   (a) **Teepee**—Podzolic and Brunisolic, sandy loam and loam.

2. Mainly grey and greyish brown, saline, sandy shale.
   (a) **Debolt**—Grey Wooded Solodized Solonetz, clay loam.
   (b) **Valleyview**—Dark Grey Solodized Solonetz (Degraded Black to Black Solodized Solonetz), silt loam and clay loam.
   (c) **Kavanagh**—Black and Dark Grey Solonetz and Solodized Solonetz, clay loam.

G. Soils Developed on Organic Materials

1. Dark brown and black, fine peat developed mainly from sedges and coarse grasses.
   (a) **Eaglesham**—Fibrous (Sedge) peat.

2. Brown and dark brown, coarse peat developed mainly from sphagnum moss.
   (a) **Kenzie**—Sphagnum (Moss) peat.

Classification of Topography

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

The topographic classes, representing additional elements of the classification and mapping system are appended to Table 4. The classification of topography involves the appreciation of important variations in surface features. These include steepness of slope, and the shape and frequency of various slopes, which determine the comparative roughness of the surface. The more important types of topography have been grouped into five mapping units and these are indicated by appropriate symbols on the soil map. The relationship of these groups to the slope classes recommended by the National Soil Survey Committee is shown in Table 4. The overlapping indicates the range of slopes found in the topography classes referred to in this report.

About 64 percent of the mapped area is classed as level to undulating. This class includes the level areas, some of which are poorly drained, and those whose slopes are fairly uniform and rarely exceed 1 percent. The long smooth slopes may be broken at infrequent intervals by minor irregularities whose slopes do not exceed 2 percent.

The gently rolling areas are generally more irregular and often have a "humpy" appearance. The irregular portions have variable slopes, usually not exceeding 9 percent, whereas the smooth portions have slopes that rarely exceed 6 percent. Long, smooth slopes are characteristic of many of the gently rolling areas indicated on the soil map. Approximately 21 percent of the mapped area is classed as gently rolling.

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

Hilly land makes up about 2 percent of the mapped area. Such land is characterized by slopes that exceed 15 percent and is considered as non-arable.

Rough broken land makes up about 5 percent of the mapped area. It consists of the rough land that borders and forms the banks of drainage courses.

Mapping

Abbreviations and symbols are used to designate the predominant soil series and some of the characteristics of each of the areas outlined on the accompanying soil map. Rarely does one soil series occur to the practical exclusion of all other soil series. Soils having different profile types occur in close association throughout most of the mapped area. In some cases this is due to local differences in relief and drainage, while in others it is due to the close association of different parent materials. Donnelly and Esher soils are good examples of the former, whereas Judah and Davis soils are good examples of the latter association. Separation of such intimate mixtures was not always practical or possible on the scale of mapping used in this survey. Thus most of the soil areas outlined on the soil map consist of two and sometimes three series. The first named is believed predominant, and in naming the soil areas, only the dominant soil series are indicated. Those that make up less than about 20 percent of the outlined areas are rarely indicated in the area designations.

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

SOIL RATING

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

In view of the fact that most of the soil areas that appear on the soil map consist of more than one soil series, and that each of these series may have a different soil rating, it is necessary to indicate

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

Group 1. Pasture and Woodland (non-arable)	466,000
Group 4. Poor to Fair Arable Land	514,000
Group 5. Fair to Fairly Good Arable Land	487,000
Group 6. Fairly Good to Good Arable Land	429,000
Group 7. Good to Very Good Arable Land	198,000

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

In addition to the foregoing there has been some concern regarding the effects of elevation. Experience has shown that differences in elevation affect precipitation, moisture distribution, frost-free periods, and other factors significant to crop production. Lacking positive evaluation of this relationship, it is suggested that the soils at the higher elevations of the central and southern portions of this mapped area should have a somewhat lower productivity grouping. Thus for the purposes of this report, soils occurring at elevations greater than 2,700 feet in this region have received a lower rating than comparable soils at lower elevations.

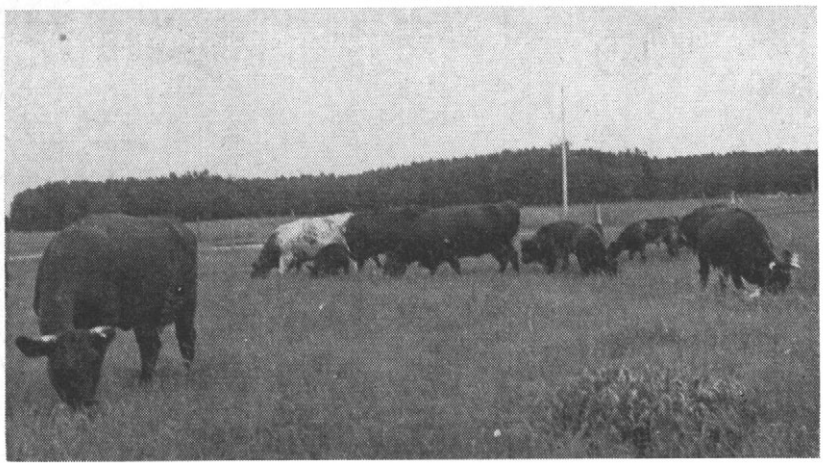


Figure 18—Cultivated pasture in a Saddle soil area near La Glace.

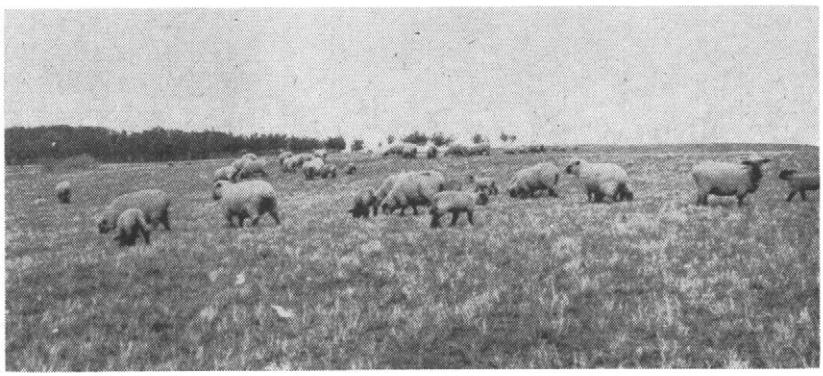


Figure 19—Grazing on stubble in a Demmitt soil area near Brainard.

DESCRIPTION OF SOILS

A. Soils Developed on Glacial Till

1. Yellowish brown and greyish brown, slightly calcareous, loam and clay loam.

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

(a) Hillburn Series—Orthic Grey Wooded loam and clay loam.

Extent and Occurrence: In the southern portion of the mapped area, there are about 45,000 acres in which Hillburn soils are predominant. They are found at the higher elevations in association with Braeburn soils.

Topography: Usually simple slopes varying in percent slope. Predominantly gently rolling and rolling.

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

Native Vegetation: Predominantly aspen poplar with varying mixtures of white spruce and pine.

Profile Description: Hillburn soils have a moderately thick, greyish, leached Ae horizon in which there are indications of the development of a Podzol sequence of horizons. Thus the upper portion of the Ae horizon is usually much lighter in color than the remaining portion of this horizon. This characteristic of the Ae horizon differentiates this soil from that of the Braeburn series. The following is a description of a Hillburn soil profile:

Horizon	*Thickness in inches*	*Description*
F-H (A_{00})	1	Very dark greyish brown (10YR 3/2 moist) semi-decomposed and decomposed leaf litter. pH. 6.4.
Ah (A_1)	1	Dark grey (10YR 4/1 moist) loam. Usually too thin to sample and often absent. pH 6.4.
Ae1 (A_{e1})	2	Grey (10YR 6/1 moist) silt loam, gritty, friable, fine platy structure. pH 6.4.
Ae2 (A_{e2})	3	Pale brown (10YR 6/3 moist) silt loam, gritty, friable, fine platy structure. pH 6.4.
Ae3 (A_{e3})	2	Pale brown (10YR 6/3 moist) silt loam, gritty, coarse platy structure. pH 6.4.
AB (B_1)	3	Brown (10YR 5/3 moist) clay loam, fairly loose, fine nuciform. pH 5.5.
Bt (B_2)	8	Brown (10YR 5/3 moist) grading to dark yellowish brown (10YR 4/4 moist) clay loam to clay, weakly prismatic, nuciform. pH. 4.7.
B-C (B_3)	8	Dark yellowish brown (10YR 4/4 moist) with occasional dark grey (10YR 4/1 moist) staining on cleavage faces, clay loam, coarse nuciform, containing occasional stones. pH 4.8.
C	at 28 below surface	Greyish brown (10YR 5/2 moist) with occasional rusty staining on the cleavage faces, clay loam, nuciform, frequently contains imbedded coal fragments. pH 6.5. Accumulations of lime are found usually at depths of 45 to 50 inches.

Soil Rating: Hillburn soils, occurring at the higher elevations and in rolling to hilly areas, are considered as non-arable.

Agricultural Use: These soils are not used for agricultural purposes. They should be withheld from cultivation.

(b) Braeburn Series—Orthic Grey Wooded, loam and clay loam.

Extent and Occurrence: There are about 268,000 acres in which Braeburn soils are predominant. They occur mainly in the central and southern portions of the mapped area on the higher elevations which might be the remnants of a former till plain. In the central portion, these higher remnants comprise the Saddle hills, a prominent feature in the relief of the mapped area.

Topography: Simple slopes, varying in degree of slope, are typical of these till areas. Approximately 27 percent of the Braeburn soils occur on undulating topography, 47 percent on gently rolling topography, 21 percent on rolling topography, and about 5 percent on hilly topography. The various topographic phases are indicated on the accompanying soil map.

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

Native Vegetation: Predominantly aspen poplar with varying mixtures of white spruce, pine, birch, and various shrubs.

Profile Description: Braeburn soils have a moderately thick, greyish, leached Ae horizon, and a yellowish brown to greyish brown, medium and fine textured B horizon. A lime concentration horizon occurs at depths of 36 to 48 inches. Occasional stones of variable size are found throughout the profile. The accompanying illustration (centrepiece) and the following description is typical of a Braeburn soil profile:

Horizon	*Thickness in inches*	*Description*
F-H (A_0)	1	Dark greyish brown (10YR 4/2 moist) to very dark brown (10YR 2/2 moist) semi-decomposed and decomposed leaf litter. pH 6.8.
Ah (A_1)	1	Greyish brown (10YR 5/2 moist) loam, little definite structure. Usually thin, often absent. pH 6.6.
Ae (A_2)	4	Light yellowish brown (10YR 6/4 moist) very fine sandy loam, fine to medium platy structure, friable consistence. Often gritty and may contain occasional iron concretions. pH 5.5.
AB (B_1)	3	Yellowish brown (10YR 5/4 moist) silt loam, nuciform structure, fairly loose consistence, somewhat porous. pH 5.2.
Bt (B_2)	10	Dark yellowish brown (10YR 4/4 moist) clay loam to clay, weakly columnar, nuciform, some dark grey (10YR 4/1 moist) staining on cleavage faces. pH 5.0
BC (B_3)	16	Dark yellowish brown (10YR 4/4 moist) to greyish brown (10YR 5/2 moist) loam to clay loam, with occasional pockets or streaks of sandy loam or silty clay loam, fairly loose consistence, fine to medium nuciform structure, occasional imbedded coal flecks. pH 5.5.
Ck (B_{Ca})	at 34-48 below surface	Greyish brown (10YR 5/2 moist) with occasional bands of dark grey (10YR 4/1 moist) clay loam to clay. Lime occurs in pockets or in small beds. pH 7.5.
C		Greyish brown (10YR 5/2 moist) to yellowish brown (10YR 5/4 moist) clay loam till. pH 6.8.

Soil Rating: The undulating to gently rolling phases of Braeburn soils are fair to fairly good arable land. The rolling phases are poor to fair arable land, while the hilly phases are non-arable.

Agricultural Use: Only a very small proportion of Braeburn soils are under cultivation at the present time. (See Cultivation Map, Fig. 4.)

Braeburn soils are relatively low in native fertility. As a result of the leaching process responsible for the formation of these soils, many of the soluble plant nutrients have been removed from the upper horizons and deposited in the lower horizons. Consequently the B horizons are generally better supplied with mineral plant nutrients than are the leached A horizons. In addition, the organic matter developed under a woodland vegetation is not as fibrous nor as stable as that developed under a grass cover. Thus, the addition of organic matter and the periodic applications of commercial fertilizer appear to be the prime requirements associated with the successful cropping of Braeburn soils.

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

(c) Saddle Series—Dark Grey Wooded, loam and clay loam.

Extent and Occurrence: Soils of the Saddle series predominate in about 1,000 acres of the mapped area. They occur on some of the better drained, sparsely wooded portions of the area, particularly in the vicinity of the Saddle hills in the central portion of the area.

Topography: Undulating to gently rolling topography consisting of long simple slopes.

Drainage: Well drained soils that in some cases may have a somewhat excessive run-off.

Native Vegetation: Parkland type of cover consisting mainly of grasses, shrubs, and fairly open stands of aspen poplar.

Profile Description: These soils have a well developed dark colored Ah horizon and a yellowish brown Ae horizon that is rarely more than 6 inches thick. In addition, the upper part of the B horizon is often more compact than that of Braeburn soils. The following is a description of a typical Saddle soil profile:

Horizon	*Thickness in inches*	*Description*
L–H (A_0)	1	Dark brown (10YR 3/3 moist) to very dark grey (10YR 3/1 moist) leaf litter. pH 7.0.
Ah (A_{11})	2	Dark brown (10YR 3/3 moist) to very dark grey (10YR 3/1 moist) loam, weakly prismatic, fine granular, loose consistence. pH 6.6.

Horizon	*Thickness in inches*	*Description*
Ahe (A_{1g})	2	Greyish brown (10YR 5/2 moist) loam, weakly prismatic, granular to nuciform, loose consistence. pH 5.6.
Ae (A_2)	3	Yellowish brown (10YR 5/4 moist) very fine sandy loam, friable consistence. Medium platy in the upper 2 inches to vesicular nuciform in the lower portion. pH 5.3.
AB (B_1)	3	Yellowish brown (10YR 5/4 moist) clay loam, nuciform, vesicular. pH 4.6.
Bt (B_2)	10	Dark yellowish brown (10YR 4/4 moist) to dark brown (10YR 4/3 moist) clay loam to clay, weak columnar, nuciform to blocky, firm consistence. pH 4.5.
BC (B_3)	10	Dark yellowish brown (10YR 4/4 moist) to brown (10YR 5/3 moist) clay loam, weak prismatic, blocky to nuciform, friable consistence. pH 5.1.
Ck (B_{Ca})	at 30-36 below surface	Brown (10YR 5/3 moist) to greyish brown (10YR 5/2 moist) clay loam, fine nuciform to blocky, friable, moderate lime content. pH 7.8.
C		Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam till. pH 7.0.

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

Agricultural Use: Most of the Saddle soil areas are under cultivation. (See Cultivation Map, Fig. 4.) Grain is the principal crop grown in these areas.

These soils are quite desirable for agricultural crop production. However, precautions should be taken to maintain their native fertility. Preference should be given to a mixed farming agriculture that includes legumes and grasses in the crop rotation. Many of these soils are found on sloping land that is subject to water erosion. Thus, the inclusion of organic matter on the surface and the elimination of cultivation up and down the slope should receive consideration.

(d) Sexsmith Series—Eluviated Black, loam and clay loam.

Extent and Occurrence: Relatively small areas, totalling approximately 1,000 acres, are found in the eastern portion of the mapped area in which Sexsmith soils are predominant. They are found in association with Saddle and Landry soils on some of the southern slopes adjacent to the Braeburn soil areas. No estimate is made of their occurrence in those areas in which they are not predominant.

Topography: Gently rolling and rolling.

Drainage: Well drained soils that in some cases may have a somewhat excessive surface run-off.

Native Vegetation: Parkland cover, consisting of grasses, sparse stands of aspen poplar, and various shrubs.

Profile Description: These soils have a well developed dark brown to very dark brown Ah horizon and a leached yellowish brown Ae horizon that is rarely more than 3 inches thick. The B and C horizons are similar to those previously described in this catena. The accompanying illustration (centrepiece) and the following description is typical of a Sexsmith soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	6	Very dark greyish brown (10YR 3/2 moist) to very dark brown (10YR 2/2 moist) silt loam, fine granular, friable. pH 6.1.
Ae (A_2)	2	Pale brown (10YR 6/3 moist) to light yellowish brown (10YR 6/4 moist) very fine sandy loam, fine platy in upper portion to vesicular nuciform in bottom portion, friable. pH 6.0.
AB (B_1)	2	Yellowish brown (10YR 5/4 moist) clay loam, nuciform, vesicular, somewhat firm. pH 5.0.
Bt1 (B_{21})	6	Dark greyish brown (10YR 4/2 moist) to dark yellowish brown (10YR 4/4 moist) clay, weak columnar, nuciform to blocky, firm. pH 5.6.
Bt2 (B_{22})	6	Dark yellowish brown (10YR 4/4 moist) clay loam to clay, nuciform to blocky, firm. pH. 5.6.
BC (B_3)	8	Brown (10YR 4/3) moist) to dark yellowish brown (10YR 4/4 moist) clay loam, nuciform to blocky, friable. pH 5.7.
Ck (B_{ca})	at 30-34 below surface	Greyish brown (10YR 5/2 moist) to brown (10YR 4/3 moist) clay loam, fine nuciform to blocky, friable, moderate lime. pH 7.2.
C		Greyish brown (10YR 5/2 moist) to brown (10YR 4/3 moist) clay loam, fine nuciform to blocky, friable, occasional imbedded coal flecks and stones. pH 7.0.

Soil Rating: Depending on topography, these soils rate as good to very good arable soils.

Agricultural Use: Most of the Sexsmith soil areas are under cultivation. (See Cultivation Map, Fig. 4.) Present agricultural use involves mainly grain crop production.

Sexsmith soils have a good reserve of mineral plant nutrients but consideration should be given to the maintenance of their native fertility. The curtailment of water erosion through contour cultivation and the return of organic material and nutrient elements should form part of the permanent management on these soils.

(c) Snipe Series—Low Humic Eluviated Gleysol, loam and clay loam.

Extent and Occurrence: Snipe soils are of common occurrence in the mapped area. However, comparatively few areas have been

outlined, approximately 41,000 acres, in which these soils predominate. No attempt is made to determine the extent of their occurrence in those areas in which they are of secondary significance. They are found in many of the low, poorly drained areas associated with soils developed on till and on other medium and fine textured parent materials.

Topography: Level and depressional.

Drainage: Poor, and may be ponded for varying periods.

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

Profile Description: Snipe soils are distinguished by a peaty horizon, and by a fairly thick, somewhat iron stained, Ae horizon. The rusty, iron staining is not usually apparent in the darker colored B horizon. The accompanying illustration (centrepiece) and the following description is typical of a Snipe soil profile:

Horizon	*Thickness in inches*	*Description*
L (A_{oo})	4	Dark brown (10YR 4/3 to 3/3 moist) peat. May be absent in burned over areas. pH 5.9.
H (A_o)	1	Very dark brown (10YR 2/2 moist) decomposed peat. pH 6.2.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) loam to silt loam, weak granular, friable. pH 5.6.
Aeg (A_{2g})	5	Light grey (10YR 7/2 moist) to very pale brown (10YR 7/4 moist) very fine sandy loam to silt loam, platy, friable, with some brownish colored (10YR 5/4 moist) mottling. pH 5.2.
ABg (B_{1g})	2	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay, nuciform, firm. pH 4.9.
Btg (B_{2g})	11	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay, fine blocky, firm, with a waxy or glazed appearance when dry. pH 5.3.
BCg (B_{3g})	11	Dark grey (10YR 4/1 moist) clay, nuciform, friable. pH 6.9.
Ck (B_{Ca})	at 32-36 below surface	Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam to clay, blocky, friable. pH 7.3.
C		Greyish brown (10YR 5/2 moist) to yellowish brown (10YR 5/4 moist) clay loam, till. pH 7.5.

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

Agricultural Use: Many of the larger areas of Snipe soils are not cultivated. Smaller areas that are associated with better drained soils are usually cultivated along with the better drained areas, if drainage has been sufficiently improved to permit such a practice.

However, the crops grown in the poorer drained areas are much slower in maturing when compared to those grown on the adjacent better drained soils. Heavy applications of manure, supplemented by occasional applications of phosphate fertilizer, have proven beneficial on Snipe soils.

In many of the areas the removal of tree cover by clearing or burning and the construction of roads has resulted in a marked improvement in drainage, and has permitted the development of these soils. However, even with the improved drainage, it is doubtful if grain crops can be grown successfully for several years after breaking. Grasses, legumes, and coarse grains should receive first consideration. The successful utilization of these poorly drained soils will depend on the results obtained in improving their physical characteristics and in improving their fertility status.

Much remains to be done in determining the best management practices for these and other poorly drained soils. Many farmers have had marked success with alsike clover on Snipe soils. The possibility of improving the quality of forage on poorly drained soils is receiving the attention of the Experimental Farm at Beaverlodge. Additional work of this nature is required to determine the successful utilization of these and other poorly drained soils.

2. Yellowish brown, slightly calcareous, usually gravelly or stony, sandy loam and clay loam.

Soils of the *Demmitt* and *Hythe* series are formed in the better drained positions on this till, which is somewhat coarser in texture and stonier than the till referred to in the previous section. Sandstone fragments, quartzitic gravels and stones are common to this till. It occurs in the west central and southwestern portion of the mapped area, mainly in slight ridges that have a northeast, southwest bearing. It is suggested that this till may be of western origin. Finer textured till or lacustro-till underlies this till at varying depths, usually within 60 inches. The Demmitt and Hythe soils were the only ones differentiated on this material. Soils formed in poorly drained positions have features similar to those developed on other parent materials. Soils of the Snipe, Goose, Prestville, Eaglesham, and Kenzie series are found in poorly drained areas that are associated with the better drained Demmitt and Hythe soil areas. In addition, Braeburn, Codesa, and Hazelmere soils are often found in close association with these soils in the mapped area. Following are descriptions of the two soil series formed on this parent material:

(a) Demmitt Series—Orthic Grey Wooded, sandy loam and loam.

Extent and Occurrence: In the western and southwestern portion of the mapped area there are approximately 148,000 acres in which Demmitt soils are of predominant occurrence. No estimate is made of their extent in areas in which their association with other soils is of minor significance. Demmitt soils are found on the till

plain remnants, slight ridges or knolls occurring at elevations of about 2,600 feet to 2,800 feet in the vicinity of Demmitt.

Topography: Approximately 35 percent of the Demmitt soil areas have undulating topography, 35 percent have a gently rolling topography, 27 percent have rolling topography, and about 3 percent have hilly topography. The slopes associated with the ridges, knolls, or crowns are usually uniform.

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

Native Vegetation: Mainly aspen poplar with varying mixtures of white spruce, pine, birch, and various shrubs.

Profile Description: Demmitt soils have a moderately thick, greyish, leached Ae horizon whose upper portion is often lighter in color. The finer textured B horizon is pale brown to brown in color, has occasional stones and sandstone fragments, and is usually somewhat coarser in texture than that of the Braeburn soil. Moderate concentrations of lime may occur at depths of 40 to 50 inches. The accompanying illustration (centrepiece) and the following description is typical of a Demmitt soil profile:

Horizon	*Thickness in inches*	*Description*
F (A_0)	1	Dark greyish brown (10YR 4/2 moist) to very dark brown (10YR 2/2 moist) semi-decomposed leaf litter. pH 6.2.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) loam, weak platy, friable. Often absent. pH 6.3.
Ae1 (A_{21})	3	Light grey (10YR 7/2 moist) very fine sandy loam to very fine sand, fine platy, friable. pH 6.1.
Ae2 (A_{22})	3	Pale brown (10YR 6/3 moist) very fine sandy loam, fine platy, friable. pH 5.9.
AB (B_1)	2	Brown (10YR 5/3 moist) loam, weak platy to nuciform, friable. pH 5.6.
Bt1 (B_{21})	6	Yellowish brown (10YR 5/4 moist) clay loam, fine to medium nuciform, firm. pH 5.4.
Bt2 (B_{22})	10	Greyish brown (10YR 5/2 moist) to brown (10YR 5/3 moist) clay loam, nuciform to blocky, firm. pH 5.3.
BC1 (B_{31})	6	Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam, nuciform to blocky, firm. pH 5.5.
BC2 (B_{32})	10	Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam, blocky, firm. Stones and sandstone fragments are common throughout the profile. pH 6.6.
Bk (B_{Ca})	at 42-48 below surface	Similar to above, with lime accumulation in pockets or in some of the root channels. pH 7.7.
C		Brown (10YR 5/3 moist) sandy clay loam till. pH 6.6.

Soil Rating: The undulating and gently rolling phases are fair to fairly good arable land. The stony phases and the steeply sloping phases are non-arable.

Agricultural Use: There is very little cultivation on Demmitt soils at the present time. (See Cultivation Map, Fig. 4.)

Similar considerations, as outlined for the Braeburn soils, should apply to Demmitt soils. Mixed farming and supplementary applications of commercial fertilizer should be considered in the agricultural development of these soils.

(b) Hythe Series—Dark Grey Wooded, sandy loam and loam.

Extent and Occurrence: There are about 1,000 acres in which Hythe soils are predominant. They occur in the central portion of the mapped area on the better drained, sparsely wooded slight ridges or knolls that are of common occurrence in this region.

Topography: Undulating to gently rolling topography, consisting of long simple slopes associated with the low ridges or knolls.

Drainage: Well drained soils that often have a somewhat excessive run-off.

Native Vegetation: Parkland vegetation consisting mainly of grasses, shrubs, and fairly open stands of aspen poplar.

Profile Description: These soils have a well developed dark colored Ah horizon. The remaining portion of the solum is brownish in color, and has occasional stones and sandstone fragments. Dark colored organic staining is common to many of the cleavage faces in the lower portion of the solum. Generally, Hythe soils are somewhat coarser in texture than Saddle soils. The accompanying illustration (centrepiece) and the following description is typical of a Hythe soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Very dark brown (10YR 2/2 moist) leaf litter. pH 6.8.
Ah (A_1)	3	Very dark greyish brown (10YR 3/2 moist) loam, platy, fine granular, friable. pH 6.4.
Ae (A_2)	3	Brown (10YR 5/3 moist) grading to pale brown (10YR 6/3 moist) in lower portion, sandy loam, platy, friable. pH 5.5.
AB (B_1)	1	Pale brown (10YR 6/3 moist) loam, nuciform, vesicular, friable. pH 5.3.
Bt1 (B_{21})	5	Brown (10YR 5/3 moist) clay loam, weak columnar, nuciform, firm. pH 5.0.
Bt2 (B_{22})	8	Brown (10YR 5/3 moist) to yellowish brown (10YR 5/4) moist) clay loam, nuciform to blocky, firm. Occasional dark grey (10YR 4/1) moist) staining on cleavage faces. pH 5.3.

Horizon	*Thickness in inches*	*Description*
BC (B_3)	7	Yellowish brown (10YR 5/4 moist) to dark yellowish brown (10YR 4/4 moist) sandy clay loam, blocky to coarse blocky, firm. Occasional dark grey (10YR 4/1 moist) staining on cleavage faces. pH 5.7.
C	6	Yellowish brown (10YR 5/4 moist) to dark yellowish brown (10YR 4/4 moist) sandy clay loam, coarse blocky. Occasional stones, and sandstone fragments occur in this till. pH 6.2.
IIC (D)	at 34 below surface	Dark greyish brown (10YR 4/2 moist) clay, nuciform, firm. Lime occurs in small pockets. pH 7.6.

Soil Rating: The undulating and gently rolling phases are good arable land whereas the rougher phases are fair to fairly good arable land depending on the variability and degree of slope.

Agricultural Use: The Hythe soil areas are under cultivation (see Cultivation Map, Fig. 4), producing a variety of crops. Considerable success has been experienced in the seed production of grass, legume, and grains.

These soils are quite desirable for agricultural purposes. Care should be given to the maintenance of fertility and to the prevention of soil erosion. In many areas, these soils occur on sloping land that is subject to water erosion. The inclusion of organic matter in the surface and the elimination of cultivation up and down the slopes should receive consideration in farm management.

B. Soils Developed on Lacustro-till

1. Grey to dark greyish brown, slightly to moderately calcareous, somewhat saline, clay loam and clay.

Lacustro-till is a heavy textured material that has the characteristics of both lacustrine and till materials. This dark colored material is generally fairly uniform, has a few stones, and may have lighter colored strata that consist of till-like material. In this mapped area, it was advisable to make a separation relating to the occurrence and thickness of the lighter colored sandy to silty till-like strata. The more uniform material, characterized by infrequent, thin strata, occurs at elevations of about 2,200 to 2,500 feet, and provides the parent material for *Donnelly, Esher,* and *Landry* soils that are developed in the better drained positions. In the poorly drained positions, soils of the Snipe, *Goose,* Prestville, Eaglesham, and Kenzie series are formed on this and on other somewhat similar parent materials.

The following are descriptions and illustrations of the principal soils formed on this material:

(a) Donnelly Series—Grey Wooded Solod, loam and clay loam.

Extent and Occurrence: Donnelly soils are found on the lower slopes of the till plain at elevations usually below 2,500 feet, and in the basins or valleys adjacent to the stream courses. Extensive areas of Donnelly soils are found in the northern portion of the

mapped area north of the Saddle hills. There are about 152,000 acres in which Donnelly soils are predominant. No estimate is made of the extent of their occurrence in the many areas in which they are not predominant.

Topography: Undulating to gently rolling topography that consists mainly of long, uniform slopes.

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

Native Vegetation: Mixed tree cover consisting predominantly of aspen poplar with varying mixtures of black poplar, white spruce, pine, willow, birch, alder, and various shrubs.

Profile Description: Donnelly soils usually have a thin Ah horizon, a grey, leached Ae horizon, and a grey to greyish brown, nuciform AB horizon. The remainder of the solum consists, in the upper portion, of a dark yellowish brown grading to dark grey brown clay that is plastic and firm. The lower part is often much darker colored and this change can be quite abrupt. The following is a description of a Donnelly soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) leaf litter. pH 6.7.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) loam to clay loam, little definite structure. This horizon may be absent. pH 6.0.
Ae (A_2)	3	Light yellowish brown (10YR 6/4 moist) very fine sandy loam, medium to coarse platy, friable. pH 5.4.
AB (B_1)	2	Light yellowish brown (10YR 6/4 moist) to brown (10YR 5/3 moist) loam to clay loam, nuciform, vesicular, friable. pH 4.9.
Bt1 (B_{21})	6	Dark yellowish brown (10YR 4/4 moist) clay, columnar, nuciform to blocky, firm to very firm. pH 5.1.
Bt2 (B_{22})	6	Dark yellowish brown (10YR 4/4 moist) grading to dark brown (10YR 3/3 moist) clay, blocky, firm. pH 5.4.
BC (B_3)	8	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) clay, blocky, firm. pH 6.2.
Ck (B_{ca})	at 24-36 below surface	Greyish brown (10YR 5/2 moist) to dark grey (10YR 4/1 moist) clay with occasional yellowish brown (10YR 5/4 moist) sandy clay loam strata that may be stony. Moderate lime content. pH 7.2.
Cs (B_{sa})		As above but with an accumulation of salts. pH 7.8.
C		Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay with occasional, relatively thin strata of yellowish brown (10YR 5/4 moist) sandy clay loam in which stones are common. pH 7.8.

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

Agricultural Use: A small proportion of the Donnelly soil areas is under cultivation at the present time. (See Cultivation Map, Fig. 4.) They are being used in grain and legume seed production with encouraging results.

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

Fertility experiments are being conducted on similar soils by the Beaverlodge Experimental Farm. These experiments indicate that a marked response can be obtained from the applications of phosphate fertilizers.

(b) Esher Series—Dark Grey Solod, loam and clay loam.

Extent and Occurrence: In the northern and central part of the mapped area there are approximately 67,000 acres in which Esher soils are predominant. They are found mainly in association with Donnelly, Landry, and Albright soils.

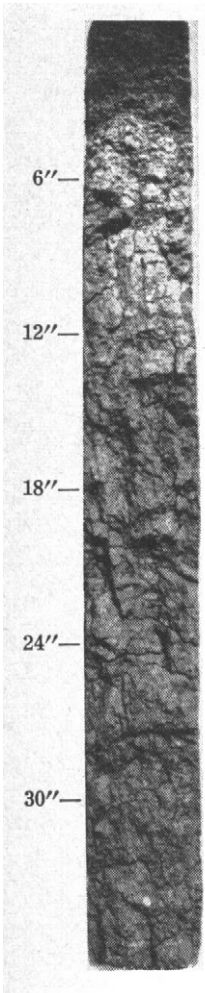
Topography: Undulating to gently rolling, consisting of long fairly uniform slopes that seldom exceed a gradient of 5 percent.

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

Native Vegetation: Apparently similar to that of the Donnelly soils, but not as dense and tending to parkland.

Profile Description: Esher soils are distinguished by their well developed dark colored Ah horizon that is usually 2 to 6 inches thick. The B horizon is often quite compact but will break fairly readily into fine blocky to nuciform aggregates. The illustration and the following description is typical of an Esher soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) to very dark greyish brown (10YR 3/2 moist) leaf litter. pH 7.3.
Ah (A_1)	4	Dark brown (10YR 3/3 moist) to brown (10YR 4/3 moist) silt loam to clay loam, weak prismatic, weak nuciform, friable. pH 5.7.
Ae (A_2)	3	Light yellowish brown (10YR 6/4 moist) silt loam to loam, platy in the upper portion, coarse platy and nuciform in lower portion, friable. pH 5.5.



Horizon	*Thickness in inches*	*Description*
AB (B_1)	3	Light yellowish brown (10YR 6/4 moist) to yellowish brown (10YR 5/4 moist) silt loam to silty clay loam, nuciform, vesicular, friable. Resemble the tops of old columns. pH 4.9.
Bt1 (B_{21})	5	Dark yellowish brown (10YR 4/4 moist) silty clay to clay, columnar, blocky to nuciform, very firm, cleavage faces stained dark brown (10YR 3/3 moist). pH 4.7.
Bt2 (B_{22})	6	Dark yellowish brown (10YR 4/4 moist) to dark brown (10YR 3/3 moist) clay, weak columnar to massive, blocky, very firm. pH 5.0.
BC (B_3)	10	Greyish brown (10YR 5/2 moist) to dark grey (10YR 4/1 moist) clay, weak massive, blocky to nuciform, firm. Occasional strata of stony, yellowish brown (10YR 5/4 moist) clay loam. pH 5.9.
Ck (B_{ca})	at 30–36 below surface	Greyish brown (10YR 5/2 moist) to dark grey (10YR 4/1 moist) clay loam to clay. Moderate lime content. pH 7.9.
C		Dark grey (10YR 4/1 moist) clay with occasional strata of greyish brown (10 YR 5/2 moist) to yellowish brown (10 YR 5/4 moist) clay loam, in which stones and salt pockets are of common occurrence. pH 8.1.

Soil Rating: Good arable soils.

Agricultural Use: Esher soils are among the more desirable soils of this area and are largely under cultivation. (See Cultivation Map, Fig. 4.)

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

(c) Landry Series—Black Solod, loam and clay loam.

Extent and Occurrence: There are approximately 77,000 acres in which Landry soils are predominant. They occur principally in the vicinities of Wembley, Beaverlodge, Halcourt, and La Glace in the central portion of the mapped area and Blueberry Mountain in the northern portion.

Topography: Undulating to gently rolling consisting of long uniform slopes that rarely exceed a gradient of 5 percent.

Drainage: Moderately to imperfectly drained soils found in well drained positions that may have an excessive surface run-off.

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

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

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	6	Very dark brown (10YR 2/2 moist) silt loam to clay loam, weak fine nuciform to granular, friable. pH 5.8.
Ae (A_2)	2	Dark greyish brown (10YR 4/2 moist) grading to yellowish brown (10YR 5/4 moist) silt loam, fine to medium platy, friable. pH 5.7.
AB (B_1)	2	Yellowish brown (10YR 5/4 moist) to brown (10YR 5/3 moist) clay loam, nuciform, vesicular, fairly firm, often occurs in loose clusters. pH 5.3.
Bt (B_2)	10	Dark yellowish brown (10YR 4/4 moist) to dark brown (10YR 3/3 moist) silty clay to clay, columnar, nuciform to blocky, very firm. Aggregates often have a waxy or glazed appearance. pH 6.2.
BC (B_3)	7	Very dark greyish brown (10YR 3/2 moist) and dark brown (10YR 3/3 moist) clay, coarse nuciform to blocky, firm. Pronounced horizontal cleavage is common. pH 6.3.
Ck (B_{ca})	at 26-36 below surface	Dark grey (10YR 4/1 moist) clay with occasional strata of yellowish brown (10YR 5/4 moist) sandy clay loam containing angular stones and moderate concentrations of lime. Salt concentrations are found in the lower part of this horizon. pH 7.8.
C		Dark grey (10YR 4/1 moist) clay and occasional strata of yellowish brown (10YR 5/4 moist) sandy clay loam till-like material. pH 7.8.

Soil Rating: Good to very good arable soils.

Agricultural Use: Landry soils are among the most productive soils in the mapped area and have been farmed since the beginning of settlement in this region. While grain is the principal crop produced on these soils increasing attention is being given to grass seed production. Landry soils occur in areas where outstanding success has been attained in producing creeping red fescue, Merion blue, and brome grass seed. However, increasing attention should

be given to the periodic inclusion of legume crops in the crop rotation. In addition, the maintenance of organic matter, the improvement of tilth and contour cultivation, should help in maintaining the productivity of Landry soils and will prevent the serious losses due to water erosion occurring on many of the slopes during spring run-off.

(d) Goose Series—Orthic Meadow, silty clay loam and clay.

Extent and Occurrence: Goose soils are of common occurrence in the poorly drained areas and are usually found in association with other poorly drained soils that are formed on medium and fine textured parent materials. Many of these areas are too small to be indicated on the accompanying soil map. In the outlined areas there are approximately 65,000 acres in which Goose soils are predominant.

Topography: Level and depressional.

Drainage: Poor and may be ponded for short periods.

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

Profile Description: Goose soils are variable with respect to the thickness of the surface horizons and the characteristics of the subsurface horizons. Usually the dark colored surface horizon is about 6 inches thick, has a fine granular structure, and may have some rusty staining, particularly in the lower portion. A portion of the grey, fine textured subsoil is usually yellowish in color, is quite sticky when wet and becomes very hard on drying. These soils are also found in old beaver meadows where more recent clay deposition may contribute to the thickness of the surface horizon. The accompanying illustration (centrepiece) and the following description is typical of a Goose soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark brown (10YR 3/3 moist) to very dark brown (10YR 2/2 moist) organic debris, often peaty. pH 5.6
Ah (A_1)	6	Very dark grey (10YR 3/1 moist) to black (10YR 2/1 moist) silt loam to silty clay loam, weak granular, friable in upper portion, grading to fine granular or shot-like, firm, in the lower portion. pH 5.9.
ABg (B_1)	10	Dark grey (10YR 4/1 moist) to very dark grey (10YR 3/1 moist) silty clay to clay, fine nuciform. The thickness of this horizon is quite variable and the coloring may occur as splotches or as streaks. pH 5.7.
Bg	10	Dark grey (10YR 4/1 moist) with yellowish brown (10YR 5/4 moist) mottles, silty clay to clay, massive, very sticky when wet and very firm when dry. Rusty, iron staining may be apparent throughout this horizon. pH 6.1.

Horizon	*Thickness in inches*	*Description*
BCg	4	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay with occasional yellowish brown (10YR 5/4 moist) mottles, massive, blocky, firm. pH 7.1.
C	at 30-36 below surface	Dark grey (10YR 4/1 moist) to very dark grey (10YR 3/1 moist) clay. On drying breaks into blocky fragments that are somewhat friable. pH 7.6.

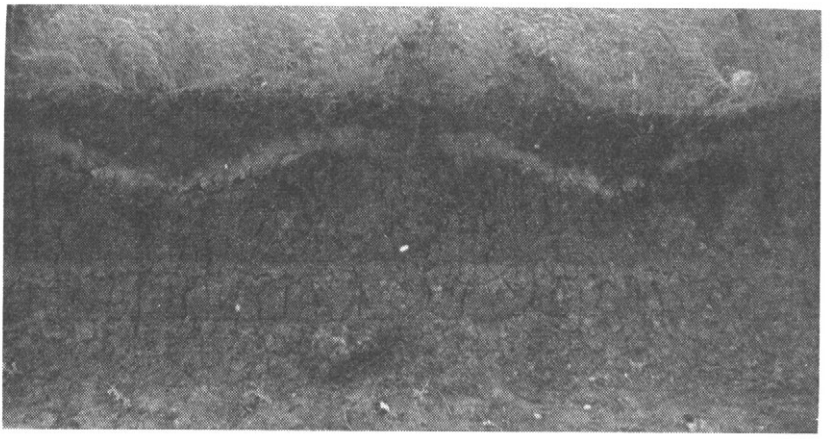


Figure 20—Landry soil profile in the vicinity of Wembley.

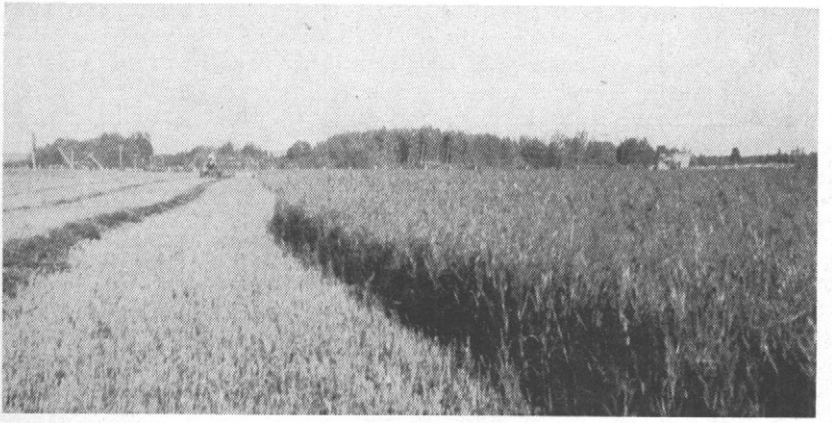


Figure 21—Brome grass in a Landry soil area near Beaverlodge.

Figure 22— Barley crop in a Donnelly soil area south of Whitburn.

Soil Rating: Goose soils are very good for pasture crop production, but until the drainage is improved they are not suitable for grain crop production.

Agricultural Use: Very little agricultural use is made of the Goose soils in the mapped area. Experience elsewhere has shown that such soils, even after draining, are "cold" and not immediately suitable for grain crop production. Considerable success has been obtained in growing alsike clover on these soils. In addition, after growing greenfeed, grasses and legumes for a few years the aeration and drainage is improved and coarse grains can then be grown to good advantage. In many cases the removal of native vegetation or the removal of the old beaver dams may be the major steps in improving the drainage of these soils.

2. Strata of grey and dark greyish brown clay loam and clay alternating with strata of sandy loam and clay loam that may be gravelly or stony.

This variable, stratified, lacustro-till is found in the west central portion of the mapped area at elevations greater than those common to the more uniform lacustro-till previously described. It generally occurs at elevations of 2,500 to 2,600 feet and is frequently found in association with the till in this region. This variable material consists of alternating strata that vary in thickness and may occur as thin bands resembling the varying typical of lacustrine deposits. When thick, the yellowish brown strata have stones and the material resembles till. It is suggested that this material may be characteristic of the deposition at the outer edges of the lacustro-till basin.

The soils formed on this material in the better drained positions are identified as the *Hazelmere* and *Albright* series. They differ from the previously described series in having a generally browner solum that may contain numerous stones. In the poorly drained positions, the soils have characteristics that are similar to those indicated in the foregoing sections.

The following are descriptions and illustrations of the principal soils formed on this material:

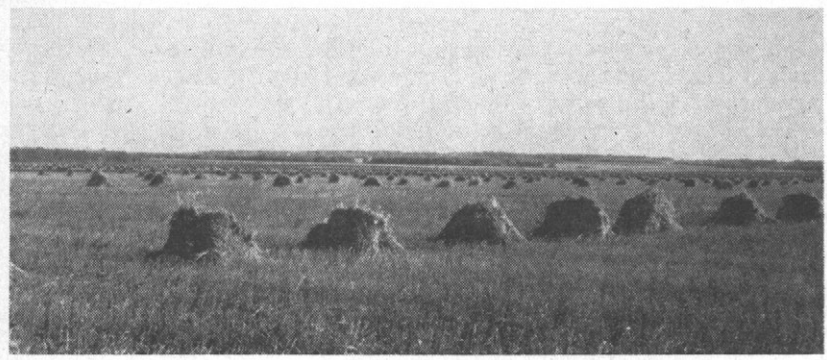


Figure 23—Oats in an Albright soil area near Hythe.

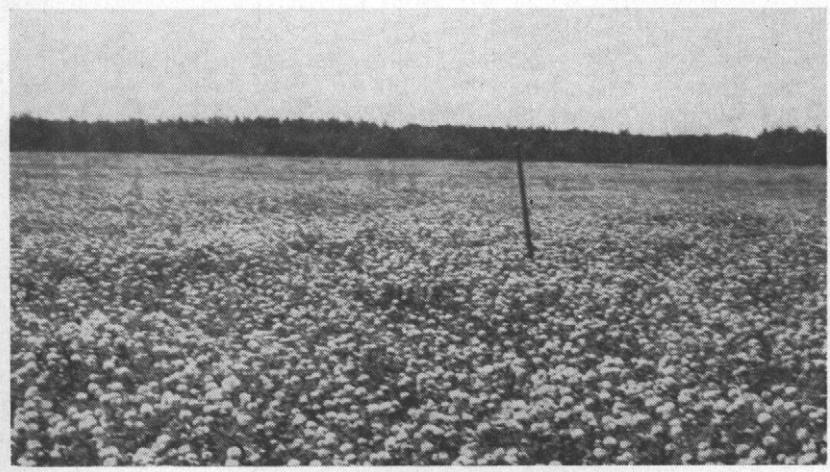


Figure 24—Alsike clover in a Hazelmere soil area near Elmworth.

(a) Hazelmere Series—Grey Wooded Solod, loam and clay loam.

Extent and Occurrence: In the western, central, and northern portions of the mapped area there are approximately 307,000 acres in which Hazelmere soils are predominant. They are found mainly in association with Demmitt, Codesa, and Donnelly soils and with various poorly drained soils at the upper elevations of the lacustro-till basin.

Topography: Undulating to gently rolling consisting mainly of long, uniform slopes.

Drainage: Imperfectly or somewhat poorly drained soils that have in some cases an excessive surface run-off.

Native Vegetation: Aspen poplar associated with varying mixtures of black poplar, white spruce, pine, willow, alder, birch, and various shrubs.

Profile Description: Hazelmere soils have a relatively thin organic surface horizon, may have a thin Ah horizon, and have a prominent leached Ae horizon that is usually about 4 inches thick. The remainder of the solum is mainly dark greyish brown to dark yellowish brown in color, is medium to fine textured, and the darker colored B horizon is fairly compact and firm. The accompanying illustration (centrepiece) and the following description is typical of a Hazelmere soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) to very dark greyish brown (10YR 3/2 moist) leaf litter. pH 6.4.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) loam to clay loam weak granular, friable. This horizon may be absent. pH 5.9.
Ae (A_2)	3	Light yellowish brown (10YR 6/4 moist) very fine sandy loam to silt loam, platy grading to coarse platy in the lower portion, friable. pH 5.7.
AB1 (B_{11})	2	Light yellowish brown (10YR 6/4 moist) to greyish brown (10YR 5/2 moist) silt loam to silty clay loam, coarse platy to coarse nuciform, vesicular, friable. Rusty stains or mottles are common in this horizon and in the lower portion of the preceding horizon. pH 5.6.
AB2 (B_{12})	2	Greyish brown (10YR 5/2 moist) silty clay loam, nuciform, friable to firm. pH 5.5.
Bt1 (B_{21})	5	Dark greyish brown (10YR 4/2 moist) clay, weak columnar, nuciform to fine nuciform, very firm. pH 5.4.
Bt2 (B_{22})	6	Dark greyish brown (10YR 4/2 moist) to dark brown (10YR 4/3 moist) clay, nuciform to blocky, very firm. pH 5.9.
BC (B_3)	7	Dark yellowish brown (10YR 4/4 moist) with occasional pockets or strata of dark grey (10YR 4/1 moist) to dark greyish brown (10YR 4/2 moist) clay to sandy clay, fine nuciform, firm. pH 7.0.
C	at 27 below surface	Strata of grey (10YR 5/1 moist) clay and yellowish to dark yellowish brown (10YR 4/4 moist) sandy clay loam in which small stones are of common occurrence. The strata are of varying thickness and lime accumulations are found in the upper portion of this horizon. pH 7.7.

Soil Rating: Hazelmere soils are fairly good arable soils.

Agricultural Use: Only a relatively small proportion of the Hazelmere soil areas are presently under cultivation. (See Cultivation Map, Fig. 4.) These soils are generally more stony than the Donnelly soils but should respond to the practices recommended for Donnelly soils. Crop rotations that include deep-rooted legume crops supplemented by applications of commercial fertilizers should be considered in the use of these soils for the continuing, profitable production of agricultural crops.

(b) Albright Series—Dark Grey Solod, loam and clay loam.

Extent and Occurrence: In the central portion of the mapped area, particularly in the vicinities of Beaverlodge, Albright, and Rio Grande, there are approximately 187,000 acres in which Albright soils are of predominant occurrence. They are found mainly in association with Esher, Landry, or Hythe soils.

Topography: Undulating to gently rolling topography consisting, generally, of long uniform slopes that rarely exceed a gradient of 5 percent.

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

Native Vegetation: Sparse woodland to parkland vegetation consisting of native grasses and shrubs with light stands or occasional bluffs of aspen poplar.

Profile Description: Albright soils differ from the Esher soils in having a somewhat browner solum and a more friable B horizon. While Albright soils usually have more stones, the stones do not occur in sufficient numbers to materially affect agricultural development. The following is a description of a typical Albright soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	5	Very dark greyish brown (10YR 3/2 moist) in upper portion grading to brown (10YR 4/3 moist) in the lower portion, silt loam to silty clay loam, weak fine granular, friable. pH 6.4.
Ae (A_2)	2	Light yellowish brown (10YR 6/4 moist) silt loam, fine platy, friable. pH 6.1.
AB (B_1)	1	Yellowish brown (10YR 5/4 moist) silty clay loam, coarse platy, nuciform, vesicular, friable. pH 6.1.
Bt1 (B_{21})	7	Greyish brown (10YR 5/2 moist) to brown (10YR 5/3 moist) silty clay loam to clay, weak columnar, nuciform, firm. pH 5.4.
Bt2 (B_{22})	5	Dark greyish brown (10YR 4/2 moist) to dark brown (10YR 3/3 moist) clay, blocky, very firm. pH 5.1.
BC (B_3)	5	Dark greyish brown (10YR 4/2 moist) and dark grey (10YR 4/1 moist) layers or patches, clay, blocky, firm, occasional small stones. pH 6.4.

Horizon	*Thickness in inches*	*Description*
C	at 25 below surface	Dark grey (10YR 4/1 moist) clay with lenses or strata of yellowish brown (10YR 5/4 moist) silt loam or sandy clay loam that are frequently stony. Lime accumulations occur in the upper portion of this horizon while salt accumulations occur at depths of 34 to 36 inches. pH 7.9.

Soil Rating: Good arable soils.

Agricultural Use: Albright soils are largely under cultivation in the mapped area. (See Cultivation Map, Fig. 4.) Considerable success has been experienced in the production of grasses, legumes, and grain crops. The maintenance of organic matter and the improvement of the permeability and structure of their subsoils are essential considerations to their continued successful cropping. As pointed out for the Esher soils, similar attention should be given to the prevention of loss by water erosion which is becoming a problem in many of these soil areas.

C. Soils Developed on Lacustrine Materials

1. Grey and dark grey, slightly to moderately calcareous, somewhat saline, clay.

Soils of the *Nampa, Falher, Rycroft, Kleskun,* and *Prestville* series are formed on this material in the mapped area. In addition, soils of the Snipe, Goose, Eaglesham, and Kenzie series are formed on this and on similar parent materials.

This fine textured material, while similar to that described as lacustro-till in the previous section, is generally more uniform, darker in color, and usually free of stones. It occurs at elevations rarely exceeding 2,200 feet and is found at the base of the lacustro-till areas adjacent to some of the lakes or major stream courses. The following is a description of the principal soil series formed on this parent material:

(a) Nampa Series—Grey Wooded Solod, clay loam and clay.

Extent and Occurrence: There are approximately 12,000 acres in which Nampa soils are of predominant occurrence. They are found mainly in the northwestern portion of the area in the vicinity of Bonanza. No estimate is made of their occurrence in association with Falher soils.

Topography: Level and depressional.

Drainage: Imperfectly to poorly drained.

Native Vegetation: Sparse woodland consisting of variable stands of aspen poplar, black poplar, willows, alders, with an understory often consisting of coarse grasses.

Profile Description: Similar to that of Donnelly soils except that the leached Ae horizon is usually thinner, and the B horizon is more compact and firmer and usually considerably darker in color.

The accompanying illustration (centrepiece) and the following description is typical of a Nampa soil profile:

Horizon	*Thickness in inches*	*Description*
L–H (A_0)	1	Dark brown (10YR 3/3 moist) leaf litter. pH 5.8.
Ah (A_1)	1	Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam, fine granular to nuciform, friable. May be absent . pH 6.3.
Ae (A_2)	2	Light brownish grey (10YR 6/2 moist) very fine sandy loam to silt loam, platy to coarse platy, friable. Iron staining is common in the lower portion of this horizon. pH 5.4.
AB (B_1)	3	Light brownish grey (10YR 6/2 moist) grading to light yellowish brown (10YR 6/4 moist) silt loam to silty clay loam, nuciform, vesicular, fairly firm. Aggregates often occur in clusters and may be the tops of former columns. pH 5.2.
Bt1 (B_{21})	6	Dark greyish brown (10YR 4/2 moist) to dark brown (10YR 4/3 moist) clay to silty clay, weak columnar, nuciform to blocky, very firm. pH 5.3.
Bt2 (B_{22})	6	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) clay, coarse nuciform to blocky, very firm. pH 5.6.
BC (B_3)	8	Dark grey (10YR 4/1 moist) clay, blocky to fine blocky, firm. pH 5.6.
Ck (B_{Ca})	at 27 below surface	Dark grey (10YR 4/1 moist) to very dark grey (10YR 3/1 moist) silty clay loam to clay, blocky to fine blocky, friable. Lime occurs in pockets or in thin silty strata when these are present. pH 7.6.
Cs (B_{SO_4})	at 33 below surface	As above but with gypsum accumulation. pH 8.0.

Soil Rating: Fairly good arable soils.

Agricultural Use: The Nampa soils in this area are largely under cultivation. (See Cultivation Map, Fig. 4.) They are used mainly for grain crop production but increasing emphasis is being given to grain-legume rotations.

These soils tend to be low in organic matter and have a relatively impermeable subsoil. Water penetration is slow and during heavy rains the surface of Nampa soil areas may be submerged for varying periods. Deep breaking, followed by the inclusion of deep-rooted legumes in the crop rotation should improve the structure and the permeability of these soils.

Field trials on Nampa soils are conducted at the Canada Illustration Station near McLennan. Substantial increases in yield have been obtained on crop rotation plots that have been treated by applications of nitrogen-phosphorus commercial fertilizers.

(b) Falher Series—Dark Grey Solod, clay loam and clay.

Extent and Occurrence: Falher soils occur mainly in the northern portion of the mapped area in the vicinities of Blueberry Mountain and Bonanza. There are approximately 49,000 acres in which Falher soils are predominant. They also occur in association with Nampa, Rycroft, and Judah soils.

Topography: Level to undulating.

Drainage: Imperfectly drained soils found in better drained positions than those of the Nampa soils.

Native Vegetation: Sparse woodland to parkland consisting of native grasses, willow, alder, and occasional bluffs of poplar.

Profile Description: Falher soils are distinguished by a well developed, dark colored surface horizon that is usually about 4 to 6 inches thick. There is usually an abrupt break between the A and B horizons and the Ae horizon is usually thinner or less distinct than that of the Esher soil. The following is a description of a typical Falher soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) leaf litter. pH 7.6.
Ah (A_1)	4	Dark brown (10YR 3/3 moist) to dark greyish brown (10YR 4/2 moist) silt loam to clay loam, granular, friable. pH 6.4.
Ae (A_2)	2	Yellowish brown (10YR 5/4 moist) to light yellowish brown (10YR 6/4 moist) very fine sandy loam to silt loam, platy to nuciform, friable. pH 5.3.
AB (B_1)	3	Greyish brown (10YR 5/2 moist) silt loam to silty clay loam, nuciform, vesicular, fairly firm. Aggregates have some dark brown staining. pH 5.5.
Bt1 (B_{21})	6	Dark greyish brown (10YR 4/2 moist) clay, columnar, nuciform to blocky, very firm. pH 5.7.
Bt2 (B_{22})	8	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) clay, massive, very firm. Aggregates have a waxed or glazed appearance. pH 7.2
BC (B_3)	6	Dark grey (10YR 4/1 moist) clay, massive, firm. pH 7.6.
Ck (B_{ca})	at 28-36 below surface	Dark grey (10YR 4/1 moist) clay with occasional silty laminae. Low to medium lime accumulation found in pockets in silty laminae. pH 8.0.

Soil Rating: Good arable soils.

Agricultural Use: Falher soils are largely under cultivation in the mapped area. (See Cultivation Map, Fig. 4.) Increasing attention is being given to the inclusion of legumes in the crop rotation.

Careful attention should be given to the management of these soils. Their friable surface soil is vulnerable to both wind and water

erosion, while the relatively impermeable subsoil may become waterlogged during periods of heavy precipitation. The improvement of the structure and the permeability of the subsoil is of prime concern and should be improved by the inclusion of deep-rooted legumes in the crop rotations.

(c) Rycroft Series—Black Solodized Solonetz, clay loam and clay.

Extent and Occurrence: There are several small areas, consisting of approximately 7,000 acres, in which Rycroft soils are of predominant occurrence. They are found in the vicinities of Bear lake, Blueberry Mountain, and Bonanza. In addition, they are often found in areas where Falher soils are predominant.

Topography: Level to undulating.

Drainage: Imperfectly drained soils that are found in better drained positions than those typical of Falher and Nampa soils.

Native Vegetation: Parkland vegetation consisting of native grasses, willow, alder, with occasional bluffs of poplar.

Profile Description: Rycroft soils are usually stone-free and have a darker solum than that of Landry soils. They are similar to Falher soils except that they have a dark colored Ah horizon and usually have a thin or indistinct leached Ae horizon.

The accompanying illustration (centrepiece) and the following description is typical of a Rycroft soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	6	Very dark brown (10YR 2/2 moist) to black (10YR 2/1 moist) silty clay loam, weak prismatic, fine granular, friable. pH 6.0.
AB (B_1)	2	Yellowish brown (10YR 5/4 moist) to brown (10YR 5/3 moist) silty clay loam to clay loam, nuciform, vesicular, fairly firm. Aggregates often occur in loose clusters and there may be a thin, platy, horizon in the upper portion of this horizon. pH 5.6.
Bt (B_2)	10	Very dark greyish brown (10YR 3/2 moist) to very dark grey (10YR 3/4 moist) clay, coarse columnar to massive, blocky, very firm. pH 6.4.
BC (B_3)	6	Dark grey (10YR 4/1 moist) to very dark grey (10YR 3/1 moist) clay, massive, blocky, very firm. Aggregates have a waxy or glazed appearance. pH 6.8.
Ck (B_{ca})	12	As above with occasional yellowish brown (10YR 5/4 moist) silty laminae. Moderate lime content, that may be found in the silty laminae or in pockets. pH 7.7.
Cs (B_{so_4})	at 36 below surface	As above with salt accumulation. pH 8.0.

Soil Rating: Very good arable soils.

Agricultural Use: The Rycroft soil areas are under cultivation in the mapped area. (See Cultivation Map, Fig. 4.) While grain-

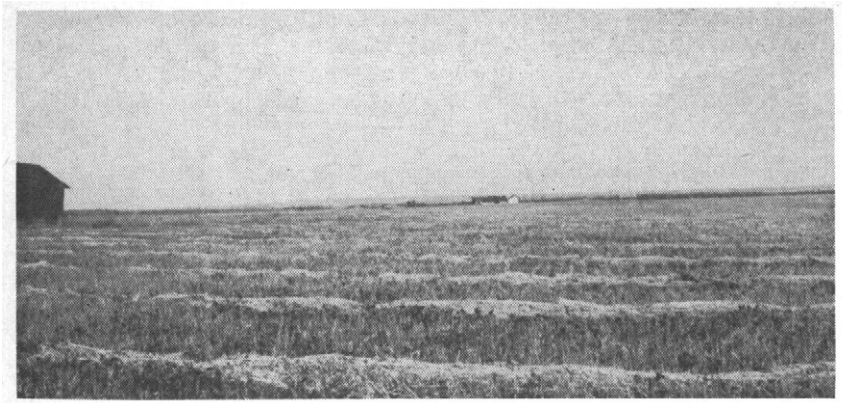


Figure 25—Swathed wheat in a Falher soil area near Bonanza.

summerfallow cropping has been followed, increasing attention is being given to the inclusion of legumes in the crop rotation. The improvement of tilth and the rate of percolation is of prime concern in the management of Rycroft soils.

(d) Kleskun Series—Black Solonetz, clay loam and clay.

Extent and Occurrence: Kleskun soils are of limited occurrence in the mapped area. They are found in small areas adjacent to Bear lake and in the vicinity of La Glace. They are also of patchy occurrence in association with Rycroft soils near Bear lake. In these areas there are about 3,000 acres in which Kleskun soils predominate.

Topography: Usually level and may be depressional.

Drainage: Imperfect to poor.

Native Vegetation: Parkland that consists of native grasses including coarse and salt grasses with willow, alder, and occasional bluffs of poplar.

Profile Description: Kleskun soils have a thin, dark colored A horizon, and a dark colored, columnar, fine textured B horizon. As compared to the Rycroft soils, they have a much shallower A horizon and very little or no greyish Ae or AB horizon. The following is a description of a typical Kleskun soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	2	Very dark greyish brown (10YR 3/2 moist) to very dark brown (10YR 2/2 moist) clay, fine granular. pH 6.0.
Bt1 (B_{21})	6	Very dark brown (10YR 2/2 moist) to black (10YR 2/1 moist) clay, columnar, nuciform to blocky, extremely firm. The darkly stained aggregates have a waxy or glazed appearance. pH 5.6.

Horizon	*Thickness in inches*	*Description*
Bt2 (B_{t2})	7	Very dark greyish brown (10YR 3/2 moist) clay, blocky, very firm with occasional dark grey stains on the cleavage faces and frequent root mats. pH 6.3.
BC (B_3)	6	Very dark grey (10YR 3/1 moist) grading to dark grey (10YR 4/1 moist) clay, blocky, firm with occasional root mats. pH 7.9.
Ck (B_{Ca})	at 20-24 below surface	Dark greyish brown (10YR 4/2 moist) clay, nuciform, firm with brown (10YR 4/3 moist) silty laminae or pockets that contain moderate lime accumulation. pH 7.8.
C		Dark grey clay (10YR 4/1 moist) clay, fine blocky, to nuciform, firm with brown (10YR 4/3 moist) silty laminae or pockets that contain accumulations of salts. pH 8.0.

Soil Rating: Fair to fairly good arable soils depending on surface drainage.

Agricultural Use: Kleskun soils, occurring on slopes that permit some surface drainage, are being farmed with some success in the mapped area. However, their extremely firm, dark colored subsurface horizon is relatively impermeable to both water and root penetration. Farmers have found, through experience, that cultivation must be made at a time when these soils are neither too wet nor too dry and that occasional deep plowing or the periodic rotation of deep-rooted legumes can improve the tilth of these soils.

(e) Prestville Series—Peaty Meadow, silty clay loam and clay.

Extent and Occurrence: Prestville soils are of common occurrence in many of the poorly drained areas. They are of predominant occurrence in approximately 91,000 acres in the mapped area. Numerous poorly drained areas are indicated in the accompanying map in which Prestville soils are of secondary significance. In such areas no estimate is made of the extent of their occurrence. They are associated with other poorly drained soils such as Goose, Snipe, and Eaglesham soils and are developed on medium and fine textured parent materials.

Topography: Depressional.

Drainage: Poor, and may be ponded during varying periods.

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

Profile Description: Prestville soils have an accumulation of peat that rarely exceeds a thickness of 12 inches. They have an Ah horizon but seldom an Ae horizon. The following is a description of a profile typical of the Prestville series:

Horizon	*Thickness in inches*	*Description*
L (A_{oo})	7	Brown (10YR 4/3 moist) to dark brown (10YR 3/3 moist) peat. pH 5.8.
F (A_o)	3	Dark brown (10YR 3/3 moist) semi-decomposed peat. pH 6.8.
Ah (A_1)	2	Very dark brown (10YR 2/2 moist) to black (10YR 2/1 moist) silt loam to clay loam, little definite structure. pH 7.2.
ABg (B_{1g})	1	Dark greyish brown (10YR 4/2 moist) clay loam, massive, firm. pH 7.4.
Bg (B_{2g})	6	Dark grey (10YR 4/1 moist) clay, massive, blocky, very firm, iron stained. pH 7.8.
BCg (B_{3g})	8	Grey (10YR 5/1 moist) clay, granular to shot-like and loose when dry. pH 7.6.
Ck (B_{ca})	at 26-30 below surface	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay, nuciform, friable, with moderate lime accumulation. pH 8.0.

Soil Rating: In their native state these soils are suitable for pasture. However, with improved drainage, they can be developed into good arable soils.

Agricultural Use: Prestville soils are among the first of the peaty soils to be cultivated. They do not have a deep accumulation of peat, and with their lack of tree cover they can be prepared for cropping very economically. However, after drainage, they are "cold" soils that are not immediately suitable for grain production. The general practice on such soils has been the cropping to oats, sweet clover, and other crops for feed during the first few years after breaking. With the increased aeration due to improved drainage, grain crops can be ripened and mixed farming has yielded satisfactory returns.

2.. Brown, moderately calcareous, friable, silty clay loam and silty clay.

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

These and other brown colored silty textured areas are often characterized by a humpy and dune-like topography consisting of irregular and variable slopes. Usually the slopes are short and from a distance the areas appear to be part of an undulating plain.

In some of the knolls of such areas stratification is much less apparent in the parent material, and it may be that some of these deposits have been reworked and deposited by wind. In recent studies* of the soils and vegetation of Alaska, somewhat similar topography is described and attributed largely to frost heaving. It may be that at some former time, conditions favorable to a similar phenomenon prevailed in the mapped area and found their best expression in some of the brown, friable, silty to very fine sandy deposits that are described in the following section.

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

(a) Kathleen Series—Orthic Grey Wooded, silt loam and silty clay loam.

Extent and Occurrence: There are about 3,000 acres in which Kathleen soils are of predominant occurrence. They are found in association with Nampa and Davis soils in the southern portion of the mapped area, mainly in the areas adjacent to the Wapiti river.

Topography: Generally quite variable, complex slopes, often humpy. Some of the knolls have depressed crowns that resemble doughnuts.

Drainage: Moderately well drained soils that may have a moderately high surface run-off.

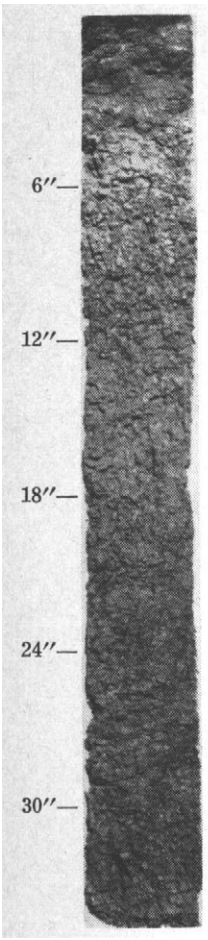
Native Vegetation: Mixed woodland in which aspen poplar is predominant.

Profile Description: Kathleen soils are distinguished by their pale brown Ae horizon and fine textured, brown B horizon. While the latter is often fairly compact in the upper portion, it is more friable and browner in color than that of either of the Nampa or Donnelly soils. The following description is typical of a Kathleen soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) to dark greyish brown (10YR 4/2 moist) leaf litter. pH 6.4.
Ahe (A_1)	2	Dark greyish brown (10YR 4/2 moist) to greyish brown (10YR 5/2 moist) loam, granular, friable. pH 5.0.
Ae (A_2)	2	Pale brown (10YR 6/3 moist) to light brownish grey (10YR 6/2 moist) very fine sandy loam to silt loam, platy, friable. pH 4.5.

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

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



Horizon	Thickness in inches	Description
AB (B_1)	2	Brown (10YR 4/3 moist) silt loam to silty clay loam, nuciform, firm, with light brownish grey (10YR 6/2 moist) coating on the sides of the aggregates. pH 4.4.
Bt (B_2)	8	Dark greyish brown (10YR 4/2 moist) to brown (10YR 4/3 moist) silty clay, nuciform to blocky, firm. pH 4.5.
BC (B_3)	6	Brown (10YR 4/3 moist) silty clay, blocky, fairly firm. pH 5.3.
Ck (B_{ca})	at 24-30 below surface	Dark grey (10YR 4/1 moist) silty clay and light yellowish brown (10YR 6/4 moist) silt loam to very fine sandy loam laminae that vary in thickness. Often the laminations may not be apparent, and the horizon consists of a mixture of grey and yellowish brown blocky aggregates. Lime concentration most apparent in the lighter colored portions. pH 7.5.

Soil Rating: Generally fairly good arable soil.

Agricultural Use: Some of the Kathleen soil areas are under cultivation (see Cultivation Map, Fig. 4) and are producing, mainly, coarse grain crops.

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

(b) Judah Series—Dark Grey Wooded, silty clay loam and silty clay.

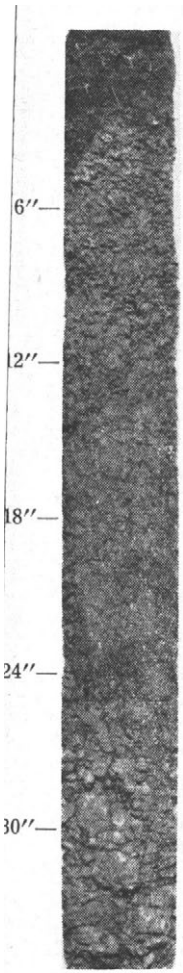
Extent and Occurrence: There are comparatively few areas (8,000 acres) in which Judah soils are of predominant occurrence. They are found in the vicinity of Bonanza, in the northwestern portion, and in the vicinity of the Wapiti river in the southern portion of the mapped area. They occur in association with Falher, Tangent, and Davis soils but no estimate is made of their extent in areas in which they are not predominant.

Topography: Generally quite variable, but an undulating to gently rolling somewhat humpy topography is typical of the larger areas of Judah soils.

Drainage: Well drained soils in which both the internal and external drainage is generally good.

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

Profile Description: Judah soils can be recognized by their brown colored surface horizon and a brown, friable, fairly fine textured, usually stone-free subsoil. The structural aggregates of the subsoil lack the cohesion typical of most of the previously described soils. There is usually a gradual greying of the lower part of the A horizon rather than a distinct Ae horizon. With respect to both their color and their structure they are unlike other Dark Grey Wooded soils of this area. The following description is typical of a Judah soil profile:



Horizon	*Thickness in inches*	*Description*
H (A_0)	1	Dark brown (10YR 3/3 moist) decomposed leaf litter. pH 7.4.
Ah (A_{11})	3	Dark brown (10YR 3/3 moist) to strong brown (7.5YR 5/6 moist) silt loam to silty clay loam, granular to fine granular, friable. pH 7.0.
Ahe (A_{12})	2	Yellowish brown (10YR 5/4 moist) very fine sandy loam to silt loam, fine granular, friable. pH 6.6.
AB (B_1)	6	Brown (10YR 3/3 moist) to dark yellowish brown (10YR 4/4 moist) silty clay loam, granular to nuciform, friable. pH 6.0.
Bt (B_2)	6	Dark yellowish brown (10YR 4/4 moist) silty clay loam to silty clay, nuciform, friable. Occasionally has thin, yellowish brown (10YR 5/4 moist) silty laminae. pH 7.2.
Ck (B_{Ca})	at 18-36 below surface	Brown (10YR 4/3 moist) to yellowish brown (10YR 5/4 moist) silty clay loam, nuciform, friable, frequently stratified; usually medium to high lime content. pH 8.1.
C		Greyish brown (10YR 5/2 moist) silty clay loam to silty clay, granular to nuciform, friable. Brownish yellow (10YR 6/6 moist) laminae of very fine sand or silt are often present. pH 7.9.

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

Agricultural Use: The areas in which Judah soils occur are largely under cultivation and cropped mainly to grain.

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

(c) Bronco Series—Orthic Black, silt loam and silty clay loam.

Extent and Occurrence: In the northwest and northeast portion of the mapped area Bronco soils are found in association with Falher and Rycroft soils. There are no areas in which Bronco soils are predominant.

Topography: Generally quite variable, usually gently rolling and rolling.

Drainage: Well drained soils that may have an excessive surface run-off.

Native Vegetation: Parkland consisting of native grasses, shrubs, and occasional bluffs of aspen poplar.

Profile Description: Bronco soil profiles have a distinct, very dark brown to black A horizon and a brown, friable, fine textured B horizon. Following is a description of a profile typical of the Bronco series:

Horizon	*Thickness in inches*	*Description*
Ah1 (A_{11})	3	Black (10YR 2/1 moist) silt loam, weak granular. pH 7.3.
Ah2 (A_{12})	5	Very dark grey (10YR 3/1 moist) to very dark greyish brown (10YR 3/2 moist) silt loam to silty clay loam, weak prismatic, fine granular, friable. pH 6.8.
AB (B_1)	4	Dark yellowish brown (10YR 4/4 moist) silt loam to silty clay loam, weak prismatic, fine granular to nuciform, friable. pH 6.5.
Bt (B_2)	8	Dark yellowish brown (10YR 4/4 moist) to brown (10YR 5/3 moist) silty clay loam, nuciform, firm. pH 6.6.
BC (B_3)	4	Dark yellowish brown (10YR 4/4 moist) to dark brown (10YR 4/3 moist) silty clay loam, fine nuciform, friable. pH 7.8.
Ck (B_{Ca})	at 24-36 below surface	As above with moderate concentration of lime. pH 7.8.

Soil Rating: Depending on topography, Bronco soils are good to very good arable soils.

Agricultural Use: Areas in which Bronco soils occur are under cultivation and cropped mainly to grain.

These soils are among the most productive soils in this region and every care should be given to maintain their native fertility.

D. Soils Developed on Alluvial and Aeolian Materials

These water and wind sorted deposits are found in association with water courses. They are often stratified. The strata are usually fairly thick and may consist of alternating beds of sand, silt, and clay. Some of the strata are cross-bedded, and it would appear that wind may have been at least partly responsible for sorting and depositing some of this material. These deposits often overlie till or lacustrine material and usually exceed a thickness of three feet. Frequently the best examples of the humpy, variable topography, attributed to frost action and referred to in the previous section, may be found in areas in which this variable parent material is predominant.

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

1. Brown and yellowish brown, very calcareous, variable, silty materials.

Toad, Davis, and *Tangent* soils are formed on this yellowish brown parent material. In addition, poorly drained soils of the Eaglesham, Kenzie, and Codner series can be formed on similar stratified material. The strata vary in thickness and consist mainly of silt and silty clay. Following are descriptions of the better drained soils formed on this variable material:

(a) Toad Series—Bisequa Grey Wooded, sandy loam and silt loam.

Extent and Occurrence: There are about 10,000 acres in which Toad soils are predominant. They occur in the southern portion of the mapped area adjacent to the Wapiti river. They are frequently found in association with Davis and Kathleen soils in this southern region.

Topography: Generally undulating to gently rolling, somewhat humpy.

Drainage: Moderately well drained.

Native Vegetation: Mixed forest consisting primarily of aspen poplar with varying mixtures of white spruce, pine, and shrubs.

Profile Description: Toad soil profiles are quite variable. They are medium to fine textured soils that have a brown colored solum. The stratified parent material is composed of alternating strata of

clay, silt, and occasional sand that vary considerably in thickness. However, Toad soils differ from the Davis and Kathleen soils mainly in the surface horizons. They are characterized by the development of a Podzol sequence of horizons within the Ae horizon of a Grey Wooded profile. (See centrepiece.) Following is a description of a typical Toad soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark brown (10YR 3/3 moist) organic debris. pH 6.4.
Ae (A_{2p})	5	Very pale brown (10YR 7/3 moist) very fine sandy loam to loam, fine platy in upper portion to platy in lower portion, friable. pH 6.2.
Bf (B_p)	3	Light yellowish brown (10YR 6/4 moist) to yellowish brown (10YR 5/4 moist) loam to silt loam, platy, friable. pH 5.9.
Ae (A_2)	4	Light yellowish brown (10YR 6/4 moist) in upper portion grading to pale brown (10YR 6/3 moist) in lower portion, silt loam, platy grading to coarse platy, friable. pH 5.8.
Bt1 (B_{21})	4	Brown (10YR 5/3 moist) silty clay loam to silty clay, weak columnar, nuciform, firm. pH 5.7.
Bt2 (B_{22})	8	Dark brown (10YR 4/3 moist) to dark yellowish brown (10YR 4/4 moist) clay, blocky to nuciform, firm to very firm. pH 6.7.
BCk (B_{Ca})	8	Dark greyish brown (10YR 4/2 moist) to greyish brown (10YR 5/2 moist) silty clay loam, nuciform to blocky, friable, with occasional sandy laminae or pockets. Moderate lime accumulation. pH 7.7.
C	at 34 below surface	Variable strata consisting of grey (10YR 5/1 moist) clay, light yellowish brown (10YR 6/4 moist) silt loam and brownish yellow (10YR 6/6 moist) sandy loam strata that usually do not exceed a thickness of 6 inches. The medium and fine textured strata predominate. pH 8.0.

Soil Rating: Toad soils on undulating to gently rolling topography rate as fair to fairly good arable soils.

Agricultural Use: At present, very little agricultural use is made of these soils in the mapped area. (See Cultivation Map, Fig. 4.)

These brown, friable, medium textured soils are vulnerable to both wind and water erosion. In addition they have a low content of organic matter, nitrogen, and phosphorus. Thus crop rotations that include legumes and grasses, supplemented by the periodic applications of nitrogen-phosphorus fertilizers, should be considered in the agricultural management of these soils.

(b) Davis Series—Orthic Grey Wooded, loam and silt loam.

Extent and Occurrence: Davis soils occur in some of the areas adjacent to the main stream courses. In the northern and the southern portion of the mapped area there are approximately 8,000 acres in which Davis soils predominate. They are usually found in association with Tangent, Judah, Kathleen, Toad, and Culp soils.

Topography: Usually gently rolling to rolling complex topography consisting of low, steep-sided knolls. In the depressional areas associated with this humpy terrain, poorly drained and Organic soils are of common occurrence. Depressions are also found in the central portion of the crowns on some of the knolls that are of common occurrence in Davis soil areas.

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

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

Profile Description: A brownish colored solum is typical of Davis soils. The upper portion is lighter in color than the lower portion and the darkest portion often occurs immediately above the lime accumulation horizon. (See centrepiece.) The stratified material consists of alternating strata of clay, silt loam, and loamy sand to sandy loam that vary in thickness. A solum that is predominantly silty is characteristic of these soils. The following is a description typical of a Davis soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark brown (10YR 3/3 moist) organic debris. pH 7.2.
Ah (A_1)	1	Brown (10YR 4/3 moist) loam to silt loam, little definite structure. This horizon is often absent. pH 7.0.
Ae (A_2)	3	Light brown (7.5YR 6/4 moist) to very pale brown (10YR 7/4 moist) very fine sandy loam, fine platy, very friable. pH 6.8.
AB1 (B_{11})	3	Pale brown (10YR 6/3 moist) silt loam to silty clay loam, nuciform, vesicular, friable. pH 6.4.
AB2 (B_{12})	8	Yellowish brown (10YR 5/4 moist) silt loam to silty clay loam, nuciform, friable. pH 5.6.
Bt (B_2)	6	Brown (10YR 4/3 moist) to strong brown (7.5YR 5/6 moist) silty clay, nuciform, firm (more compact than the horizon above). pH 6.5.
Ck (B_{Ca})	at 22-30 below surface	Light brownish grey (10YR 6/2 moist) silty clay and light yellowish brown (10YR 6/4 moist) silty and very fine sandy loam strata. Fairly high lime accumulation that often exceeds 12 inches in thickness. pH 8.2.
C		Light yellowish brown (10YR 6/4 moist) very fine sandy loam to silt loam in upper 8 inches. Remainder, very fine sandy loam to silt loam with occasional bands of silty clay or silty clay loam. pH 8.1.

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

Agricultural Use: These brown, friable, medium textured soils are being used for grain and forage crop production. However, they appear to have a low reserve of mineral plant nutrients and there is a marked crop response to applications of nitrogen-phosphorus fertilizers.

(c) Tangent Series—Dark Grey Wooded, loam and silt loam.

Extent and Occurrence: In the southern portion of the mapped area, adjacent to the Wapiti river, there are about 5,000 acres in which Tangent soils are predominant.

Topography: Undulating to gently rolling, usually with complex slopes.

Drainage: Well drained soils that may have an excessive surface run-off.

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

Profile Description: Compared to Davis soils, Tangent soils have a thicker and darker colored surface horizon. The prevailing brown color of the solum is a distinctive characteristic of these soils, and in that respect they are unlike other Dark Grey Wooded soils. The following is a description of a typical Tangent soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	3	Very dark brown (10YR 2/2 moist) to brown (10YR 4/3 moist) fine sandy loam to silt loam, little definite structure. A thin L-H horizon is usually found above this horizon. pH 7.7.
Ae (A_2)	2	Pale brown (10YR 6/3 moist) grading to very pale brown (10YR 7/3 moist) very fine sandy loam, fine platy. pH 7.5.
AB (B_1)	3	Light yellowish brown (10YR 6/4 moist) very fine sandy loam to silt loam, weak platy to fine granular, friable. pH 7.4.
Bt (B_2)	8	Yellowish brown (10YR 5/4 moist) to brown (10YR 5/3 moist) silt loam to silty clay loam, weak prismatic, nuciform, friable. Lower 2 to 3 inches often darker colored. pH 7.6.
Ck (Bca)	at 16-30 below surface	Grey (10YR 5/1 moist) to light brownish grey (10YR 6/2 moist) very fine sandy loam to silt loam. Fairly high lime content. pH 8.2.
C		As above, usually finely laminated or cross-bedded.

Soil Rating: Fairly good to good arable soils.

Agricultural Use: Most of the Tangent soils are under cultivation in this area. (See Cultivation Map, Fig. 4.) They are vulnerable

to both wind and water erosion. Fibre and organic matter are needed to bind the loose soil aggregates and to increase the water-holding capacity of these soils.

Figure 26—Apiaries are of common occurrence in the mapped area. The production of honey is assuming increased importance in this region.

2. Brown and yellowish brown, moderately calcareous, variable, sandy materials.

Sundance, Culp, Leith, and *Codner* soils are the dominant soils formed on this yellowish brown, stratified material. The sand to loamy sand strata are usually thick whereas the sandy clay or clay strata generally do not exceed a thickness of about 2 inches. The following is a description of the principal soils formed on this parent material:

(a) Sundance Series—Bisequa Grey Wooded, loamy sand and sandy loam.

Extent and Occurrence: There are about 7,000 acres in which Sundance soils are predominant. They are found in the southern portion of the mapped area often in close association with Toad, Culp, and Davis soils.

Topography: Variable, usually gently rolling.

Drainage: Well drained.

Native Vegetation: Woodland vegetation consisting of a variable mixture of aspen poplar, white spruce, and pine.

Profile Description: Sundance soils have a thick, leached surface horizon in which there is a Podzol sequence of horizons. In that respect they are similar to Toad soils. The underlying, finer textured B horizon occurs at varying depths. In an exposed road cut, this dark colored, thin horizon often appears as a continuous wavy band. The following is a description typical of a Sundance soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) leaf litter. pH 6.5.
Ae (A_{2p})	2	Light grey (10YR 6/1 moist) loamy sand to sand, weak fine platy, loose. pH 5.9.
Bf (B_p)	5	Yellowish red (5YR 5/6 moist) loamy sand to sand, very friable. pH 5.6.
Ae (A_2)	3	Yellowish brown (10YR 5/4 moist) grading to light yellowish brown (10YR 6/4 moist) loamy sand to sand, single grain, loose. pH 5.9.
Bt (B_2)	3	Yellowish brown (10YR 5/6 moist) sandy clay loam, fine nuciform, friable. pH 6.5.
BC (B_3)	10	Yellowish brown (10YR 5/4 moist) fine sandy loam, single grain, loose with occasional thin bands or pockets of finer textured materials that occur in weak nuciform clusters. pH 7.1.
Ck(ca)	at 24 below surface	Greyish brown (10YR 5/2 moist) loamy sand to sand, single grain, loose. pH 8.1. There is a fairly high lime accumulation in this horizon which occurs at depths varying from 20 inches to 40 inches.
C		Brown (10YR 5/3 moist) loamy sand to sand, single grain, loose, with occasional finer textured strata. pH 7.3.

Soil Rating: On uniform topography Sundance soils may be considered as poor to fair arable soils. However, areas characterized by a variable, gently rolling or rolling topography should be withheld from cultivation.

Agricultural Use: Sundance soils are not cultivated at the present time. Crop rotations that include legumes supplemented by the periodic applications of nitrogen-phosphorus fertilizer appear advisable in the successful agricultural use of Sundance soils.

(b) Culp Series—Orthic Grey Wooded, loamy sand and sandy loam.

Extent and Occurrence: In the southern portion of the mapped area, adjacent to the Wapiti river, there are about 12,000 acres in which Culp soils are predominant.

Topography: Generally variable, gently rolling to rolling.

Drainage: Well drained soils that may have excessive surface run-off.

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

Profile Description: Culp soils are brownish colored sandy soils that have a fairly well developed, compact, finer textured B horizon at depths of 12 to 18 inches below the surface. The accompanying illustration (centrepiece) and the following description is typical of a Culp soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_o)	1	Dark brown (10YR 3/3 moist) leaf litter. pH 7.0.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) loamy sand to sandy loam, weak structure. This horizon is often absent. pH 7.1.
Ae (A_2)	6	Light brownish grey (10YR 6/2 moist) grading to light yellowish brown (10YR 6/4 moist) loamy sand, loose. pH 6.8.
AB (B_1)	4	Light yellowish brown (10YR 6/4 moist) to yellowish brown (10YR 5/4 moist) loamy sand, weak structure but firmer than the preceding horizon. pH 6.1.
Bt1 (B_{21})	6	Yellowish brown (10YR 5/4 moist) to brown (10YR 5/3 moist) sandy loam to sandy clay loam, blocky, firm. pH 6.6.
Bt2 (B_{22})	6	Dark yellowish brown (10YR 4/4 moist) sandy loam to sandy clay loam, coarse blocky, with sand along the cleavage faces and in root channels. pH 6.7.
BC (B_3)	6	Yellowish brown (10YR 5/4 moist) sand to loamy sand with occasional clay loam laminae. pH 7.2.
Ck (ca)	at 26–40 below surface	Similar to the preceding horizon but with a moderate concentration of lime particularly in the finer textured laminae. pH 7.7.
C		Similar to above and quite calcareous. pH 7.8.

Soil Rating: Culp soils with a fairly uniform topography are rated as fair arable soils. Those with a variable, steeply sloping topography should be withheld from cultivation or seeded permanently to pasture.

Agricultural Use: Some of the Culp soil areas are under cultivation in this area. They respond favorably to mixed farming practices that include periodic applications of nitrogen-phosphorus fertilizer. However, careful management is required since these sandy soils are very vulnerable to wind erosion.

(c) Leith Series—Dark Grey Wooded, loamy sand and sandy loam.

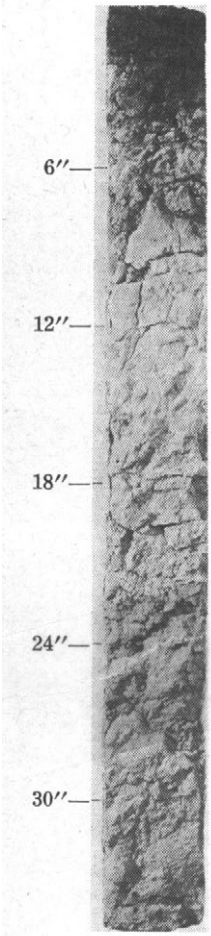
Extent and Occurrence: In the southern portion of the mapped area there are about 1,000 acres in which Leith soils are predominant. They occur in association with Davis, Culp, and Tangent soils and often with Meadow or Organic soils.

Topography: Generally variable, dune-like, undulating to gently rolling.

Drainage: Well drained to somewhat excessively drained soils.

Native Vegetation: Sparse woodland or parkland vegetation.

Profile Description: Leith soils are brownish colored, sandy soils that differ from the Culp soils in having a thicker and darker colored surface horizon. The following is a description of a Leith soil profile:



Horizon	Thickness in inches	Description
L-H (A_0)	1	Dark brown (10YR 3/3 moist) organic debris. pH 7.0.
Ah (A_1)	6	Brown (10YR 5/3 moist) to dark brown (10YR 4/3 moist) fine sandy loam, weak blocky. pH 7.6.
Ae (A_2)	6	Pale brown (10YR 6/3 moist) to light yellowish brown (10YR 6/4 moist) loamy sand, loose. pH 7.8.
Bt (B_2)	12	Yellowish brown (10YR 5/4 moist) to brown (10YR 5/3 moist) sandy loam to sandy clay loam, nuciform, friable. Has occasional sandy lenses. pH 7.6.
Ck (B_{ca})	at 25 below surface	Greyish brown (10YR 5/2 moist) very fine sandy loam. Fairly high lime content. pH 8.4. The depth to this horizon is quite variable.
C		Brown (10YR 5/3 moist) to yellowish brown (10YR 5/4 moist) loamy sand with occasional laminae of sandy or silty clay loam. pH 8.2.

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

Agricultural Use: Some of the Leith soil areas under cultivation and producing fairly satisfactory crops of grains, legumes, and grasses. Like other sandy soils, Leith soils are vulnerable to wind erosion and soil drifting is quite apparent in many of the cultivated areas.

(d) Codner Series—Orthic Meadow, sandy loam and silt loam.

Extent and Occurrence: In many of the low lying areas associated with the Leith, Culp, Davis, and Tangent soil areas and in some of the flood plains adjacent to stream courses there are about 13,000 acres in which Codner soils are predominant.

Topography: Level and depressional.

Drainage: Imperfectly to poorly drained.

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

Profile Description: Codner soils can be distinguished by their dark colored highly organic A horizons which are underlain by brownish colored coarse to medium textured B horizons in which rusty staining is of common occurrence. They differ from the Goose soils in being coarser textured and having a distinctly browner, more variable B horizon. Following is a description of a Codner soil profile:

Horizon	*Thickness in inches*	*Description*
F (A_0)	5	Very dark brown (10YR 2/2 moist) semi-decomposed peat. pH 6.8.
Ah (A_1)	5	Very dark grey (10YR 3/1 moist) to very dark greyish brown (10YR 3/2 moist) loam, weak granular, friable. Some firmness due to organic fibre. pH 6.4.
ABg (B_{1g})	4	Brown (10YR 5/3 moist) to yellowish brown (10YR 5/4 moist) loam to silt loam, weak granular. Some rusty staining. pH 6.4.
Bg (B_{2g})	12	Brown (10YR 5/3 moist) and greyish brown (10YR 5/2 moist) very fine sandy loam to loam, weak granular to nuciform, friable. Variable textures and colors occur in streaks throughout this horizon. Rusty staining is common. pH 6.9.
C		Patchy dark grey (10YR 4/1 moist) and yellowish brown (10YR 5/4 moist) sandy loam. This material is variable and may have occasional strata of silt loam or clay. Moderate lime accumulations occur at depths of 24 to 36 inches. pH 7.5.

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

Agricultural Use: Little use is being made of Codner soils in this area. Elsewhere considerable success has been experienced in the production of forage and alsike clover seed.

3. Brown and yellowish brown, slightly to moderately calcareous, fairly loose, sand.

Heart soils are the dominant soils formed on this wind and water sorted sand material which is found adjacent to some of the main drainage courses. It varies from fine to course sand and is sometimes underlain by finer textured materials at depths of 4 to 6 feet below the surface. This material is found mainly in the southern portion of the mapped area adjacent to the Wapiti river. It forms a part of a larger area, extending eastward of this region, that was described and illustrated in Alberta Soil Survey Report No. 18.

(a) Heart Complex—Podzolic and Brunisolic, loamy sand and sand.

Extent and Occurrence: In the southern portion of the mapped area there are about 49,000 acres in which Heart soils predominate. They occur in close association with Sundance, Culp, Pinto, and Organic soils. The presence of Organic soils often exceeds the proportion of Heart soils in much of this sand area.

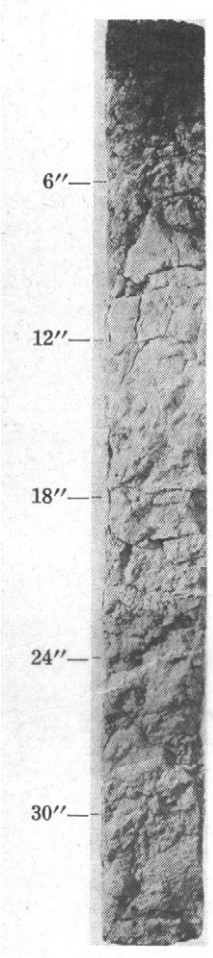
Topography: Undulating to rolling, consisting of complex slopes.

Drainage: Well drained to excessively drained soils.

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

are of common occurrence in the depressional, poorly drained portions of these areas.

Profile Description: Both Grey Wooded and Bisequa Grey Wooded profile types are found on sand in this area. Beyond recognizing the occurrence of both types, no attempts were made to make further series separations of the soils formed on this material. The following is a description of a soil profile that is commonly found in the well drained portions of this sand area. It is a Bisequa Grey Wooded profile which has a Podzol sequence of horizons in the upper portion of the solum and a finer textured accumulation, typical of Grey Wooded soils, in the lower portion of the solum.



Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Brown (10YR 4/3 moist) organic debris. pH 6.0.
Ae (A_{2p})	3	White (10YR 8/2 moist) to pinkish white (5YR 8/2 moist) grading in lower portion to light grey (10YR 7/2 moist) fine sand, single grain, loose. pH 5.6.
Bf (B_p)	7	Pale brown (10YR 6/3 moist) grading to brownish yellow (10YR 6/6 moist) in the lower portion, fine sand, weak blocky, very friable. pH 5.4.
Ae (C_p)	6	Light yellowish brown (10YR 6/4 moist) fine sand, loose and weak blocky. pH 5.6.
AB (B_1)	10	Very pale brown (10YR 7/3 moist) fine sand, loose and weak blocky with occasional soft aggregates of loamy sand to sandy loam. pH 5.7.
Btj (B_2)	13	Very pale brown (10YR 7/4 moist) fine sand to loamy sand with strong brown (7.5YR 5/6 moist) clusters of soft aggregates of loamy sand to sandy loam. Lime flecks are sometimes found in the lowest portion of this horizon. pH 6.4. Generally more pronounced lime accumulations occur at depths of about 48 inches.

Soil Rating: Heart soils are non-arable.

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

4. Brown and pale brown, slightly calcareous, comparatively recent river and flood plain deposited materials.

High Prairie and *Enilda* soils are formed on this parent material in the mapped area. These soils usually have weakly developed profiles in which there is little apparent evidence of horizons formed as the result of illuviation. However, there is a marked difference, particularly in the color and depth of the A horizons of the soils found on the upper and older terraces, compared with those found on the lower and most recent flood plains. The former are often darker colored as the result of a greater accumulation of organic matter. The following are descriptions of the principal soils formed on this comparatively recently deposited parent material:

(a) High Prairie Complex—Gleyed Black and Gleyed Dark Grey, sandy loam and clay loam.

Extent and Occurrence: There are about 6,000 acres in which High Prairie soils are of predominant occurrence. They are found on the flood plains associated with some of the stream courses in the eastern and southern portions of the mapped area.

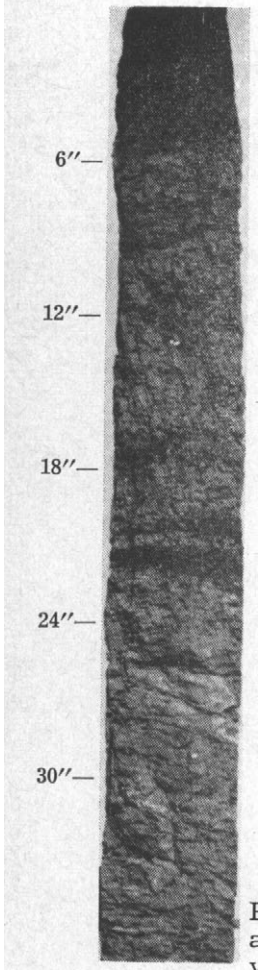
Topography: Level to gently undulating.

Drainage: Moderately well drained to somewhat poorly drained soils. Rusty staining is found at depths of 12 to 18 inches, and it would appear that periodically there is a fairly high water table in these soils.

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

Profile Description: High Prairie soils are quite variable. Some are coarse textured and others are fairly fine textured. The coarser textured members are found usually at slightly higher elevations adjoining the drainage courses. They are stone-free soils that have a brown to very dark brown surface horizon. The subsoil is brown in color and consists of stratified material that shows little evidence of horizon development. The following is a description of a medium textured High Prairie soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Dark brown (10YR 3/3 moist) to very dark brown (10 YR 2/2 moist) leaf and grass litter. pH 7.2.
Ah (A_1)	4	Dark greyish brown (10YR 4/2 moist) with splotches of dark grey (10YR 4/1 moist), silt loam, weak blocky, friable. pH 7.0.
Bm (B)	8	Brown (10YR 5/3 moist) to pale brown (10YR 6/3 moist) silt loam, weak fine blocky to nuciform, friable. Upper portion often splotched with dark grey (10YR 4/1 moist) stains. pH 6.3.



Horizon	Thickness in inches	Description
C and Cg		Pale brown (10YR 6/3 moist) to brown (10YR 5/3 moist) stratified material with little uniformity with respect to the thickness or the texture of the various strata. Buried horizons are common. The following are typical of these strata:—
	4	Brown (10YR 5/3 moist) to pale brown (10YR 6/3 moist) silt loam, weak nuciform, friable. pH 6.1.
	2	Brown (10YR 5/3 moist) very fine sandy loam to loam. pH 6.1.
	4	Brown (10YR 5/3 moist) to pale brown (10YR 6/3 moist) silt loam, weak nuciform, friable. pH 6.0.
	3	Pale brown (10YR 6/3 moist) silt loam, weak nuciform, friable, with frequent rusty stained streaks or splotches. pH 6.3.
	½	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) loam to silt loam. May be a buried A horizon. pH 6.8.
	3	Pale brown (10YR 6/3 moist) loam, weak nuciform, with numerous rusty streaks or mottles. pH 7.2.
	12	Pale brown (10YR 6/3 moist) very fine sandy loam to loam, iron stained, and may have some lime concretions. pH 7.6.

Soil Rating: Generally good arable soils.

Agricultural Use: Some of the larger areas of High Prairie soils are under cultivation in the mapped area and are producing a variety of crops. While very good yields are reported recent investigations indicate that a marked response can be expected from supplementary applications of nitrogen-phosphorus fertilizers at recommended rates.

(b) Enilda Series—Orthic Meadow, sandy loam and clay loam.

Extent and Occurrence: There are about 2,000 acres in which Enilda soils predominate. They are found in depressional, poorly drained positions frequently associated with or adjacent to areas of High Prairie soils.

Topography: Level to depressional, subject to periodic flooding.

Drainage: Poor, may be wet for considerable periods.

Native Vegetation: Coarse grasses, occasional sedges, and bluffs of willow and dwarf birch.

Profile Description: Except for a dark colored surface horizon there is little further evidence of horizon development in these soils. Below the dark colored surface the profile is greyish in color and consists of differing depositional strata that are usually iron stained. Occupying the lower or depressional position, Enilda soils usually are finer textured than High Prairie soils. The following is a description of an Enilda soil profile:

Horizon	*Thickness in inches*	*Description*
L (A_0)	1	Dark brown (10YR 3/3 moist) sedge peat. pH 7.2.
Ah (A_1)	3	Very dark brown (10YR 2/2 moist) with occasional grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) splotches, silt loam, weak nuciform, friable. pH 7.1.
Bg	3	Greyish brown (10YR 5/2 moist) silty clay loam, weak fine granular to nuciform, very friable. pH 6.5.
Cg	3	Light brownish grey (10YR 6/2 moist) silt loam, weak nuciform, friable, some iron staining. Thin, dark grey (10YR 4/1 moist) laminae separates this stratum from the upper and lower portions of this profile. pH 6.7.
	2	Grey (10YR 5/1 moist) silt loam, weak fine granular. pH 6.7.
	1	Dark grey (10YR 4/1 moist) loam. May be a buried A horizon. pH 6.4.
	5	Light brownish grey (10YR 6/2 moist) silty clay, weak blocky, friable. Thin mats of organic matter occur along some of the cleavage faces. Numerous iron stains. pH 6.3.
	8	Pale brown (10YR 6/3 moist) loamy sand, with considerable iron staining or mottling. pH 6.9.
	6	Pale brown (10YR 6/3 moist) silt loam and alternating strata of grey (10YR 6/1 moist) clay loam with occasional thin laminae of fine sand. pH 6.9.
	6	Grey (10YR 5/1 moist) silt loam strata and alternating strata of greyish brown (10YR 5/2 moist) very fine sandy loam, highly iron stained. pH 6.9.

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

Agricultural Use: Native hay is cut on many of the Enilda soil areas. On cultivation, early consideration should be given to crop rotations that include legumes and to the supplementary applications of commercial fertilizer.

(c) Alluvium—Undifferentiated river flat and river bench deposits.

Alluvium refers to material, deposited by water, that occurs on the terraces and flood plains in the river valleys. This material is of recent origin and has variable characteristics. Consequently

a wide variety of immature soils is found in these valleys. Many are similar to those of the High Prairie and Enilda soils, but since the valley flats are usually very variable in size and often badly cut up by oxbows and old stream courses, no attempt is made to delineate the various soils. Usually the soils in these flats are greyish brown to dark brown in color and vary in texture from a fine sandy loam to a silt loam. The subsoils are frequently sandy and sometimes gravelly. Since a wide variety of soils are found on this material and since differing conditions prevail respecting these areas, the following is a general description of the Alluvium indicated in the mapped area.

Extent and Occurrence: In the river flats adjoining the Wapiti, Red Willow, Beaverlodge, and Pouce Coupe rivers there are about 7,000 acres of Alluvium.

Topography: Usually level to undulating, often dissected by stream channels or oxbows.

Drainage: Variable—usually good, often excessive.

Native Vegetation: Variable. Some river flats have heavy tree cover consisting of black poplar, white spruce, and aspen poplar with a dense understory of willow and alders. Others have a parkland vegetation consisting of coarse grasses and scattered bluffs of poplar, willow, and alder.

Profile Description: Soils developed on Alluvium are quite variable. The following is a description of a profile found on one of the flats adjoining the Red Willow river.

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	6	Black (10YR 2/1 moist) grading to dark brown (10YR 4/3 moist) silt loam to very fine sandy loam, weak nuciform, some firmness due to organic fibre. pH 6.8.
C	18	Alternating strata of brown (10YR 5/3 moist) silt loam and yellowish brown (10YR 5/6 moist) very fine sandy loam. pH 5.7.
IIC (D)	at 24	Cobbly gravel.

Soil Rating: Usually fair to good arable soils.

Agricultural Use: While the larger, more uniform areas consist of agricultural land suitable to a variety of crops, the smaller and dissected areas are not particularly desirable. Moreover, many of these small areas appear to be extremely vulnerable to water and wind erosion. It would therefore seem desirable to exercise extreme caution in the agricultural use of many of these flats and benchlands.

5. Brown and pale brown, slightly calcareous, coarse and medium textured materials that occur as a mantle (not exceeding 30 inches) overlying other fine textured materials.

These deposits are about 12 to 24 inches thick and may be shallow beach or flood plain deposits. In many cases, the profiles

developed on this material are the thin counterparts of profiles developed on similar but deeper deposits. Thus the Peoria profile may resemble a thin phase Spirit River profile while the Codesa profile may resemble a thin phase Culp or Davis profile. The following are the principal soils developed on this relatively thin deposit.

(a) **Pinto Series—Bisequa Grey Wooded, loamy sand and silt loam.**

Extent and Occurrence: In the southern portion of the mapped area there are about 40,000 acres in which Pinto soils are predominant. They occur in association with Sundance, Culp, Davis, and Codesa soils.

Topography: Undulating to rolling topography consisting primarily of long simple slopes.

Drainage: Usually imperfectly drained soils in which drainage deficiencies are apparent in the horizon above the finer textured substratum.

Native Vegetation: Woodland vegetation consisting of variable stands of aspen poplar, white spruce, pine, and dense undergrowth of shrubs.

Profile Description: Pinto soils are sandy to silty and may be somewhat gravelly. They have a fairly thick, leached Ae horizon in which there is development of a Podzol sequence of horizons. At depths of 18 to 24 inches there may be a gravelly layer at the contact with the underlying finer textured material. Following is a description of a typical Pinto soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Very dark greyish brown (10YR 3/2 moist) leaf litter. pH 5.4.
Ae (A_{2p})	3	Light grey (10YR 6/1 moist) loamy sand to sandy loam, weak fine platy, loose. pH 5.5.
Bf (B_p)	5	Yellowish brown (10YR 5/6 moist) loamy sand to sandy loam, weak nuciform, very friable. pH 5.9.
BC (B_3)	6	Brown (10YR 5/3 moist) loamy sand, weak blocky to nuciform, very friable. Weakly stratified. pH 5.8.
C	4	Greyish brown (10YR 5/2 moist) loamy sand to sand, stratified, single grain. pH 5.7.
IIC (D)		Dark brown (10YR 4/4 moist) clay loam, coarse nuciform, friable, with occasional stones. pH 5.4.

Soil Rating: Generally fair arable soils.

Agricultural Use: Areas of Pinto soils are not under cultivation at the present time. They should respond to good management practices involving supplementary application of fertilizer.

(b) Codesa Series—Orthic Grey Wooded, loamy sand and silt loam.

Extent and Occurrence: There are about 123,000 acres in which Codesa soils are predominant. They are commonly associated with Braeburn, Demmitt, Donnelly, and Hazelmere soils, particularly on the sloping margins of these soil areas. No estimate is made of their extent in those areas in which Codesa soils are not of dominant occurrence.

Topography: Undulating to rolling topography consisting primarily of long simple slopes.

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

Native Vegetation: Woodland, consisting of variable mixtures of aspen poplar, white spruce, and pine with a dense undergrowth of native shrubs.

Profile Description: Codesa soils are sandy and may be gravelly or stony. They usually have a brownish grey to yellowish brown weakly developed profile that is underlain at depths of 12 to 30 inches by a different, finer textured material. (See centrepiece.) There may be a gravelly layer at the contact with this underlying material. Following is a description of a profile typical of the Codesa series:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark brown (10YR 3/3 moist) organic debris. pH 6.1.
Ah (A_1)	1	Light brownish grey (10YR 6/2 moist) loam to sandy loam, little definite structure, very friable. This horizon is often absent. pH 6.4.
Ae (A_2)	4	Light yellowish brown (10YR 6/4 moist) loamy sand to fine sandy loam, weak platy, very friable. pH 5.3.
BC	10	Yellowish brown (10YR 5/4 moist) loamy sand to sandy loam, weak blocky to nuciform, friable, occasionally stratified. Gravel lenses or stones may occur, particularly in the lower portion. pH 5.0.
IIC (D)	at 17 below surface	Dark greyish brown (10YR 4/2 moist) clay loam, blocky, firm to very firm. Accumulations of lime are found at depths of 30 to 36 inches. pH 7.0.

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

Agricultural Use: Some of the Codesa soil areas are under cultivation and producing satisfactory crops. (See Cultivation Map, Fig. 4.) It is essential in the management of these soils that the fibre and organic matter be maintained. These loose sandy upper deposits have a lower fertility reserve than the finer textured, compact substratum. Deep-rooted legumes should improve the tilth of the substratum and replenish the supply of plant nutrients in the upper, coarse textured material. Supplementary applications of fertilizer

may also be beneficial in establishing a mixed farming agriculture on these soils.

(c) Belloy Series—Dark Grey Wooded, sandy loam and loam.

Extent and Occurrence: There are several areas, making up a total of about 4,000 acres, in which Belloy soils are predominant. They are found mainly in the east-central portion of the mapped area in association with Landry and Sexsmith soils.

Topography: Undulating to rolling topography consisting of long simple slopes.

Drainage: Imperfectly drained soils due to the presence of an impervious substratum at a relatively shallow depth.

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

Profile Description: Belloy soils are generally more variable than Peoria soils, and frequently have gravelly lenses and stones. The depth to the underlying finer textured substratum is quite variable and gravel or stones occur at the contact. Following is a description typical of a Belloy soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Very dark brown (10YR 2/2 moist) organic debris. pH 7.8.
Ah (A_1)	6	Very dark brown in the upper part grading to brown (10YR 5/3 moist) in the lower part, loam to sandy loam, weak prismatic, friable. pH 7.0.
Ae (A_2)	3	Light yellowish brown (10YR 6/4 moist) sandy loam, weak platy, very friable. pH 5.8.
BC	6	Yellowish brown (10YR 5/4 moist) sandy loam to loam, weak blocky, with occasional lenses of gravel or stones. Gravelly layer occurs at contact with the underlying material. pH 6.3.
IIC (D)		Dark greyish brown (10YR 4/2 moist) clay loam, blocky, firm. Lime accumulations occur at depths of 24 to 30 inches. pH 7.4.

Soil Rating: Depending on the amount of gravel or stones, Belloy soils are fair to good arable soils.

Agricultural Use: In many areas Belloy soils are under cultivation producing satisfactory crops. These sandy soils are vulnerable to wind erosion and consideration should also be given to the improvement of the tilth of the underlying, fine textured substratum.

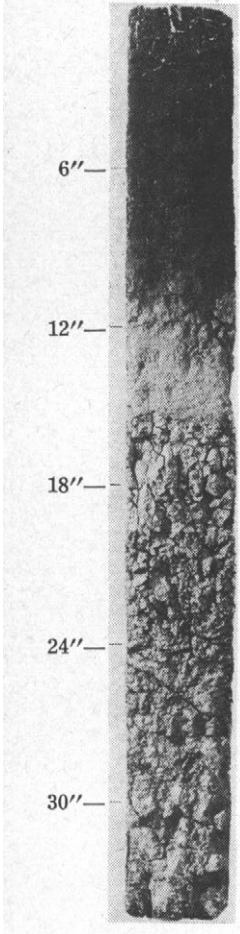
(d) Peoria Series—Eluviated Black, sandy loam and silt loam.

Extent and Occurrence: Peoria soils are found mainly in association with Landry soils in the vicinity of Wembley. While there are approximately 7,000 acres in which Peoria soils are predominant no estimate is made of their extent in areas in which they are not dominant.

Topography: Mainly undulating. long simple slopes.

Drainage: Generally moderately well drained soils whose finer textured substratum tends to restrict the drainage.

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



Profile Description: A dark colored profile developed on sandy to silty, fairly uniform material that is underlain at depths of 12 to 24 inches by a finer textured substratum. The following is a description of a medium textured Peoria soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	6	Very dark brown (10YR 2/2 moist) grading to dark brown (10YR 4/3 moist) loam, weak prismatic, very friable. pH 6.7.
B	6	Dark yellowish brown (10YR 4/4 moist) grading to yellowish brown (10YR 5/4 moist) silt loam to very fine sandy loam, weak blocky, friable. pH 6.7.
C1	6	Brown (10YR 5/3 moist) fine sandy loam, weak blocky, friable. pH 7.5.
C2g	8	Strong brown (7.5YR 5/6 moist) in upper portion, reddish brown (5YR 5/4 moist) in lower portion, loamy sand, iron stained. pH 8.0.
IIC (D)	at 26 below surface	Dark grey (10YR 4/1 moist) clay, mottled and iron stained. Varved with lime accumulation at 30 inches. pH 8.2.

Soil Rating: Usually good to very good arable soils.

Agricultural Use: Most of the Peoria soils are being used for grain crop production. While the fine textured substratum tends to improve the moisture-holding capacity of the deeper Peoria soils, it may restrict water and root penetration when it occurs within depths of about 18 inches below the surface. Deep-rooted legumes that will penetrate this substratum should improve this soil.

E. Soils Developed on Coarse Outwash and Beach Materials

These materials are coarse textured and gravelly or stony. They are found as islands of varying size in association with some of the till areas or along some of the lower slopes of these areas or on the shoreline of the laking or flood plain basins. Soils of the *Nose* and *Clouston* series are formed on this material in the mapped area. They are usually sandy and may be gravelly or stony. Their subsoil may contain thick gravel lenses or may consist of a deep deposit

of gravel and cobble stones. The following are descriptions of the principal soils found on this type of parent material:

(a) Nose Series—Bisequa Grey Wooded, gravelly or stony loamy sand and sandy loam.

Extent and Occurrence: In the southern portion of the mapped area there are about 6,000 acres in which Nose soils are predominant. They are found in association frequently with Clouston soils and occasionally with Demmitt and Hazelmere soils. Only the larger areas have been indicated on the accompanying soil map.

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

Drainage: Usually well drained to excessively well drained soils.

Native Vegetation: Woodland consisting of varying mixtures of aspen poplar, pine, and white spruce.

Profile Description: Nose soils are gravelly or stony soils that have a relatively thick leached surface horizon in which there is a development of a Podzol sequence of horizons. The following is a description typical of a Nose soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark greyish brown (10YR 4/2 moist) organic debris.
Ae (A_{2p})	4	Very pale brown (10YR 7/3 moist) loamy sand to sandy loam, somewhat gravelly, weak platy.
Bf (B_p)	8	Reddish brown (5YR 5/4 moist) sandy loam to loamy sand, cobbly, very friable.
Ae (C_p)	3	Pale brown (10YR 6/3 moist) loamy sand, gravelly.
BC	12	Light yellowish brown (10YR 6/4 moist) to yellowish brown (10YR 5/4 moist) gravelly loamy sand with occasional pockets or lenses of sandy loam to loam.
C		Yellowish brown (10YR 5/4 moist) gravelly and stony loamy sand to sand.

Soil Rating: Generally non-arable soils.

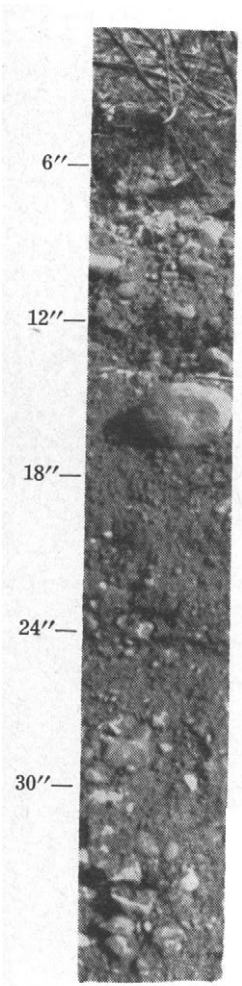
Agricultural Use: Nose soils are inferior agricultural soils. They are not cultivated in the mapped area and should be maintained in their native state. In some areas the development of gravel pits may be of commercial importance.

(b) Clouston Series—Orthic Grey Wooded, gravelly or stony loamy sand and sandy loam.

Extent and Occurrence: There are about 6,000 acres in which Clouston soils are predominant. They are found in relatively small areas in or associated with till and lacustro-till areas.

Topography: Variable, consisting of low knolls, ridges or long uniform slopes.

Drainage: Well drained to excessively well drained soils.



Native Vegetation: Woodland consisting of various mixtures of aspen poplar, black poplar, and willow.

Profile Description: Clouston soils are gravelly or stony soils that have a leached profile similar to that of other Grey Wooded soils. They usually have a lime accumulation horizon within 48 inches of the surface. The following is a description of a Clouston soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Very dark greyish brown (10YR 3/2 moist) leaf litter. pH 7.4.
Ah (A_1)	1	Brown (10YR 5/3 moist) coarse sandy loam, stony, weak blocky. pH 7.2.
Ae (A_2)	3	Pale brown (10YR 6/3 moist) coarse loamy sand, weak platy. pH 5.3.
B	24	Yellowish brown (10YR 5/4 moist) coarse sandy loam to loamy sand. Weak structure but slight compaction. Gravelly and stony. pH 6.0.
Ck (B_{ca})	at 30	As above but with lime accumulation, particularly on the undersides of the stones or pebbles. pH 7.0.
C		Yellowish brown (10YR 5/4 moist) gravelly and stony loamy sand.

Soil Rating: Generally poor to fair arable soils.

Agricultural Use: Soils with gravelly subsoils are droughty since they have a low water holding capacity. They also have a low fertility reserve. If the gravel and stone accumulation occurs at or near the surface such soils are not suited for crop production. If the gravel occurs at depths greater than about 12 inches and the topography is suitable such soils may be fair arable soils. Commercial gravel pits occur in some of the Clouston soil areas.

F. Soils Developed on Residual and Modified Residual Materials

There are several types of parent material in the mapped area that are derived directly from bedrock or from disturbed bedrock material. Thus reddish colored soils are developed from reddish shale near Blueberry Mountain, and gravelly soils from conglomerate rock exposed south of Bay Tree. However, areas of such soils were too small to be indicated on the accompanying soil map. In other, larger areas, soils have been developed on brown sandstone and greyish colored sandy shale. In the Saddle hills and in the till areas of the southern portion of the mapped area there are outcrops of yellowish brown sandstone on the faces of some of the steep

slopes. The soils formed in such areas have a distinct yellowish brown color and have pieces of sandstone throughout their profiles. In the vicinities of Hythe, Valhalla, and Saskatoon mountain there are exposures of greyish brown sandy shale. Soils developed on such saline shale or on materials containing a significant proportion of this saline bedrock material have pronounced Solonetzic soil characteristics.

1. Mainly brown and yellowish brown sandstone.

Teepee soils are formed on this sandstone or on materials that have a high proportion of weathered sandstone. They are found on many of the steeper slopes in association with Braeburn soils.

(a) Teepee Complex—Podzolic and Brunisolic, sandy loam and loam.

Extent and Occurrence: There are several areas, making up a total of about 18,000 acres in which Teepee soils are predominant. No estimate is made of their extent in areas in which they are not of dominant occurrence. They are found throughout much of the Saddle hills area and in the southern till area.

Topography: Gently rolling to hilly—generally crowns of hills and on long uniform slopes.

Drainage: Moderately well drained soils that often have an excessive surface drainage.

Native Vegetation: Woodland consisting of variable mixtures of aspen poplar, white spruce, and pine.

Profile Description: Teepee soils have a strong brown to yellowish brown B horizon in which occasional sandstone fragments are found. Their profiles are quite variable. Depending on location they may have a solum showing little evidence of eluviation and illuviation or a solum showing marked eluviated or illuviated horizons. The following is a description of a Grey Wooded profile common to Teepee soils.

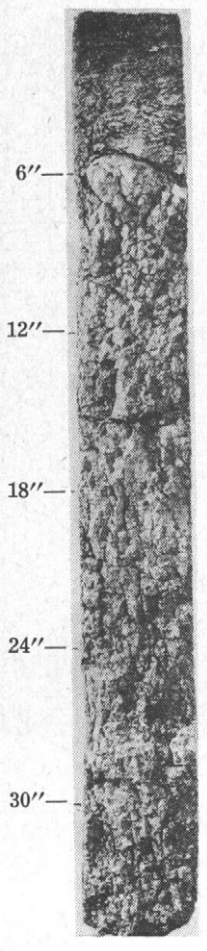
Horizon	*Thickness in inches*	*Description*
L-H (A_0)	2	Dark brown (10YR 3/3 moist) organic debris. pH 6.6.
Ah (A_1)	1	Brown (10YR 5/3 moist) sandy loam, very friable. pH 6.0.
Ae (A_2)	3	Pale brown (10YR 6/3 moist) very fine sandy loam, platy, very friable. pH 5.5.
Bt (B_2)	12	Strong brown (7.5YR 5/6 moist) loam to clay loam, nuciform, friable. pH 4.7.
BC (B_3)	8	Yellowish brown (10YR 5/6 moist) loam grading to sandy loam in lower part, weak nuciform, friable. pH 5.0.
C		Yellowish brown (10YR 5/4 moist) sandy loam—with chips of sandstone. Apparently decomposed and semi-decomposed sandstone. pH 7.0.

Soil Rating: Non-arable to fair arable soils, depending on the depth to the underlying sandstone and the topography.

Agricultural Use: There are no Teepee soils in the mapped area that are under cultivation. The thin Teepee soils and those on steep slopes should not be cultivated. The deeper Teepee soils found on the undulating crowns or benches, often found in association with Braeburn soils, should respond favorably to a mixed crop farm management.

2. Mainly grey and greyish brown, saline, sandy shale.

Soils of the *Debolt, Valleyview,* and *Kavanagh* series are formed on materials that are derived primarily from saline, sandy shales of the Wapiti formation. In many cases the unaltered bedrock may be found exposed in these soil areas. Generally, however, the parent material consists of till that has a high content of saline, sandy shale residues that impart a hard or cemented character to the till. The following are descriptions of the principal soils formed on this type of parent material:



(a) Debolt Series—Grey Wooded Solodized Solonetz, clay loam.

Extent and Occurrence: There are about 1,600 acres in which Debolt soils are predominant. They are found principally east of Beaverlodge in the vicinity of Saskatoon mountain.

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

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

Native Vegetation: Woodland consisting of somewhat stunted aspen poplar and various shrubs.

Profile Description: Debolt soils have a greyish leached surface horizon underlain by a subsurface horizon that is very firm and is relatively impervious to both root and water penetration. The material in the B horizon consists of a till that is very firm or cemented and contains fragments of shale. The lower part of the solum may consist of residual material derived from the Wapiti formation. Following is a description typical of a Debolt soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_{00})	1	Very dark brown (10YR 2/2 moist) leaf mat. pH 5.9.
Ah (A_1)	1	Dark greyish brown (10YR 4/2 moist) clay loam, weak granular, friable. Often absent. pH 4.8.
Ae (A_2)	4	Grey brown (10YR 5/2 moist) to grey (10YR 5/1 moist) silt loam, platy—fine in upper portion grading to coarse platy in lower portion—very friable. pH 4.6.

Horizon	*Thickness in inches*	*Description*
AB (B_1)	1	Light grey brown (10YR 6/2 moist) clay loam, nuciform, very firm to hard—perhaps a part of the B_2 horizon. pH 5.0.
Btn1 (B_{21})	6	Grey brown (10YR 5/2 moist) to grey (10YR 5/1 moist) clay to clay loam, strong columnar, blocky, very hard. pH 4.5.
Btn2 (B_{22})	6	Dark grey (10YR 4/1 moist) to grey (10YR 5/1 moist) clay to clay loam, massive, blocky, hard. pH 7.1.
Ck (C_{Ca})	6	Grey (10YR 5/1 moist) with occasional dark grey (10 YR 4/1 moist) strata, clay to clay loam, fine blocky, hard. pH 7.9.
C-IIC (C-D)		Grey (10YR 5/1 moist) to light grey (10YR 6/1 moist) clay to clay loam, blocky to fragmental, largely residual material. pH 8.0.

Soil Rating: Poor to fair arable soils.

Agricultural Use: Debolt soils are inferior agricultural soils. Very few of these soil areas are presently cultivated. However, cultural experiments are being conducted near Beaverlodge by the Canada Experimental Farm Research staff to determine the ressponse to various cultural treatments.

(b) Valleyview Series—Dark Grey Solodized Solonetz, silt loam and clay loam.

Extent and Occurrence: In the vicinities of Valhalla, Hythe, Huallen and Wembley there are about 25,000 acres in which Valleyview soils are predominant.

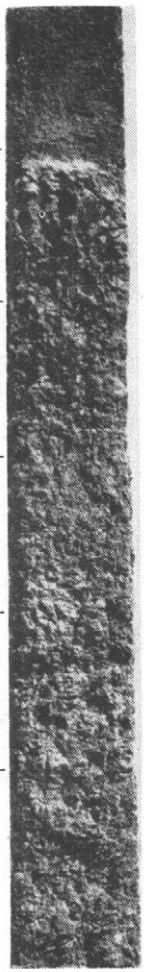
Topography: Undulating to gently rolling—consisting usually of long uniform slopes.

Drainage: Imperfectly drained soils that usually have an excessive surface run-off.

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

Profile Description: Valleyview soils are somewhat similar to Debolt soils except they have a darker and thicker A horizon. The B horizon is usually not as compact as that of the Kavanagh soils. Following is a description typical of a Valleyview soil profile:

Horizon	*Thickness in inches*	*Description*
L-H (A_0)	1	Very dark brown (10YR 2/2 moist) leaf mat. pH 6.1.
Ah (A_{11})	3	Very dark grey (10YR 3/1 moist) loam, weak granular, friable. pH 5.6.
Ahe (A_{12})	3	Dark greyish brown (10YR 4/2 moist) loam to very fine sandy loam, weak granular to platy, friable. pH 5.6.
Ae (A_2)	1	Grey (10YR 5/1 moist) very fine sandy loam, platy, very friable. pH 5.6.



Horizon	Thickness in inches	Description
Btn1 (B_{21})	2	Very dark greyish brown (10YR 3/2 moist) clay, columnar, very hard to indurated. pH 6.4.
Btn2 (B_{22})	10	Very dark greyish brown (10YR 3/2 moist) clay, blocky, with occasional very dark grey (10YR 3/1 moist) stains on cleavage faces, hard. pH 6.2.
Ck (Bca)	8	Greyish brown (10YR 5/2 moist) clay loam to clay, weak blocky, friable, moderate lime. pH 7.8.
Cs (B_{so1})	8	As above but with more pronounced horizontal cleavage. Contains chips of sandy shale and pockets of salts. pH 7.9.
C		Dark grey (10YR 4/1 moist) clay loam, nuciform to blocky, firm. Chips of sandy shale, coal, and stones are common. pH 7.6.

Soil Rating: Generally fairly good arable soil.

Agricultural Use: Many of the Valleyview soil areas are under cultivation. (See Cultivation Map, Fig. 4.) While varities of crops are grown, consideration is being given to the improvement of the tilth of the B horizon by the inclusion of deep-rooted legumes in the crop rotations.

(f) Kavanagh Complex—Black and Dark Grey Solonetz and and Solodized Solonetz, clay loam.

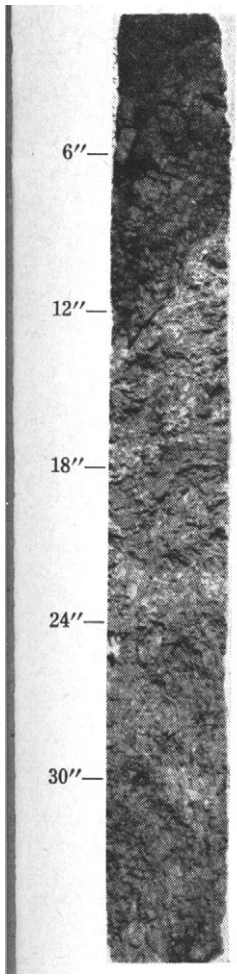
Extent and Occurrence: In small areas in the vicinities of Valhalla and Huallen there are about 1,000 acres in which Kavanagh soils are predominant. They occur in association with Valleyview and frequently with Kleskun soils.

Topography: Level and undulating—consisting of long uniform slopes.

Drainage: Imperfectly to poorly drained soils that may have a somewhat excessive surface run-off on slopes or may be ponded in the level areas.

Native Vegetation: Parkland, consisting of grasses that include salt grasses and scattered bluffs of willow and stunted or scrub poplar.

Profile Description: Kavanagh soils have a thin, dark colored surface horizon underlain by a relatively impermeable subsurface horizon. While there is usually a fairly heavy concentration of salts in the lower part of the B horizon there appears to be very little lateral movement of these salts. Soils with surface salt incrustations



do not often occur in association with Kavanagh soils. Following is a description typical of a Kavanagh soil profile:

Horizon	*Thickness in inches*	*Description*
Ah (A_1)	4	Greyish brown (10YR 5/2 moist) to very dark brown (10YR 2/2 moist) loam to silt loam. Weak structure but firm due to organic fibre. The lower portion of this horizon may be somewhat greyer in color or there may be a very thin, leached Ae horizon. pH 6.7.
Btn (B_2)	8	Dark greyish brown (10YR 4/2 moist) to dark grey (10YR 4/1 moist) clay loam, indurated round topped columns, blocky, very firm. Very dark grey (10YR 3/1 moist) staining on cleavage faces. pH 8.1.
BCn (B_3)	6	Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam, massive, blocky to nuciform, firm. pH 9.2.
Cks (Bca & $_{so_4}$)		Greyish brown (10YR 5/2 moist) to dark greyish brown (10YR 4/2 moist) clay loam to loam, nuciform, friable. Occasional sandy streaks, ironstone nodules, coal flecks, and pieces of sandy shale. Lime and salts occur in small beds or pockets. pH 8.9.

Soil Rating: Poor to fair arable soils.

Agricultural Use: Kavanagh soils are inferior agricultural soils. Their very firm dark colored subsurface horizon is relatively impervious to both water and root penetration. The successful utilization of these soils will depend on the improvement of tilth in the subsoil. Experience indicates that improvement can be obtained by deep plowing at the time of breaking or preferably by growing deep-rooted crops such as sweet clover which will penetrate the hard layer and facilitate drainage and aeration.

G. Soils Developed on Organic Materials

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

Organic soils have an accumulation of organic matter that exceeds a thickness of 12 inches. The organic matter may be derived mainly from the partial decomposition of sedges and grasses or from mosses. For the purposes of this report, Organic soils are classified according to the dominant characteristics of the organic accumulation.

1. Dark brown and black fine peat developed mainly from sedges and coarse grasses.

(a) Eaglesham Series—Fibrous peat.

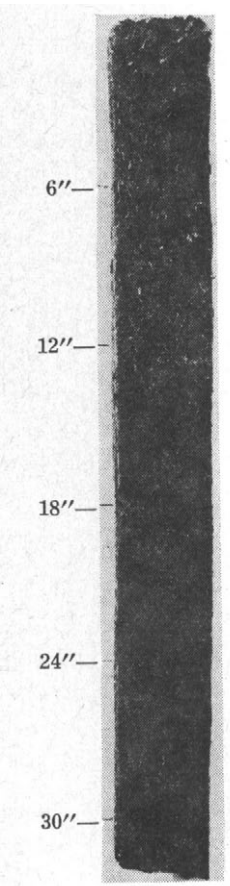
Extent and Occurrence: Throughout the mapped area there are about 26,000 acres in which Eaglesham soils are predominant. Numerous small areas are not indicated on the accompanying soil map.

Topography: Level and depressional.

Drainage: Poor to very poor.

Native Vegetation: Sedges and coarse grasses with occasional bluffs of willow, dwarf birch, and black spruce.

Profile Description: The solum of Eaglesham soils consists of an accumulation of peat, the greater part of which appears to be derived from sedge and grass remains. Separation into horizons is made on the basis of color and degree of decomposition. The thickness of the peat varies but seldom exceeds 36 inches in the mapped area. Following is a description typical of an Eaglesham profile:



Horizon	*Thickness in inches*	*Description*
F1 (1)	16	Dark brown (10YR 3/3 moist) partially decomposed sedge and rush remains. pH 5.8.
F2 (2)	8	Very dark brown (10YR 2/2 moist) well decomposed sedge and rush remains. May be wet. pH 6.8.
F3 (3)	4	Black (10YR 2/1 moist) well decomposed peat in which there are few recognizable remains. Usually very wet. pH 7.3.
IICg (DG)	10	Light brownish grey (10YR 6/2) moist) to grey (10YR 6/1 moist) clay, fine granular when dry. Usually wet and very plastic. Numerous rusty stains or streaks. pH 7.8.
IICk (ca)	at 30-40 below surface	Grey (10YR 5/1 moist) to dark grey (10YR 4/1 moist) clay, fine granular, *moderate lime content. Rusty stains or* streaks are common particularly in the upper portion of this horizon. pH 7.9.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: Few of the Eaglesham soil areas are under cultivation. On draining, the shallower Eaglesham soils are used to good advantage for pasture crop production. The deeper Eaglesham soils in which the organic accumulation exceeds a thickness of about 30 inches should not be cultivated. They are valuable in storing and conserving water. The conservation of

such areas will do much towards replenishing the ground water supplies of this area.

2. Brown and dark brown coarse peat developed mainly from sphagnum moss.

(b) Kenzie Series—Sphagnum peat.

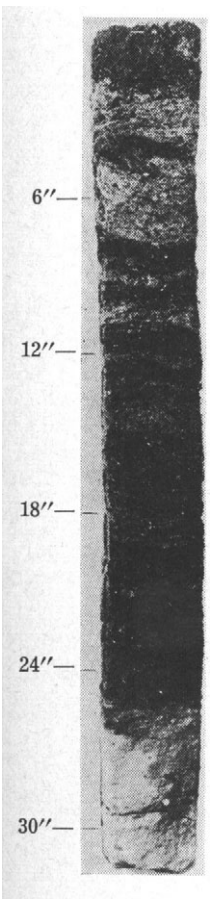
Extent and Occurrence: In many areas, varying in size, there are about 86,000 acres in which Kenzie soils are predominant. Only the larger areas of these soils were outlined in this survey.

Topography: Level and depressional.

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

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

Profile Description: The organic material of Kenzie soils is much coarser and woodier than that of Eaglesham soils. It consists predominantly of moss peat that has a pronounced acidic reaction. The thickness of peat is variable. It seldom exceeds 60 inches and may average about 36 inches. The following description is typical of a Kenzie soil profile:



Horizon	*Thickness in inches*	*Description*
L (1)	8	Dark brown (10YR 4/3 moist) moss peat, coarse, with tree root and stem remains. pH 4.7.
F1 (2)	10	Yellowish brown (10YR 5/4) moist) peat containing recognizable remains of mosses or roots, with occasional thin, darker colored, fine peat. pH 4.3.
F2 (3)	8	Dark brown (10YR 3/3 moist) peat, fairly well decomposed with very few recognizable plant remains. Usually very wet. pH 4.8.
IICg1 (DG_1)	9	Pale brown (10YR 6/3 moist) fine sandy loam, coarse blocky, usually saturated but very firm when dry. Occasional rusty stains or streaks. pH 6.8.
IICg2 (DG_2)	6	Grey (10YR 5/1 moist) to light brownish grey (10YR 6/2 moist) clay, saturated, very plastic. When dry it is massive, fine granular, very firm. Rusty streaks or stains are common. pH 7.0.
IICg3 (D_g)	8	Greyish brown (10YR 5/2 moist) clay, saturated and very plastic. Fine granular and firm when dry. pH 7.2.

Soil Rating: Non-arable unless reclaimed.

Agricultural Use: On draining, Kenzie soils are inferior agricultural soils. The woody nature of the peat makes it difficult to prepare a desirable seed bed. Their

Figure 27—Cover typical of the Kenzie soil areas.

Figure 28—Cover typical of the Eaglesham soil areas.

acidity tends to interfere with the decomposition of the peat and may adversely affect the growth of agricultural crops. Most of Kenzie soil areas are not being cultivated.

Peat deposits play a very important part in the storage and conservation of water. They act like sponges in soaking up much of the spring run-off. This stored moisture is then released gradually to the streams. Peat bogs therefore tend to have a regulating effect in maintaining the water level of streams and local water tables. From the standpoint of moisture conservation and flood control, it would be extremely desirable that at least the larger and deeper peat deposits be protected and permanently withheld from cultivation.

AGRICULTURAL PROBLEMS

Land Development

Tree cover is the major impediment to agricultural development in this area. Through the use of adaptable power equipment, however, methods are being developed to bring about a rapid, efficient, and more economical improvement of bush lands. The cost of clearing, piling and breaking vary with the size and density of tree cover, the size of the equipment and the efficiency of operator. In the mapped area, the custom charges averaged from $10.00 per hour to $15.00 per hour (depending on the size of the machinery used) for clearing and piling, and about $9.00 per acre for breaking. Fairly open areas or areas with a light tree cover can be cleared at the rate of four acres per hour, whereas in those areas that have a fairly heavy tree cover the rate of clearing may not exceed one acre per hour.

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

Water Supply

Throughout most of the Peace River area the difficulties experienced in obtaining a suitable well-water supply have been a

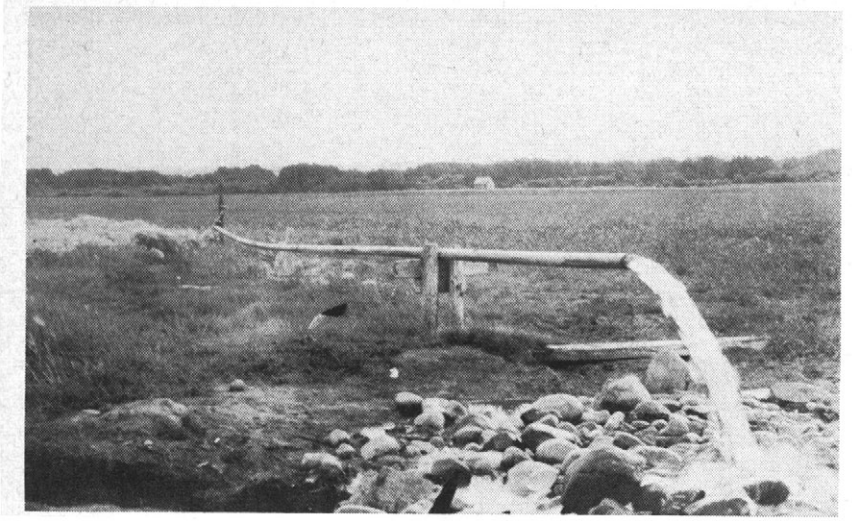


Figure 29—Artesian well near Valhalla. Such wells are of common occurrence in the Hythe area.

matter of grave concern. Rutherford's study, as reported in Research Council of Alberta Report No. 21, was made in order to obtain data on the possible underground water resources in the southwestern portion of the Peace River area. Further studies were made in the Beaverlodge area by Jones and reported in Research Council of Alberta Preliminary Report 59-2.

It would appear, from the observations made during the soil survey of this area, that in some portions there is a very good likelihood of obtaining a suitable well-water supply. This is particularly true of the areas adjacent to Valhalla and Hythe where artesian flow is encountered in the wells drilled to depths of 200 to 400 feet. Elsewhere in the central portion of the mapped area, suitable ground-water supplies have been found in wells at depths of 50 to 200 feet. However, in the northern portion, north of the Saddle hills, considerable difficulty is encountered in obtaining a suitable ground-water supply. In many cases, settlers have to resort to the construction of dug-outs. When constructed properly, according to the plans supplied by the District Agriculturists, they can provide a suitable and assured water supply.

Soil Management and Conservation

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

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

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

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

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

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

In an area that has a fairly heavy spring run-off and a growing season in which moisture can be a limiting factor in crop produc-

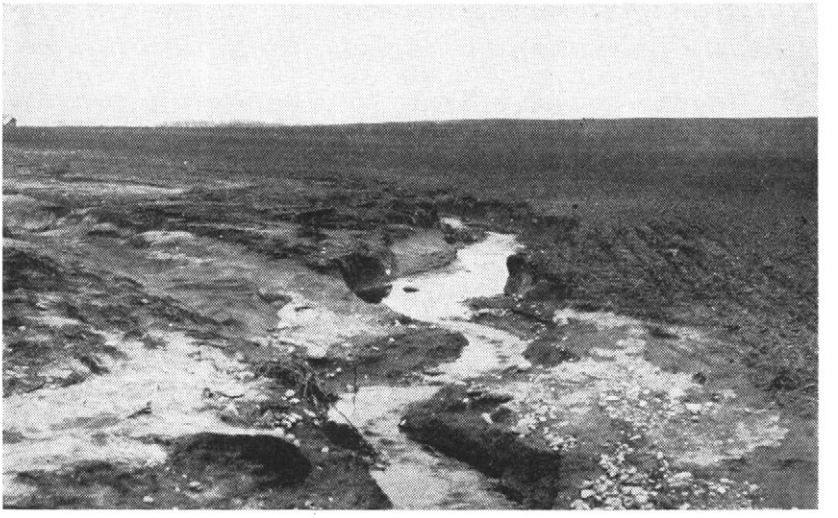


Figure 30—Spring run-off erosion in a Landry soil area near Wembley.

Figure 31—Gully erosion near Gordondale resulting from the spring run-off in 1958, on a Donnelly soil area having a 2 per cent slope.

tion, the conservation of that moisture will not only ensure better yields, but will also help to cut down soil losses due to water erosion. Organic material acts much like a sponge in soaking up water, and maintaining a good supply of organic material will do much towards making the best use of all available moisture. In addition, crop residues that are left on the surface appear to provide adequate protection for the soil against the action of raindrops during hazardous periods of high intensity storms. Such cover absorbs the energy of the falling raindrops and prevents the destructive action of rain beating on bare ground. The repeated impact of falling raindrops and the damaging reactions which the splashing raindrops set in motion may be the chief factors responsible for starting erosion. "Trash cover" farming, first practised in the southern portion of the province in order to prevent wind erosion, is likewise effective against water erosion.

To further conserve the moisture in an area that is characterized by the presence of long uniform slopes consideration should be given to contour farming. Cultivation should be made across the slope to further entrap the run-off. On the Canada Experimental Farm at Beaverlodge fields are arranged on the contour in a steeply sloping portion of the farm. The recommended rotations and practices on these fields have prevented accelerated soil erosion. The former gullies have been reclaimed successfully. These studies show that such practices will conserve moisture, prevent accelerated soil erosion, and should provide a basis in establishing a successful enduring agriculture.

APPENDIX I

CLIMATE OF THE BEAVERLODGE AREA

by

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Canada Department of Agriculture
Research Branch, Beaverlodge, Alberta

Meteorological records collected at the Beaverlodge Experimental Farm provide a reasonably accurate record of the climate of the region. They indicate that the regional climate is fairly uniform. Elevated areas such as Saskatoon mountain and the Saddle hills have a local orographic effect to the extent of increasing rain and snowfall. The precipitation pattern north of the Saddle hills, however, appears to be similar to that at Beaverlodge. Low-lying areas may be expected to be more vulnerable to early fall frost than upland areas. Such variations are usually extremely local in nature and are often caused by poor air drainage. Nevertheless, there seem to be extensive tracts of country that are particularly subject to frosts despite the fact that they may be higher in elevation than nearby areas not so affected. The reason for these climatic differences is not clear.

Data in Table 5 show that the mean annual temperature at Beaverlodge is 35.6°F. This is largely because of the very cold winters where extremes greater than 50°F. have been experienced. On the other hand, the summers are comparatively warm, July having a mean temperature of about 60°F. These conditions are conducive to the satisfactory growth of trees and grasses adapted to a temperate climate.

A frost-free period of 101 days indicates that the production of cool-season crops is possible. However, the data in the table show that this climatic characteristic varies greatly and in the occasional year damage by frost occurs. In the last 30 years there have been five seasons with a frost-free period of less than 90 days and 16 seasons frost-free for more than 110 days. The frost-free period is generally not as long as the "cropping season". Most farm crops are not damaged when the temperature reaches 32°F. A killing frost occurs at the temperature of 28°F. or lower. Thus, as shown, the average number of crop days is 133, but has varied from 70 to 172.

TABLE 5—Meteorological Records, Beaverlodge

Month	Temperature, °F.			Precipitation, inches		Protective snow cover(2) days	Bright sun, hours	Evaporation,(3) inches
	Mean	Extreme high	Extreme low	Total	Snow(1)			
Average	43 yr.	43 yr.	43 yr.	43 yr.		43 yr.	36 yr.	6 yr.
January	7.7	62.0	—53.1	1.32	13.0	29.7	77.7	.....
February	12.7	60.7	—47.5	1.04	10.2	26.5	108.8	.....
March	21.8	61.0	—35.3	1.09	10.3	26.0	156.2	.....
April	37.0	79.1	—31.3	0.79	4.8	7.8	213.4	.....
May	49.4	91.0	17.0	1.53	0.9	0.1	269.0	5.16
June	55.7	89.1	24.0	2.06	0.5	.....	262.8	4.72
July	59.9	98.1	29.0	2.51	.....	.....	297.3	5.46
August	57.6	94.4	27.0	1.90	0.1	.....	255.7	3.97
September	49.8	89.3	14.0	1.66	2.1	.....	182.2	2.55
October	39.3	82.0	—11.2	1.19	5.7	2.0	138.4	.....
November	24.2	71.3	—26.6	1.20	9.9	10.8	82.7	.....
December	12.2	62.0	—45.2	1.24	11.6	25.9	66.5	.....
Annual	35.6	.....	.....	17.53	69.1	128.8	2110.7	21.86

(1) 10 inches of snow is assumed equal to 1 inch of rain.
(2) 4 or more inches of snow.
(3) From a free-water surface.

Frost records (43 yr.)	Frost (32°F. or lower)	Killing frost (28°F. or lower)
Average date, last spring frost	May 25	May 9
Average date, last fall frost	Sept. 3	Sept. 19
Number of frost-free days	101	133
Shortest frost-free season	1918: 48 days	1916: 70 days
Longest frost-free season	1944: 140 days	1940: 172 days

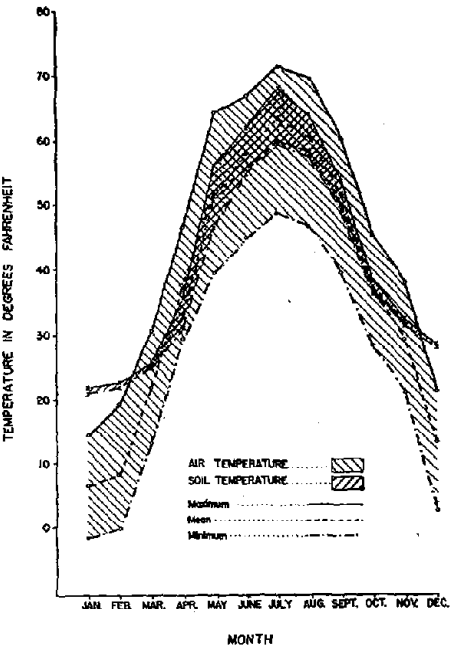


Figure 32—Average monthly air and soil temperature at Beaverlodge 1956 to 1958.

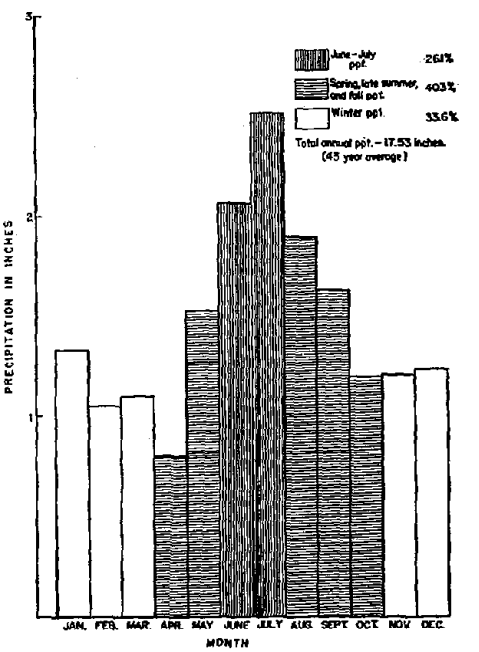


Figure 33—Average monthly distribution of precipitation at Beaverlodge.

The cropping season at Beaverlodge compares favourably with that of more southerly districts. Lacombe experiences an average of 118 and Lethbridge an average of 140 days.

Where the ground is usually blanketed with snow during the winter, soil temperatures are very much warmer at this time than those of the air, rarely falling below 20°F. With spring they rise rapidly and in summer at shallow depths, i.e., above plough sole, the mean temperatures may exceed those of the air (Figure 32). Soil temperatures from May to September are favourable at Beaverlodge for plant growth. A feature of the soil temperatures indicated in Figure 32 is that their fluctuations are much smaller than those of air temperatures, particularly during winter. This relationship is brought about by the insulating effect of the soil, and in winter by the added insulating effect of the snow.

With an annual precipitation of 17.53 inches (Table 5), the Beaverlodge area would appear to be almost semi-arid. However, as shown in Figure 33, two-thirds of the precipitation falls during the spring, summer and autumn months when it can be used to advantage by vegetation. In addition, the majority of this falls during June and July when plants are at their stage of maximum water requirement. This is particularly true for farm crops. Another factor making for a favourable moisture balance is a comparatively low rate of evaporation. About one-third of the precipitation occurs during the winter months. Most of this falls in the form of snow and it may be considered that in forested lands about half of the water held in the snow is lost in the spring run-off. In prairie areas and cultivated fields this loss is greater.

Figure 34, indicating annual and early summer (June-July) precipitation over the years that records have been taken at Beaverlodge, shows that considerable variation occurs. From the driest year (1923) to the wettest year (1951) there is a range of 14.5 inches in annual precipitation. This is 82 percent of the mean.

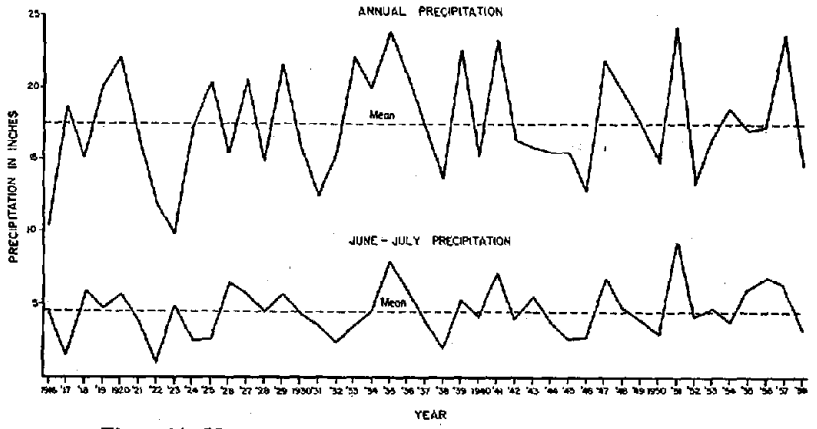


Figure 34—Mean annual and summer precipitation at Beaverlodge.

Similar but more significant variability with respect to crop growth can be noted in Figure 34 for the June and July precipitation. Such variability may be expected to reduce the effect of favourable rainfall distribution. Figure 34 suggests a cyclic nature of wet and dry years, but much more data will be required before any conclusions can be drawn respecting this feature.

Data in Table 5 show that 69 inches of snow normally fall at Beaverlodge, mostly in the period of November to March. Snowfall is important in that it offers a protective cover for over-wintering plants. Despite the melting and settling of this snow the data indicate that there are very few instances during the winter when there is not a protective snow cover. This blanket builds up from late November, reaching a maximum in February. Over a 22-year period its average maximum depth approaches 15 inches. Melting reduces it rapidly from early March so that by the middle of April bare ground usually appears. In the hilly and forested areas north and south of Beaverlodge heavier snowfalls occur so that the snow is deeper and lays longer.

Beaverlodge receives 2,110 hours of bright sunshine a year (Table 5). Sixty percent or 1,267 hours of this occurs during the months of May to September when plant growth is active. Sunshine during this period compares favourably with most points located farther south in Canada. For example, Lacombe receives 1,235 hours and Lethbridge, noted for its sunny climate, receives 1,382 hours over these months. The large quota at Beaverlodge is due to the long summer days common to northern regions. At the

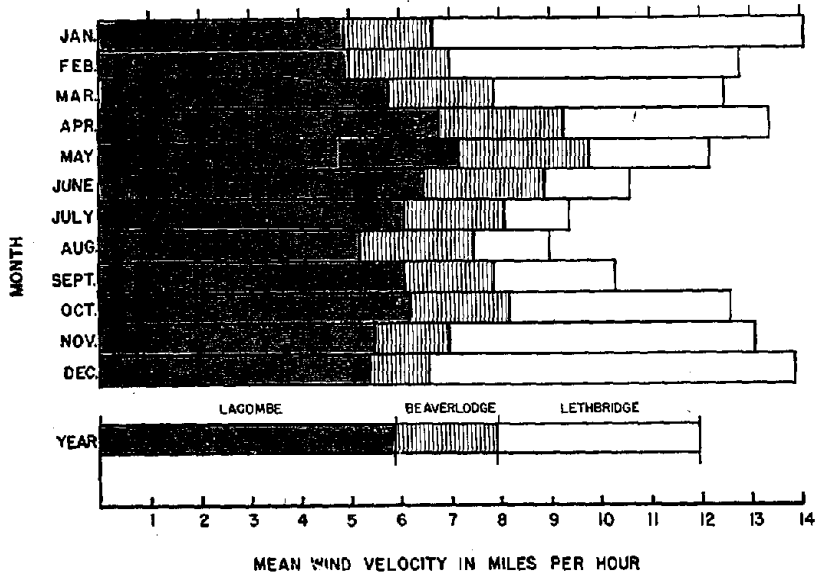


Figure 35—Mean monthly wind velocities at Beaverlodge, Lacombe, and Lethbridge.

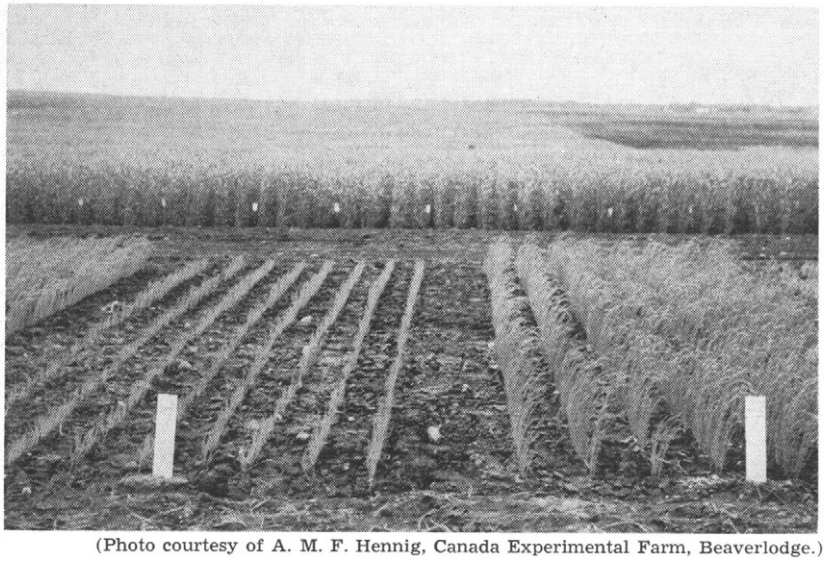
summer solstice, the time from sunrise to sunset approaches 17.5 hours. Long summer days hasten reproductive development and permit survival of numerous wild and cultivated species of plants.

As shown in Figure 35, the climate at Beaverlodge is relatively windy, particularly during the period of active plant growth, May to September. In the summer months the wind velocities at Beaverlodge approach those at Lethbridge which is one of the windiest localities in Alberta. Wind is important because it increases rate of evaporation. However, this is not high at Beaverlodge because of cool temperatures. High winds also cause damage to leaf tissue by mechanical injury. Thus, they adversely affect deciduous trees to the advantage of grasses.

The high wind speeds at Lethbridge during the winter months are due largely to the frequency of the Chinook. This warm, southwest wind is also more common at Beaverlodge than at Lacombe. Chinook winds have a considerable effect on vegetation and this, of course, is reflected in the soil. By its warming and drying action the Chinook increases winter killing, particularly to shrubs and trees. It also removes snow cover and in agricultural areas may cause the soil to blow, resulting in erosion.

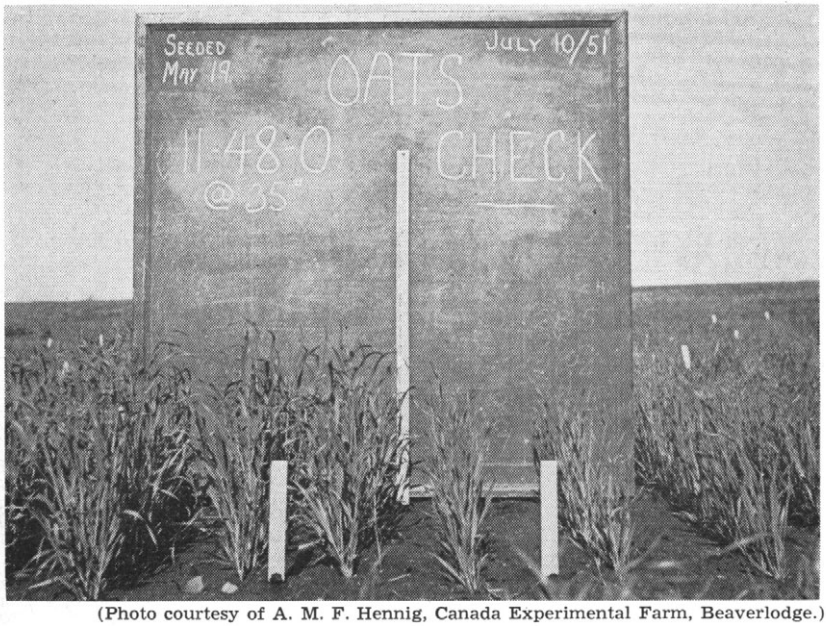
In a region with undulating terrain, climatic factors can vary considerably between locations. Minimum temperatures taken at Beaverlodge from 1926 to 1942 on a hilltop and in a slough one-half mile distant and 134 feet lower in elevation averaged 6.9°F. lower in the slough. Extremes were as great as 28 degrees in winter and 19 degrees in summer, indicating danger from frost at any time at the lower level. Marked differences in moisture loss by evaporation between locations have also been shown to exist at Beaverlodge. During the summers of 1954-56 an area sheltered by buildings and trees lost 34 percent less water by evaporation than an area one-quarter mile distant in the field.

Besides their effect on vegetation, climatic factors have a direct influence on soils, particularly agricultural soils which often lay open to the elements. Thus, freezing and thawing of the soil in spring and fall have an ameliorative effect on structure. Chinook winds by baring the ground of snow and raising soil temperatures above freezing bring about the same action in winter. It was pointed out that much of the winter's snow water is lost by spring run-off. This is doubly unfortunate since besides loss of moisture considerable damage by sheet erosion and gulleying may be done to cultivated fields. This condition is aggravated in much of the Peace River region by the clayey nature of the soils and the shallow depth to hardpan. The possibility of Chinook winds causing soil blowing was also mentioned. In the Beaverlodge area the strong west winds of spring and early summer (Figure 35) can bring about the same effect, particularly if proper methods of soil management are ignored.



(Photo courtesy of A. M. F. Hennig, Canada Experimental Farm, Beaverlodge.)

Figure 36—Comparison of untreated and treated plots of flax shows that at Beaverlodge there is a marked response to applications of commercial fertilizer at recommended rates.



(Photo courtesy of A. M. F. Hennig, Canada Experimental Farm, Beaverlodge.)

Figure 37—Application of ammonium phosphate at recommended rates shows a marked increase in the crop of oats. On harvesting, the check plot yielded approximately 73 bushels per acre while the fertilized plot yielded 118 bushels per acre.

APPENDIX II

CHEMICAL AND PHYSICAL CHARACTERISTICS of SOME REPRESENTATIVE SOIL PROFILES

Chemical and physical analyses of representative soil profiles are presented in Tables 6 and 7. The samples were obtained from virgin sites representative of the major areas outlined in the mapped area.

The analytical methods used in making the reported determinations were as follows:

Mechanical Analyses —Pipette method of Kilmer and Alexander, Soil Science 68: 15 - 24, 1949 with modifications of Toogood and Peters, Canadian Journal of Agricultural Science 33: 159 - 171, 1953.

Reaction —Soil paste method of Doughty, Soil Science 22: 135 - 138, 1941.

Nitrogen —Kjeldahl method of Prince, using mercury as a catalyst, Soil Science 59: 47 - 52, 1945.

Phosphorus —Colorimetric method of Truog, Journal of American Society of Agronomy 22: 874 - 882, 1930, on samples fused with sodium carbonate.

Carbon —Dry combustion method as outlined in the methods of the Association of Agricultural Chemists, 7th Edition, Washington, 1950.

Exchangeable Cations —Acetate extraction as outlined in A.O.A.C. 7th Edition, Washington, 1950. Exchangeable potassium, sodium, calcium, and magnesium were determined with the Beckman DU flame spectrophotometer involving the determination of the cations in the acetate leachate without destroying the ammonium acetate and organic matter. Radiation buffers were used in the standard solutions and in the extracts. Exchangeable hydrogen determinations were carried out by leaching with 0.5 N barium acetate buffered to pH 7.0 and titrating an aliquot of the extract with 0.1 N sodium hydroxide.

TABLE 6—Mechanical Composition and Some Chemical Properties of Representative Soil Profiles

Horizon	Thickness Inches	MECHANICAL: Particle Sizes Sand %	Silt %	Clay %	CHEMICAL: pH	N %	P %	C/N Ratio	Organic Matter %	Exchangeable Cations: Total m.e./100 gms.	Ca %	Mg %	Na %	K %	H %	Base Saturation %	Ca / Mg + Na Ratio
Soils developed on glacial till:																	
Braeburn Series - Grey Wooded, clay loam, S.W. 16-75-7 W.6.																	
A_o (L-H)	1	-	-	-	5.6	0.50	0.08	37.3	32.14	-	-	-	-	-	-	-	-
A_2 (Ae)	2	38	48	14	5.0	0.07	0.03	13.4	1.62	10.9	62.4	12.8	0.9	3.7	20.2	79.8	4.5
B_1 (AB)	9	28	36	36	4.8	0.06	0.03	9.3	0.97	13.7	55.5	16.1	0.7	2.9	24.8	75.2	3.3
B_{21} (Bt_1)	6	24	36	40	4.6	0.06	0.03	7.7	0.59	21.2	61.3	19.3	0.5	1.9	17.0	83.0	3.1
B_{22} (Bt_2)	6	24	32	44	4.5	0.06	0.04	7.3	0.76	22.8	58.3	20.2	0.4	1.8	19.3	80.7	2.8
B_3 (BC)	8	26	39	35	4.7	0.06	0.06	5.3	0.55	23.4	61.1	20.5	0.4	1.7	16.3	83.7	2.9
C	at 32	28	37	35	6.2	0.06	0.06	7.0	0.72	-	-	-	-	-	-	-	-
Demmitt Series - Grey Wooded, silt loam, N.E. 26-74-13 W.6.																	
A_o (L-H)	1	-	-	-	6.2	1.06	0.08	23.4	42.82	42.9	72.7	7.0	1.4	6.1	12.8	87.2	8.6
A_2 (Ae)	3	26	67	7	6.3	0.05	0.06	13.6	1.17	6.7	56.7	10.4	4.5	4.5	23.9	76.1	3.8
B_1 (AB)	5	28	60	12	5.9	0.03	0.04	11.7	0.60	7.2	62.5	12.5	2.8	2.8	19.4	80.6	4.1
B_2 (Bt)	12	38	22	40	5.4	0.04	0.04	16.3	1.12	22.9	71.6	14.0	0.9	1.3	12.2	87.8	4.8
B_3 (BC)	6	38	30	32	5.5	0.04	0.06	13.0	0.90	26.3	81.0	14.0	0.8	0.8	3.4	96.6	5.5
C	at 27	36	31	33	6.6	0.04	0.05	12.0	0.83	26.3	81.0	14.0	0.2	1.0	3.4	96.6	5.7
Hythe Series - Dark Grey Wooded, loam, N.E. 7-73-11 W.6.																	
A_1 (Ah)	4	37	42	21	6.4	0.62	0.07	13.1	14.05	31.7	74.2	13.6	0.6	4.7	6.9	93.1	5.2
A_2 (Ae)	3	47	41	12	5.5	0.07	0.02	3.1	0.38	11.2	74.1	19.6	0.9	5.4	0.0	100.0	3.6
B_2 (Bt)	7	24	39	37	5.0	0.10	0.04	5.8	1.00	19.3	71.0	22.8	0.5	5.7	0.0	100.0	3.0
B_3 (BC)	20	51	23	26	5.1	0.06	0.04	-	-	22.2	74.0	22.0	0.5	3.5	0.0	100.0	3.3
C	at 34	27	37	36	7.6	0.06	0.07	-	-	22.0	70.5	20.4	0.9	0.9	7.3	92.7	3.3
Soils developed on lacustro-till:																	
Donnelly Series - Grey Wooded Solod, silty clay loam, S.W. 1-79-9 W.6.																	
A_o (L-H)	1	-	-	-	7.4	0.75	0.09	11.6	15.02	37.8	88.4	6.3	0.5	4.8	0.0	100.0	1.3
A_2 (Ae)	3	12	73	15	5.8	0.06	0.04	10.5	1.09	7.4	44.7	21.6	1.3	2.7	29.7	70.3	1.9
B_1 (AB)	5	8	52	40	5.3	0.08	0.04	10.6	1.47	17.0	45.9	31.2	1.2	3.5	18.2	81.8	1.4
B_2 (Bt)	8	8	36	56	4.5	0.07	0.05	12.4	1.50	26.8	40.6	33.2	2.2	2.2	21.6	78.4	1.1
B_3 (BC)	10	8	40	52	5.5	0.06	0.08	16.3	1.69	28.0	50.7	36.4	1.8	1.8	9.3	90.7	1.3
C	at 27	8	44	48	7.8	-	0.08	-	-	-	-	-	-	-	-	-	-
Landry Series - Black Solod, silt loam, N.E. 4-74-8 W.6.																	
A_1 (Ah)	8	33	53	14	5.7	0.73	0.11	10.1	12.69	26.8	46.3	45.4	4.9	1.5	1.9	98.1	0.9
A_2 (Ae)	2	19	67	14	5.2	0.23	0.06	10.0	3.95	16.6	38.6	23.5	1.8	1.2	34.9	65.1	1.5
B_1 (AB)	1	13	58	29	5.3	0.19	0.07	8.7	2.86	22.7	38.8	30.8	4.4	1.8	24.2	75.8	1.1
B_2 (Bt)	4	9	41	50	5.4	0.17	0.06	8.0	2.34	39.8	42.3	37.9	7.5	1.5	10.8	89.2	0.9
B_3 (BC)	5	10	48	42	6.9	0.16	0.07	7.9	2.19	37.4	50.0	41.4	6.7	1.6	0.3	99.7	1.0
C	at 20	21	45	34	7.7	0.08	0.07	10.7	1.48	-	-	-	-	-	-	-	-

Horizon	Thickness inches	MECHANICAL Particle Sizes Sand %	Silt %	Clay %	pH	N %	P %	C/N Ratio	Organic Matter %	CHEMICAL Exchangeable Cations Total m.e./100 gms.	Ca %	Mg %	Na %	K %	H %	Base Saturation %	Ca / Mg + Na Ratio
Hazelmere Series - Grey Wooded Solod, silty clay loam, N.W. 20-74-12 W.6,																	
A_o (L-H)	2	-	-	-	5.9	0.64	0.11	24.5	27.07	-	-	-	-	-	-	-	-
A_2 (Ae)	3	16	74	10	5.7	0.08	0.04	12.3	1.69	8.2	50.0	19.4	1.2	2.4	27.0	73.0	2.4
B_1 (AB)	3	10	63	27	5.6	0.07	0.03	9.0	1.09	14.7	53.1	28.6	0.7	2.0	15.6	84.4	1.8
B_{21} (Bt_1)	4	6	32	62	5.4	0.07	0.05	12.0	1.45	31.3	57.2	30.7	0.3	1.6	10.2	89.8	1.8
B_{22} (Bt_2)	5	8	35	57	5.9	0.07	0.06	13.0	1.57	36.5	53.3	33.3	0.3	1.4	11.7	88.3	1.6
B_3 (BC)	8	16	37	47	7.0	0.07	0.07	10.7	1.29	29.0	61.0	34.5	0.3	0.7	3.5	96.5	1.7
C	at 25	13	45	42	7.7	0.07	0.07	9.6	1.16	31.7	71.0	27.4	0.3	1.3	0.0	100.0	2.6
Albright Series - Dark Grey Solod, clay loam, S.W. 28-72-10 W.6.																	
A_1 (Ah)	5	19	46	35	6.9	0.72	0.09	11.3	14.05	44.7	72.0	16.8	0.2	3.6	7.4	92.6	4.2
A_2 (Ae)	2	20	47	33	6.9	0.37	0.06	9.1	5.77	28.6	70.3	17.8	0.7	2.8	8.4	91.6	3.8
B_1 (AB)	5	25	41	34	6.6	0.12	0.04	10.5	2.17	22.4	59.8	30.3	0.9	1.9	7.1	92.9	1.9
B_2 (Bt)	8	5	26	69	6.0	0.09	0.07	17.0	2.63	37.2	55.6	34.1	1.4	1.4	7.5	92.5	1.6
B_3 (BC)	3	4	31	65	7.4	0.09	0.09	15.9	2.46	40.2	63.4	34.1	1.2	1.2	0.1	99.9	1.8
C	at 23	6	36	58	7.8	0.09	0.09	19.8	3.07	55.4	77.9	20.0	1.1	0.7	0.3	99.7	3.7
Snipe Series - Low Humic Eluviated Gleysol, silt loam, N.E. 3-80-8 W.6.																	
A_o (L-H)	4	-	-	-	5.5	0.98	0.11	16.6	28.10	56.8	52.0	1.2	0.0	2.5	33.5	66.5	43.3
A_{2g} (Aeg)	7	18	71	11	5.9	0.03	0.06	11.7	0.60	3.7	46.0	21.6	0.0	5.4	27.0	73.0	2.1
B_{1g} (ABg)	3	14	50	36	5.9	0.07	0.05	9.1	1.10	17.5	57.7	30.3	0.0	2.9	9.1	90.9	1.9
B_{21g} (Bt_{1g})	12	15	36	49	6.4	0.05	0.05	12.8	1.10	28.8	59.0	33.0	0.7	2.4	4.9	95.1	1.7
B_{22g} (Bt_{2g})	7	7	28	65	6.8	0.05	0.06	14.4	1.24	31.4	61.8	33.4	1.0	1.9	1.9	98.1	1.8
C	at 33	9	32	59	7.6	-	0.07	-	-	-	-	-	-	-	-	-	-
Soils developed on lacustrine materials:																	
Nampa Series - Grey Wooded Solod, clay loam, S.E. 35-80-12 W.6.																	
A_o (L-H)	1	22	41	37	6.1	0.13	0.11	72.2	16.17	43.3	63.3	15.7	0.2	2.5	18.3	81.7	4.0
A_2 (Ae)	2	23	50	27	6.1	0.07	0.05	9.0	1.09	8.7	50.6	23.1	3.4	3.4	19.5	80.5	1.9
B_1 (AB)	2	16	37	47	5.8	0.13	0.05	5.5	1.21	16.2	53.7	28.4	2.5	2.5	12.9	87.1	1.7
B_{21} (Bt_1)	6	10	22	68	4.9	0.06	0.05	15.0	1.60	29.4	42.6	31.5	2.0	2.0	21.8	78.2	1.3
B_{22} (Bt_2)	6	11	25	64	5.5	0.04	0.05	19.5	1.34	39.4	45.6	34.8	1.3	1.3	17.0	83.0	1.3
B_{23} (Bt_3)	8	9	26	65	7.8	0.06	0.07	27.5	2.84	-	-	-	-	-	-	-	-
C	at 25	16	23	61	8.0	-	0.09	-	-	-	-	-	-	-	-	-	-
Falher Series - Dark Grey Solod, silty clay, N.E. 29-79-7 W.6																	
A_o (L-H)	1	-	-	-	6.2	1.22	-	18.8	39.53	46.9	51.6	24.2	1.1	4.3	18.8	81.2	2.0
A_1 (Ah)	3	7	52	41	5.7	0.43	-	12.3	9.14	33.9	48.7	20.1	1.5	4.4	25.3	74.7	2.2
B_1 (AB)	5	6	51	43	5.0	0.13	-	10.1	2.26	19.4	35.1	27.8	3.1	1.5	32.5	67.5	1.1
B_{21} (Bt_1)	9	4	28	68	4.6	0.09	-	13.9	2.16	31.2	39.1	34.9	2.9	1.9	21.2	78.8	1.0
B_{22} (Bt_2)	14	3	33	64	6.5	0.08	-	14.3	1.97	30.9	49.5	42.7	3.6	1.6	2.6	97.4	1.1
C	at 31	15	31	54	7.5	-	-	-	-	-	-	-	-	-	-	-	-

TABLE 6—Mechanical Composition and Some Chemical Properties of Representative Soil Profiles—(Continued)

Horizon	Thickness Inches	MECHANICAL Particle Sizes Sand %	Silt %	Clay %	CHEMICAL pH	N %	P %	C/N Ratio	Organic Matter %	Total m.e./ 100 gms.	Exchangeable Cations Ca %	Mg %	Na %	K %	H %	Base Saturation %	Ca / Mg + Na Ratio
Soils developed on alluvial and aeolian materials:																	
Toad Series - Bisequa Grey Wooded, silt loam, N.W. 29-68-8 W.6.																	
A_o (L-H)	2	-	-	-	6.4	0.72	-	25.8	32.00	42.3	70.9	12.6	0.7	2.1	13.7	86.3	5.3
A_{21p} (Ae_1)	2	46	48	6	6.2	0.07	-	17.6	2.12	8.2	65.9	14.6	2.4	1.2	15.9	84.1	3.9
A_{22p} (Ae_2)	4	44	50	6	6.0	0.05	-	15.8	1.36	7.2	54.1	15.3	2.8	1.4	26.4	73.6	3.0
B_p (Bf)	4	38	54	8	5.7	0.03	-	13.7	0.71	4.4	40.9	6.8	4.5	2.3	45.5	54.5	3.6
C_p (Ae)	3	22	71	7	5.8	0.03	-	13.7	0.71	5.5	47.3	16.4	3.6	1.8	30.9	69.1	2.4
B_{21} (Bt_1)	5	19	36	45	5.7	0.06	-	13.2	1.36	24.7	62.4	25.5	0.8	0.4	10.9	89.1	2.4
B_{22} (Bt_2)	5	9	28	63	6.7	0.08	-	12.6	1.74	31.3	69.4	26.8	0.6	0.3	2.9	97.1	2.5
Bca (Ck)	9	7	51	42	7.7	-	-	-	-	-	-	-	-	-	-	-	-
C	at 34	2	34	64	8.0	-	-	-	-	-	-	-	-	-	-	-	-
Sundance Series - Bisequa Grey Wooded, loamy sand, S.E. 33-69-8 W.6.																	
A_o (L-H)	2	-	-	-	5.4	0.50	-	-	-	36.0	59.0	13.3	1.9	5.0	20.8	79.2	3.9
A_{2p} (Ae)	5	80	17	3	5.6	0.03	-	-	-	3.8	60.6	13.2	2.6	2.6	21.0	79.0	3.8
B_p (Bf)	8	85	9	6	6.8	0.02	-	15.5	0.53	3.3	57.6	21.2	3.0	6.1	12.1	87.9	2.4
C_p (Ae)	1	76	16	8	6.8	0.03	-	7.3	0.38	5.2	50.0	36.6	1.9	3.8	7.7	92.3	1.3
B_2^p (Bt)	3	69	7	24	6.8	0.05	-	12.4	1.07	13.1	65.7	24.4	3.8	3.8	2.3	97.7	2.3
B_3 (BC)	5	-	-	-	7.1	0.03	-	12.3	0.64	-	-	-	-	-	-	-	-
C	at 24	73	16	11	7.3	0.03	-	16.3	0.84	-	-	-	-	-	-	-	-
Soils developed on residual and modified residual materials:																	
Debolt Series - Grey Wooded Solodized Solonetz, silt loam, S.W. 3-72-9 W.6.																	
A_o (L-H)	1	-	-	-	6.4	1.50	0.11	14.0	36.20	69.9	56.3	23.5	2.6	5.3	12.3	87.7	2.1
A_1 (Ahe)	1	35	42	23	5.9	0.25	0.08	31.6	13.62	66.1	42.0	29.3	6.4	2.3	20.0	80.0	1.2
A_2 (Ae)	2	25	65	10	6.5	0.06	0.03	12.8	1.33	9.0	49.0	23.3	13.3	1.1	13.3	86.7	1.3
B_1 (Abm)	2	26	58	16	6.7	0.04	0.03	18.7	1.29	14.2	44.4	27.5	19.7	1.4	7.0	93.0	0.9
B_{21} (Bnt_1)	6	15	52	33	7.1	0.05	0.03	11.0	0.95	35.1	30.5	25.9	21.7	1.1	20.8	79.2	0.6
B_{22} (Bnt_2)	10	28	32	40	7.9	0.04	0.04	16.2	1.12	22.0	30.0	26.8	42.3	0.9	0.0	100.0	0.4
C (Cks)	at 22	29	41	30	8.1	0.03	0.04	-	-	-	-	-	-	-	-	-	-
Valleyview Series - Black Solodized Solonetz, silt loam, S.W. 14-71-9 W.6.																	
A_1 (Ah)	4	21	49	30	5.6	0.73	0.12	10.2	12.81	31.1	42.5	16.7	1.9	5.1	33.8	66.2	2.3
A_2 (Ae)	2	23	59	18	5.6	0.24	0.08	8.8	3.64	12.3	23.6	15.4	9.8	1.6	49.6	50.4	0.9
B_1 (ABm)	1	19	52	29	5.6	0.13	0.06	12.0	2.69	15.2	25.0	25.0	19.8	1.3	28.9	71.1	0.6
B_{21} (Bnt_1)	6	11	37	52	5.7	0.15	0.06	11.9	3.09	28.6	30.8	30.8	24.4	1.4	12.6	87.4	0.6
B_{22} (Bnt_2)	6	9	35	56	7.1	0.11	0.06	-	-	-	-	-	-	-	-	-	-
B_{23} (Bnt_3)	6	8	32	60	7.8	0.08	0.07	-	-	-	-	-	-	-	-	-	-
C (Cks)	at 25	9	44	47	7.9	0.08	0.07	-	-	-	-	-	-	-	-	-	-

Mechanical Analyses

The determination of the sand, silt, and clay size particles provides the key to the textural classification of soils according to the textural triangle indicated in the glossary. This classification, with respect to Grey Wooded soils, differs somewhat from that of Black soils in that greater concern is given to the textural characteristics of the B and C horizons rather than those of the leached A horizon.

The data in Table 6 indicate that the fine and medium textured soils predominate in the mapped area. Furthermore it will be noted that there is a depletion of clay sized particles in the A horizon. However, unlike the other soils, the Valleyview and Debolt soil profiles show the greatest amount of clay in the lowest portion of the B horizon.

Chemical Analyses

Reaction—Soil reaction is expressed in terms of the pH scale. Soils with pH 7 are neutral in reaction. Ranges below 7 indicate degree of acidity, while those above 7 indicate degree of alkalinity. The range indicated in Table 6 shows that the Black and Dark Grey soils have a neutral to slightly acid reaction in the surface horizon and a neutral to alkaline reaction in the lower portion of the profile. Apart from the relatively thin organic surface horizon, the Grey Wooded soils are acid to very acid in reaction. The greatest acidity occurs in the upper portions of the B horizons of Grey Wooded soils. Despite the fact that applications of lime have not been considered necessary in Alberta for successful crop production, it would appear that such adjustments of reaction in Grey Wooded soils might bear careful scrutiny.

Nitrogen, Phosphorus and Organic Matter—Present evidence suggests that nitrogen and phosphorus are the main plant nutrients limiting crop production in this region.

The data in Table 6 indicate that there is an appreciable variation in the nitrogen content with the lowest occurring usually in the Grey Wooded soils, particularly below the thin organic horizon. Assuming that a six-inch depth of soil weighs approximately two million pounds per acre, it would appear that the Grey Wooded soils have about 1,300 to 1,900 pounds of nitrogen per acre, the Dark Grey about 3,000 to 5,000 pounds of nitrogen per acre, and the Black soils about 4,000 to 7,000 pounds of nitrogen in the surface six inches per acre. Since there is a direct relationship between nitrogen and organic matter it will be apparent that the maintenance of an adequate supply of easily decomposed organic matter (whose C/N ratio is less than 15) is essential to good husbandry in this region.

Phosphorus is a mineral plant nutrient and the total amount is related to the soils' parent material. The finer textured materials contain a higher amount of phosphorus than the coarse textured materials. In the upper portion of the profile, however, phosphorus

TABLE 7—Total Chemical Analysis and Calculated Molecular Ratios of Some Representative Soil Profiles

Horizon	Thickness Inches	Total Chemical Analyses						Calculated Molecular Ratios									
								SiO_2		CaO		MgO		Al_2O_3		MgO	
		SiO_2	R_2O_3	Al_2O_3	Fe_2O_3	CaO	MgO	$Al_2O_3 + Fe_2O_3$		$Al_2O_3 + Fe_2O_3$		$Al_2O_3 + Fe_2O_3$		Fe_2O_3		CaO	
		%	%	%	%	%	%	Abs.[1]	Rel.[2]	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.	Abs.	Rel.
Soils developed on glacial till:																	
Hillburn Series - Grey Wooded, silt loam, S.E. 14-69-8 W.6.																	
A_{21} (Ae_1)	2	85.1	10.0	7.0	2.0	0.6	0.4	17.32	2.84	0.13	1.00	0.11	0.55	5.31	1.12	0.82	0.51
A_{22} (Ae_2)	5	83.5	11.2	7.4	2.8	0.5	0.5	15.27	2.51	0.10	0.77	0.13	0.65	4.06	0.85	1.33	0.83
B_2 (Bt)	10	66.3	23.5	16.7	6.6	1.1	1.5	5.37	0.88	0.10	0.77	0.18	0.90	4.00	0.84	1.85	1.15
B_3 (BC)	11	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
C	at 28	67.1	21.5	15.5	5.1	1.4	1.5	6.09	1.00	0.13	1.00	0.20	1.00	4.75	1.00	1.61	1.00
Demmitt Series - Grey Wooded, silt loam, N.E. 26-74-13 W.6.																	
A_2 (Ae)	3	81.4	12.5	8.8	2.8	0.3	0.8	13.11	1.19	0.05	0.18	0.19	0.65	5.06	0.98	4.00	3.67
B_1 (AB)	5	71.3	19.0	13.1	4.7	0.5	1.1	7.58	0.69	0.06	0.22	0.17	0.59	4.41	0.86	2.70	2.48
B_2 (Bt)	12	74.2	17.5	13.5	4.3	0.5	0.9	7.74	0.70	0.06	0.22	0.14	0.48	4.89	0.95	2.44	2.24
B_3 (BC)	6	66.0	20.5	14.2	5.2	2.5	1.1	6.39	0.58	0.26	0.96	0.16	0.55	4.21	0.82	0.60	0.55
C	at 27	57.1	10.4	7.4	2.3	1.3	1.0	11.05	1.00	0.27	1.00	0.29	1.00	5.14	1.00	1.09	1.00
Hythe Series - Dark Grey Wooded, loam, N.E. 7-73-11 W.6.																	
A_1 (Ah)	4	83.3	11.6	8.2	2.5	0.4	0.7	14.48	2.40	0.07	0.29	0.18	1.38	5.00	0.96	2.43	4.50
A_2 (Ae)	3	70.6	19.6	13.3	4.8	0.2	1.0	7.31	1.21	0.03	0.12	0.16	1.23	4.33	0.83	1.44	2.66
B_2 (Bt)	7	70.2	20.2	14.1	5.1	1.4	1.0	6.88	1.14	0.15	0.60	0.15	1.15	4.31	0.82	1.00	1.85
B_3 (BC)	20	74.0	17.5	12.6	4.3	0.5	0.7	8.15	1.35	0.06	0.24	0.11	0.85	4.59	0.88	1.89	3.50
C	at 34	68.1	21.8	16.0	4.8	2.6	1.0	6.04	1.00	0.25	1.00	0.13	1.00	5.23	1.00	0.54	1.00
Soils developed on alluvial and aeolian materials:																	
Sundance Series - Bisequa Grey Wooded, loamy sand, S.E. 34-69-8 W.6.																	
A_{2p} (Ae)	2	91.9	4.8	3.6	0.7	0.3	0.2	39.23	2.68	0.13	0.15	0.13	0.33	8.75	1.80	1.00	2.27
B_p (Bf)	6	88.4	7.8	5.2	2.1	0.3	0.4	22.97	1.57	0.08	0.09	0.16	0.41	3.92	0.81	2.00	4.54
C_p (Ae)	3	88.9	7.9	5.2	2.0	0.3	0.4	23.49	1.61	0.08	0.09	0.16	0.41	4.25	0.87	2.00	4.54
B_2 (Bt)	3	80.9	15.2	10.7	3.8	0.7	0.8	10.46	0.71	0.09	0.10	0.16	0.41	4.37	0.90	1.67	3.79
C	at 14	72.3	9.6	6.9	2.2	4.1	1.3	14.63	1.00	0.89	1.00	0.39	1.00	4.86	1.00	0.44	1.00
Pinto Series - Bisequa Grey Wooded, sandy loam, N.E. 16-68-9 W.6.																	
A_{2p} (Ae)	3	88.9	6.5	5.3	0.9	0.3	0.2	25.52	1.21	0.09	0.90	0.09	0.64	8.67	2.21	1.00	0.70
B_p (Bf)	9	87.1	8.0	5.6	2.0	0.4	0.4	21.32	1.01	0.10	1.00	0.15	1.07	4.23	1.08	1.43	1.00
C_p (Ae)	6	87.8	7.7	5.5	1.8	0.4	0.4	22.46	1.07	0.11	1.10	0.15	1.07	4.91	1.25	1.43	1.00
B_2 (Bt)	2	79.4	13.4	9.3	3.6	0.5	0.8	11.58	0.55	0.08	0.80	0.17	1.21	3.96	1.01	2.22	1.55
C	at 20	87.1	8.2	5.6	2.2	0.4	0.4	21.01	1.00	0.10	1.00	0.14	1.00	3.93	1.00	1.43	1.00

1. Absolute ratios.
2. Relative ratios based on the lowest horizon as unity.

appears to be associated with organic matter. Generally, soils high in organic matter contain more phosphorus. In the Grey Wooded soils particularly the total phosphorus content of the Ae and B horizons is lower than that of the C horizons, suggesting that phosphorus might be one of the first nutrients limiting crop production in this area.

Exchangeable Cations—The data in Table 6 indicate that over 50 per cent of the exchangeable cations consist of calcium, magnesium, sodium, and potassium. The dominant basic cations are calcium and magnesium.

The exchangeable cations are of significant concern in the classification of Solonetzic soils. The data show that the ratio of calcium to magnesium and sodium is less than 1 in the Solodized Solonetz profiles reported but approaches equality in the Solod profiles of this region.

Fusion Analyses—Total chemical analyses and molecular ratios are given in Table 7. The values serve to indicate the degree of leaching as reflected in the translocation of the oxides of iron, aluminum and silica. While it is apparent, Table 7, that leaching is active in all profiles the degree of this translocation is significant. Thus soils developed on the coarse textured parent materials (Sundance, Pinto) are more leached than those developed on finer textured parent materials (Hillburn, Demmitt, and Hythe). However, with respect to the latter group of soils, the Hillburn profile shows the highest translocation, suggestive of the characteristics common to the Bisequa Grey Wooded profile.

APPENDIX III

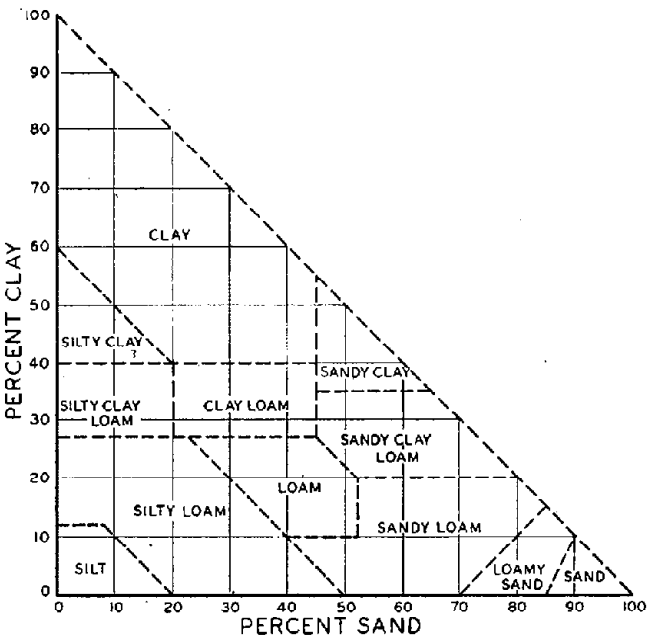
Throughout this report and in field classification frequent use is made of the relative terms to describe features of significance in the mapped area. Definitions of some of these terms and the field designations used in this area are as follows:

TABLE 8—Soil Separates (Particle Sizes) on which Textural Classes are Based

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

Figure 38—Chart showing Proportions of Soil Separates in Various Soil Textural Classes

From: Toogood, J. A.—A Simplified Textural Classification Diagram. Can. J. Soil Sci. 38: 54-55. 1958.



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

TABLE 9—Classes of Stony Land

S_0—*Stone free.*

S_1—*Occasional stones*—no serious handicap to cultivation.

S_2—*Moderately stony*—requiring removal, occasional stone piles in the field.

S_3—*Very stony*—serious handicap to cultivation, frequent stone piles in the field.

S_4—*Excessively stony*—too stony to permit cultivation.

TABLE 10—The Classification of Tree Cover

T_0—*Open land*—trees no handicap to cultivation.

T_1—*Light tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 4 acres per hour.

T_2—*Medium tree cover*—can be cleared by heavy, crawler type, clearing machinery at a rate of about 2 acres per hour.

T_3—*Heavy tree cover*—can be cleared at a rate of about 1 acre per hour.

T_4—*Excessively heavy tree cover*—preferably left for timber.

Further designations, relating to the prevailing types of trees, are often included in this field classification.

TABLE 11—The Classification of Calcareous Soil Materials

Cc_1—*Slightly Calcareous*—materials usually contain less than the equivalent of 1 percent calcium. Weak effervescence to dilute hydrochloric acid.

Cc_2—*Moderately Calcareous*—materials that contain the equivalent of from 1 to about 5 percent calcium. Moderate effervescence to dilute hydrochloric acid.

Cc_3—*Very Calcareous*—materials that contain the equivalent of from 5 to about 10 percent calcium. Strong effervescence to dilute hydrochloric acid.

Cc_4—*Extremely Calcareous*—materials that contain the equivalent of over 10 percent calcium. Violent effervescence to dilute hydrochloric acid.

Classification of Soil Structure

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

Blocky—Block-like aggregates with sharp angular corners.

Nuciform—Nut-like aggregates with more or less clearly defined edges and faces that are sub-rectangular.

Granular—More or less rounded soil aggregates with an absence of smooth faces and edges, relatively non-porous.

Platy—Thin horizontal plates or aggregates in which the horizontal axis is longer than the vertical.

Columnar—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well-defined regular edges and surfaces. The tops of the columns are usually rounded. Commonly found in the B horizon of Solonetzic soils.

Prismatic—Fairly large aggregates with a vertical axis longer than the horizontal and with fairly well defined regular edges and surfaces. The tops of the aggregates are usually flat.

Massive—Large cohesive masses of soil, almost amorphous or structureless, with irregular cleavage faces.

Vesicular—A soil structure that is characterized by small round or oval cavities or vesicles. *Crumb* structure is the term applied to porous granular aggregates.

Depending on the degree of distinctness, the various grades of structure may be indicated as weak, moderate or strong. Descriptive terms commonly used to denote size of structural aggregates are very fine, fine, medium, coarse, or very coarse. Such terms as friable, hard, firm, very firm, etc., refer to the durability of the aggregates to displacement or gentle crushing.

TABLE 12—Classification of Drainage

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

Well Drained—Removal of water is not too rapid.

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

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

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

The foregoing terms are relative and refer in a general way to the natural drainage characteristics of a soil. Specific reference to surface drainage may be designated in terms of run-off and described as high, medium, low or ponded. Similarly specific reference to the characteristics of horizons within the profile may be designated in terms of permeability or percolation characteristics and described as rapid, moderate, slow, very slow or none.

TABLE 13—Horizon Suffixes

From: Report of the National Soil Survey Committee of Canada, Feb. 1960.

a—A layer disturbed by man's activities; i.e. by cultivation and/or pasturing. To be used only with A.

c—A *cemented* (irreversible) pedogenic horizon.

cc—*Cemented* (irreversible) pedogenic *concretions*.

e—A horizon characterized by the removal of clay, iron, aluminum or organic matter. Usually lighter colored than the layer below (eluviated).

f—A horizon enriched with hydrated iron (fe). It has a chroma of 3 or more and is redder than the horizon above or below.

g—A horizon characterized by reduction and grey colors; often mottled (gley).

h—A horizon enriched with organic matter (humus). It must show at least one Munsell unit of value darker than the layer immediately below. When used as the only suffix to B(Bh) this horizon must contain 10 percent or more of organic matter.

j—A horizon whose characteristics are weakly expressed (juvenile).

k—A horizon enriched with carbonate (kalk).

m—A horizon characterized by the loss of water soluble materials only. Usually slightly altered by hydrolysis and/or oxidation (mellowed).

n—A horizon containing over 15% exchangeable sodium or more exchangeable sodium plus magnesium than calcium (natrium).

p—A relic (not currently dynamic) horizon to be used as a prefix (paleosol). For example, an Ah horizon that underlies the present solum.

q—A *quasi* cemented pedogenic horizon.
r—An inherited consolidated layer (rock). Always use with C.
s—A horizon enriched with salt including gypsum (salt).
t—A horizon enriched with silicate clay (ton).
w—A water saturated layer; the apparent water table (water).
z—A permanent frozen layer (zero).

GLOSSARY*

Aeolian deposition—Wind laid material.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Gley—Gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction, is characterized by a grey often mottled appearance which on drying shows numerous rusty brown iron stains or streaks. It is generally very sticky when wet and hard when dry. Those horizons in which the gleying is intense are often designated as Bg or Cg horizons.

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

Horizon—A layer in the soil profile approximately parallel to the land surface with more or less well defined characteristics that has been produced through the operation of soil building processes.

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

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

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

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

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

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

Orthic—A term used in soil classification, to denote the sub-group that typifies the central concept of the great group.

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

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

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

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

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

Solodization—A soil forming process that is somewhat similar to podzolization in that the soil becomes acid in the surface horizons and develops a leached A_2 horizon. Through improved drainage and an accompanying decrease in the salt content of Solonetz soils they develop a leached A horizon accompanied by a general breakdown of the hard B horizon that ultimately results in the development of a Solod soil. The process of change of Solonetz to Solod is called "solodization".

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

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

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

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

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

Varve—A periodic accumulation of sand, silt and clay deposited in a lake basin. The light colored coarser silt in each varve is at the bottom and represents the initial materials settled in the flooding. The dark colored fine clay at the top is that which settled out slowly in quiet water during the latter stages of flooding. The thickness of a varve averages from 1/8 inch to 1/2 inch or even more and depends on the prevailing conditions of the flooding.

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

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