SOIL SURVEY

of

GATINEAU AND PONTIAC COUNTIES

Quebec

Paul G. Lajoie

Research Branch, Canada Department of Agriculture
Quebec Department of Agriculture and
MacDonald College, McGill University
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INTRODUCTION

This report is an inventory of the soil resources in certain areas of Gatineau and Pontiac counties.

Brief descriptions of the areas are given, and also of their climates, vegetation, topography, drainage and surface geology. The soils are described in detail and their agricultural possibilities summarized. In addition, the agricultural history and development of the area are outlined, the present use of the land is noted, and the various soils are rated in terms of crop adaptability, natural fertility and management requirements.

A soil map, in three sheets, shows towns, villages, roads, railways, lakes, rivers and the farm houses. From these and the concession and lot numbers, any farm holding can be located. The various soil series and types as well as their stoniness and topography are shown by colors and symbols, which are explained in the map legend.

GENERAL DESCRIPTION OF THE AREA

Location

Gatineau County was surveyed from the Ottawa River to north latitude 46° 45′, a distance of 93 miles south to north, and from west longitude 75° 43′ to 76° 09′, a distance of 20 miles east to west. Pontiac County is the western boundary and Papineau and Labelle counties are the eastern boundary of the surveyed area.

Pontiac County was surveyed from the Ottawa River to north latitude 46° 00′ on the west side and to 46° 19′ on the east side, and from the Gatineau County boundary west to 77° 17′, a distance of about 54 miles.

The areas of the two counties that were surveyed and the positions of the three soil map sheets are shown in Figure 1.

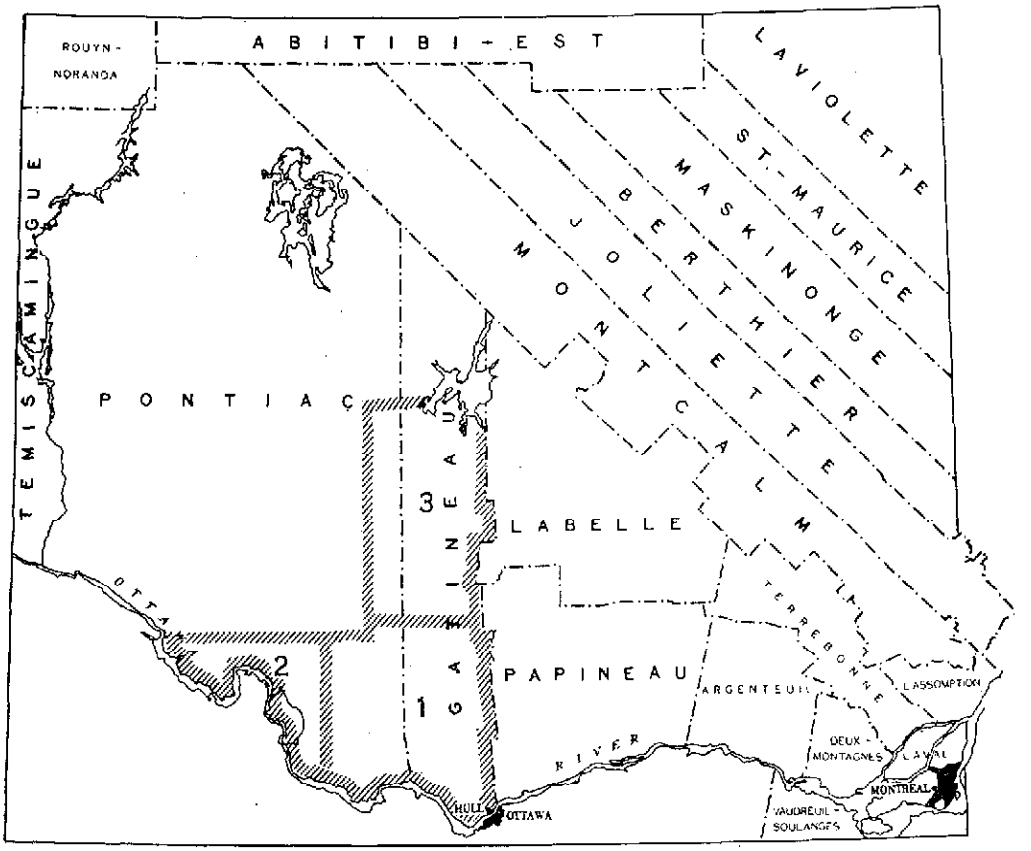

FIGURE 1.—Map of southwestern Quebec showing the areas surveyed in the counties of Gatineau and Pontiac. Sheet 1, Hull-Kazabazua; Sheet 2, Chapeau-Shawville; Sheet 3, Gracefield-Grand Remous.

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Area

The area of Gatineau County is 1,556,480 acres, and 1,134,810 acres were surveyed. The area of Pontiac County is 6,118,400 acres, and 887,174 acres were surveyed. The total area surveyed was 2,021,984 acres.

Population

In 1951, the population of Gatineau County was 35,264 and that of Pontiac County 20,696. The population is increasing faster in Gatineau than in Pontiac, because of the expansion of urban centers. By 1956 the population increased to 40,754 in Gatineau and to 20,995 in Pontiac.

In Gatineau County the most important urban centers in the surveyed area are Aylmer, Maniwaki and the outer fringes of the city of Hull. In Pontiac, Fort-Coulonge and Shawville are incorporated villages over 1,000 in population.

In Gatineau County, 23,139 persons lived in rural areas and 12,125 in urban areas in 1951. Of the rural population 10,273 were on farms. In Pontiac there were 18,106 in rural and 2,590 in urban areas; of the rural population 8,932 were living on farms.

Transportation and Markets

Economic activity in the two counties is closely related to the urban centers of Ottawa and Hull. Most traffic is along Quebec Route 8, a class one highway that follows the Ottawa River from Montreal through Hull to Sheenboro. Three bridges connect Hull and Ottawa and there are interprovincial bridges at Portage-du-Fort and Ile-aux-Allumettes. A few ferries operate between different points on the Ottawa River. Another class one highway, Quebec Route 11 from Hull to Maniwaki, joins Route 58, the highway from Montreal through Mont Laurier to Senneterre. There are many secondary roads and forest roads.

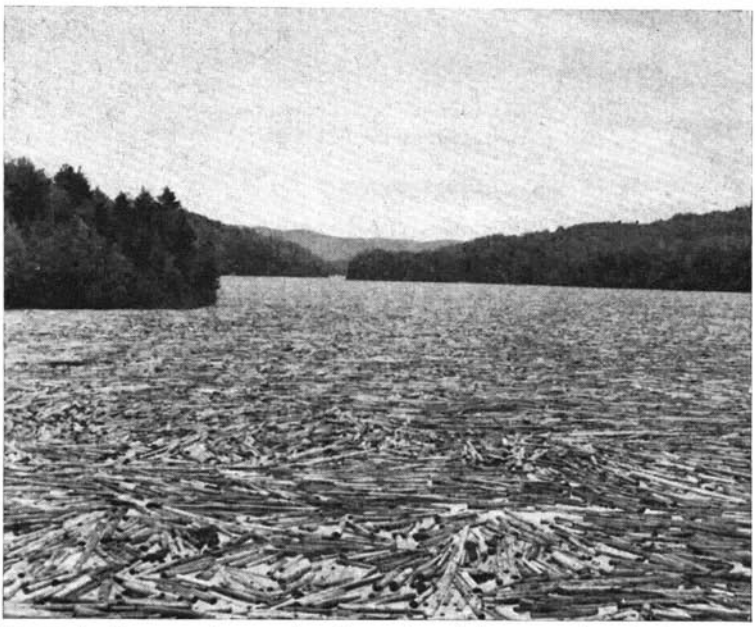

FIGURE 2.—Large volumes of pulpwood and logs are floated down the Gatineau River each year.

Rail and water transport also are important. The Canadian Pacific Railway has branch lines from Hull to Maniwaki in the Gatineau River Valley and to Waltham on the Ottawa River. The Canadian National Railway main line from Ottawa to North Bay crosses the southern part of Pontiac County. Water transportation is used only for floating pulpwood and logs to mills (Figure 2). The Gatineau River is the principal logging stream but the Ottawa River and some small streams, lakes and ponds are also used.

Ottawa and Hull are the main markets for agricultural produce.

FACTORS IN SOIL FORMATION

Soils develop through the action of climate, drainage, vegetation and topography on parent material. The topography, or relief, and the porosity of soil materials regulate the rate and degree of runoff, percolation and aeration. The natural soil drainage depends on a number of factors, and differentiates soils in the field.

Climate determines, in part, the various kinds of profiles that may be formed in a given area. The vegetation itself depends on climate but it also influences soil formation.

The chemical and physical properties of the parent materials influence the type of soil formed. The parent material is the raw substance on which relief, drainage and climate have acted to produce the present soils. A study of each factor in soil formation helps to explain some of the variations in the soils of the two counties, and also the general conditions that influence the use and management of the various soils.

Climate

The climate of western Quebec is of the cool temperate type; within the area surveyed there are minor differences due to local factors such as elevation, air drainage, exposure of slope and proximity of large water bodies. These differences evidently affect soil development, as they seem to cause the differences between the Brown Podzolic Gatineau soils and the Podzol Ste-Agathe soils, which are developed on the same parent material. The Brown Podzolic soils occupy the more southerly position, where the climate is slightly warmer and drier.

Temperature and Frost-free Periods

Table 1 shows the mean monthly and mean annual temperatures for five locations in or near the surveyed areas. Mercier Dam, in the extreme north of the surveyed area of Gatineau County, is the highest and most northerly station and is about three degrees cooler than the most southerly stations.

The frost-free periods (32° F.) vary widely at Maniwaki and considerably at Ottawa and at Chelsea Falls (Table 2). The 28° frost-free season averages two to four weeks longer than the 32° frost-free season. Mercier Dam has the shortest 28° frost-free season, 126 days.

Precipitation and Soil Moisture Supply

The mean monthly and mean annual precipitation vary fairly widely between the eight stations where records were taken (Table 3). However, the range is narrower for the stations close to the Ottawa River, in the most important agricultural area. The monthly precipitation is slightly greater in the summer than at other times. During the summer, Mercier Dam receives more precipitation than any other station.

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TABLE 1.—MEAN MONTHLY AND SEASONAL TEMPERATURES (° F.) AT SELECTED POINTS[1]

Month	Mercier Dam	Maniwaki	Chelsea	Ottawa	Pembroke
November	30	30	33	32	33
December	15	15	18	17	17
January	9	11	12	12	12
February	10	11	11	13	14
March	23	23	24	25	26
April	37	39	39	41	41
Mean	21	22	23	23	24
May	51	54	54	55	55
June	61	63	64	65	64
July	65	66	69	70	69
August	63	64	67	66	66
September	54	56	58	58	59
October	43	44	47	46	46
Mean	56	58	60	60	60
Mean for year	39	40	41	42	42

[1]Compiled from Monthly Record of Meteorological Observations, Canada Department of Transport, Toronto, 1952.

TABLE 2.—FROST-FREE PERIODS AT SELECTED STATIONS[1, 2]

—	Mercier Dam	Maniwaki	Chelsea Falls	Ottawa Experimental Farm	Pembroke
Years of observation	23	32	22	44	54
Frost-free period, 32° F., days					
shortest	72	21	131	114	83
average	115	101	154	141	132
longest	128	138	176	174	166
Frost-free period, 28° F.					
shortest	104	108		129	128
average	126	130		156	151
longest	153	152		173	179
Last spring frost, 32° F.					
earliest	May 11	May 1	April 16	April 15	April 23
average	May 26	May 29	May 7	May 11	May 16
latest	June 18	July 15	May 21	May 27	June 20
Last spring frost, 28° F.					
average	May 20	May 16		May 3	May 7
latest	June 6	June 6		May 18	May 19
First fall frost, 32° F.					
earliest	Aug. 29	July 17	Sept. 23	Sept. 10	Sept. 1
average	Sept. 18	Sept. 7	Oct. 8	Sept. 29	Sept. 25
latest	Oct. 9	Oct. 3	Oct. 29	Oct. 17	Oct. 21
First fall frost 28° F.					
earliest	Sept. 12	Sept. 3		Sept. 24	Sept. 17
average	Sept. 23	Sept. 23		Oct. 6	Oct. 5

[1]Compiled from Climatic Summaries, Vol. III, Frost Data, Department of Transport, Toronto, 1956
[2]Data on killing frosts computed from Monthly Record of Meteorological Observations, Canada Department of Transport, Toronto, 1955.

TABLE 3.—MEAN MONTHLY PRECIPITATION IN INCHES AT SELECTED STATIONS[1]

	Mercier Dam	Maniwaki	Chelsea	Ottawa Experimental Farm	Otter Lake	Shawville	Fort Coulonge	Sheenboro
Altitude, feet	740	570	329	260	700	545	370	570
Number of years of record	31	40	30	62	7	9	8	8
November	3.0	2.8	2.9	3.0	2.7	2.6	2.5	2.4
December	3.0	2.6	3.4	2.6	2.9	2.8	2.5	2.2
January	2.6	2.1	3.0	2.9	2.5	2.5	1.6	1.9
February	2.1	1.7	2.3	2.5	1.7	1.8	2.0	1.6
March	2.6	2.2	2.9	2.7	2.3	2.5	2.5	2.4
April	2.7	2.2	2.7	2.7	2.1	2.9	2.5	2.3
Total	16.0	13.6	17.2	16.4	14.2	15.3	13.5	12.8
May	2.6	2.5	3.0	2.5	3.1	2.9	3.2	1.9
June	3.5	3.1	3.1	3.5	2.9	3.3	3.4	3.2
July	3.8	3.4	3.0	3.4	3.5	3.4	3.5	3.3
August	3.5	3.0	2.6	2.6	2.8	2.6	3.1	3.2
September	3.9	3.3	3.3	3.2	3.2	3.3	3.4	3.4
October	2.7	2.7	2.5	2.9	3.5	2.5	3.0	2.8
Total	10.2	18.1	17.3	18.1	19.0	18.0	19.6	17.7
Total for year	36.0	31.7	34.5	34.4	33.1	33.2	33.1	30.5

[1]Compiled from Meteorological Bulletin, Department of Trade and Commerce, Province of Quebec, 1958, and from Monthly Records of Meteorological Observations, Meteorological Branch, Canada Department of Transport, Toronto, 1958. Ten inches of snow equals 1 inch of rain.

To estimate the soil moisture surpluses or deficiencies in the surveyed area, it is necessary to compare the precipitation figures with those for evaporation. At Ottawa[1], free surface evaporation from a tank of water averaged 19.3 inches from May 1 to September 30 for 24 years. The rainfall being 15.2 inches, the average soil-moisture deficiency was 4.1 inches.

The average annual moisture deficiencies computed by Marie Sanderson[2] for three points near the surveyed area are: at Ottawa, 1.9 inches; at Renfrew (Sand Point), 3.3 inches; and at Pembroke, 1.0 inch.

TABLE 4.—NUMBERS OF YEARS OUT OF 26 IN WHICH SOIL MOISTURE DEFICIENCIES OF VARIOUS MAGNITUDES OCCURRED AT OTTAWA[1]

Deficiency Inches	June	July	August	September	October	November
0	22	9	5	7	21	26
0 to 2	4	10	10	18	5	0
2 to 4	0	7	9	1	0	0
4 to 6	0	0	2	0	0	0

[1]Sanderson, Marie, Moisture relationships in southern Ontario, Sci. Agr. 30: 235-255, 1950.

Table 4 shows that monthly soil-moisture deficiencies at Ottawa occur most regularly from July to September. Generally, these deficiencies are less than two inches. Prolonged drought, especially in August, may reduce the yield of some crops in occasional years.

Natural Vegetation

Forest was the original vegetation of the entire area surveyed. The major forest association is found on well-drained sites such as mountains, hills, till

[1] Progress Report 1936-48, Division of Field Husbandry, Soils and Agricultural Engineering, Canada Department of Agriculture, Ottawa, 1950.

[2] Sanderson, Marie, Moisture relationship in southern Ontario, Scientific Agriculture 30: 235-255, 1950.

ridges and places where drainage is good to moderately good but not excessive. This association is made up of sugar maple (*Acer saccharum*) as the dominant species and other deciduous trees such as yellow birch (*Betula lutea*), beech (*Fagus grandifolia*), red maple (*Acer rubrum*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), white birch (*Betula papyrifera*), red oak (*Quercus borealis*) and trembling aspen (*Populus tremuloides*) in lesser numbers. Along with these deciduous trees, a few coniferous ones are found on well-drained sites; balsam fir (*Abies balsamea*), white spruce (*Picea glauca*) and eastern white pine (*Pinus strobus*).

On excessively drained soils, the usual tree association is dominated by conifers. Among these are eastern white pine (*Pinus strobus*), red pine (*P. resinosa*), jack pine (*P. banksiana*), balsam fir (*Abies balsamea*) and white spruce (*Picea glauca*). The deciduous trees in these associations are: white birch, trembling aspen and red oak.

On imperfectly drained to well-drained soils of the Laurentian valleys and of the upper Ottawa Valley, a mixed association of trees, including most of the trees mentioned above, is most common. Generally, the deciduous trees are dominant and the proportion of conifers varies greatly.

On imperfectly drained soils the soil moisture content is higher, soil temperatures are lower and coniferous and deciduous trees are about evenly distributed. The most common coniferous trees are white spruce, white cedar, balsam fir and tamarack (*Larix laricina*), and the deciduous trees are red maple, elm, white birch and white ash.

On poorly drained soils, muck soils, swamps and places where the water table is high, coniferous trees are dominant, notably black spruce (*Picea mariana*), white spruce, tamarack, balsam fir and white cedar (*Thuja occidentalis*). The deciduous trees found on poorly drained soils are black ash (*Fraxinus nigra*), elm, willow (*Salix* spp.) and aspen.

Topography

The surveyed area lies mainly in the Laurentian Upland physiographic region; a narrow band in the south is in the Ottawa Valley Lowland. The Laurentian Upland region, excepting river valleys and lacustrine basins, is an old peneplain that ranges from 800 to 1400 feet above sea level. It is rolling to mountainous. The river valleys and lacustrine basins are undulating to level and are 400 to 800 feet above sea level.

The Ottawa River valley rises from 200 feet above sea level at Hull to 400 feet at Chapeau. From the river, the valley floor extends only a few miles northward on the average, but varies considerably in width. Undulating to level topography with occasional gullying is typical of the valley.

Drainage

Hydrography

The surveyed area is part of the Ottawa hydrographic basin. The Ottawa River flows from west to east and in the surveyed area all drainage waters entering it come from the north. In Gatineau County, the most important tributary of the Ottawa is the Gatineau, which originates only a few miles southwest of the source of the Ottawa. The Gatineau flows southward into Baskatong Lake and then southward into the Ottawa River at Hull. En route, the Gatineau is joined by the Thirty-one-mile and Ste. Marie lakes system and by numerous small rivers and creeks.

In Pontiac County, three main rivers drain the surveyed area. From west to east they are: the Black River entering the Ottawa at Waltham, the Coulonge entering at Davidson and the Quyon entering at Quyon. In addition, many small streams flow from the north into the Ottawa.

The whole Laurentian Upland region is characterized by a multitude of lakes and fast-flowing streams. In Gatineau County 7.7 percent of the surveyed area is covered by water excluding the Ottawa River; in Pontiac, 4 percent. There are several hydroelectric generating stations in the area. The beauty of the lakes and streams has made them an important tourist attraction.

Soil Drainage

Soil drainage is determined mainly by the slope of the land and porosity of the soil materials.

Although soil drainage cannot be fully understood without a complete description of each site, the different soils can be grouped into drainage classes. The most frequently used classes are: excessively drained, well drained, imperfectly drained, poorly drained and very poorly drained. A class of soil drainage may be produced in different ways; for example, excessive drainage may be produced either by very steep slopes or by very high porosity or by a combination of both factors.

In the Laurentian valleys, the porosity of the materials and the kind of slopes vary to produce a wide range of drainage conditions within small areas. Excessively drained soils are found on coarse sand and on gravels regardless of topography or slope because of the rapid permeability of these materials. Swampy depressions are often associated with these excessively drained soils because the low water retention by coarse materials causes rapid seepage of drainage water to depressed areas. Swampy depressions are less numerous where clay soils predominate because these have a high moisture-holding capacity. On the Laurentian Uplands most of the soils are well drained to excessively drained because the relief is dominated by short steep slopes, which induce rapid runoff.

In the Ottawa Valley, drainage varies less sharply than in the Laurentian Upland because of more nearly level topography and the predominance of fine-textured soils. Most of these soils are imperfectly to poorly drained. The slowly permeable clays, which are present almost everywhere either on the surface or in the subsoil, are largely responsible for the slow rate of water movement. In some areas, however, gullies incised in the clays speed up the runoff and underground seepage considerably to produce well-drained soils. Excessively drained soils are found only on porous sand deposits.

Parent Materials

Bedrock Geology

The surveyed area is underlain by Precambrian rocks except for an area west and southwest of Hull and small areas along the shore of the Ottawa River that are underlain by Paleozoic formations. Paleozoic formations underlie parts of Calumet Island and all of Allumette Island. The Ottawa formation is dominant west of Hull and is mainly limestone: some shaly partings, interbedded shale, dolomite, and sandstone are present in the lower parts. The Ottawa formation belongs to the Trenton-Black River series of formations and is of the Middle Ordovician period. There is a long strip of the Rockcliffe formation (shale with lenses of sandstone) next the Ottawa River between Breckenridge and the Chaudiere Rapids. This formation belongs to the Chazy series and is of the Lower Ordovician period. A small area west of Aylmer belongs to the Oxford formation and consists of dolomite and limestone of the Beekmantown series (Lower Ordovician). Small pockets of Beekmantown are found near the Ottawa shore between Quyon and Norway Bay. At the northwest extremity of Calumet Island, there are rocks of the Chazy series, and rocks of the Chazy and Beekmantown series underlie Allumette Island.

The Precambrian rock formations belong mainly to the Grenville series, which consists largely of metamorphic rocks such as crystalline limestone, quartzite, and various kinds of gneissic rocks. The oldest Grenville rocks are intruded by relatively small bodies of granite, syenite and pegmatite as well as by some basic rocks like the gabbros.

Surface Deposits

The surface deposits, which are the soil parent materials of the surveyed area, may be classed by origin into five groups: glacial, fluvial, marine and lacustrine, alluvial and organic. This is also very much the order in which they were deposited.

Continental glaciers left glacial till of variable thickness over the surveyed area. The till consists of rock fragments and rock flour, and the particles range in size from clay and silt to sand, gravel and boulders.

The tills cover nearly all the Laurentian Uplands. They are derived from the underlying hard metamorphic and igneous rocks such as gneiss, quartzite, crystalline limestone and granites and usually contain many large rounded and semiangular boulders.

Shallow till deposits originating from acidic Precambrian rocks have given rise to soils of the Lakefield and St. Colomban land types; on deeper but similar deposits, soils of the Gatineau, Ste. Agathe (Figure 3) and Aumond series have formed. The Larose land type has formed in areas where the bedrock is largely composed of crystalline limestone.

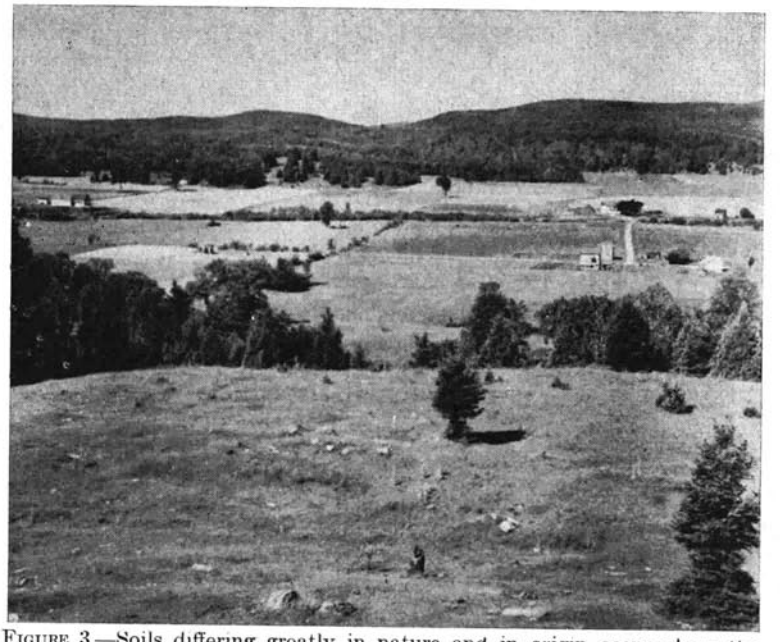

FIGURE 3.—Soils differing greatly in nature and in origin occur along the narrow valley leading to Blue Sea Lake. Larose and Ste. Agathe soils, on glacial till, border the sides of the valley; Montcerf soils, on lacustrine deposits, occupy the valley floor; and Brébeuf and Ripon soils fringe the stream in the center of the valley.

The tills derived from Paleozoic rocks may be similarly separated by their composition and their depth to bedrock. The shallow acidic tills are the parent materials of the Stonefield land type, and the shallow calcareous tills are the parent materials of the Farmington land type. The deep calcareous tills are the parent materials of the St. Bernard and Matilda soils.

The glacial tills were washed by glacial and postglacial streams, which transported and deposited fluvio-glacial materials along the main river valleys and along the shore of the lakes or sea that existed in the Ottawa Valley at the close of the glacial period. Closest to the glacier where the sorting action of streams was least pronounced, gravel and rounded cobbles, and even boulders, were deposited and are the parent material on which the St. Faustin soils have developed. Better-sorted and less-coarse deposits of noncalcareous gravels are the parent material of St. Gabriel and Mont-Rolland soils, and calcareous gravels are the parent material of Calumet soils. Some of these gravels were later buried under one to four feet of fine alluvium, on which the Coulonge series has developed.

Gravelly fluvial deposits over clay are the parent material of Lesage soils, and gravelly fluvial deposits containing marine shells and derived largely from Paleozoic calcareous rocks are the parent material of the Oka soils.

After the glacier retreated, a sea covered the low-lying areas of the Ottawa Valley, and the Gatineau Valley was apparently an estuary of a large river flowing into the sea. This estuary varied in width and connected many small lakes.

During the soil survey three main types of thick marine and lacustrine clayey deposits were recognized. The thickest is of marine origin and was apparently deposited in deep water. It is more than 60 percent clay and has a uniform massive structure. Such a marine deposit is found mainly in the Ottawa Valley and is the parent material of the Rideau, Ste. Rosalie and Laplaine soils.

FIGURE 4.—Brébeuf soils have developed on laminated, water-laid materials.

Lacustrine deposits near Maniwaki are generally laminated (Figure 4) or varved; their clay content is seldom above 40 percent and their silt content is often above 50 percent. These silty lacustrine deposits are the parent materials of the Bouchette, Montcerf and Maniwaki soils.

Other deposits are intermediate in clay and silt content and are the parent materials of Brandon, Chapeau, Dalhousie and Pontiac soils. They occur in the lower part of the Gatineau Valley and along the upper rim of the Ottawa Valley. At great depths they resemble the marine deposits and are generally of very uniform clay composition, but near the surface they are much more silty and are often laminated.

About 2 feet of this clayey lacustrine material covers small areas of calcareous till along the Ottawa River, especially near Deschenes. On these, the Châteauguay soils have developed.

After their deposition some of the tills and much of the clayey deposits were covered by alluvial material ranging from coarse sand (or gravel) to fine loamy material. The coarse and sometimes gravelly outwash sand, found mainly in the upper part of the Laurentian valleys, is the parent material of the Morin and Deligny soils. A slightly finer and very well sorted sand was deposited over the clays of the Ottawa Valley and is the parent material of the Uplands, Ste. Sophie and St. Jude soils. A fine sand containing occasional laminations of silt and very fine sand was deposited on the borders of the main lacustrine basins and is the parent material for the Ivry and Bevin soils. A uniform, very fine sand was deposited over the clay of the Ottawa Valley. It is the parent material of the St. Thomas, Achigan and Vaudreuil soils. These different kinds of sands are usually thick and are extensive.

Other sands are found in limited areas, some over acid Laurentian till like the Guindon sand, some over calcareous till in the Ottawa Valley like the St. Benoit sand, and others over clay in the Ottawa Valley such as St. Damase and Courval soils. Some valley floors are partly covered with a variable mixture of fine and coarse sand that is the parent material of the Ripon soils. Finally, some sands recently deposited along the present streams are differentiated by the immaturity of the soil profiles developed on them. Some of these sands are of medium size, like the Ottawa sand found along the Ottawa River, and some are very fine, such as the Diable sand.

Loamy materials were also deposited, mainly over clays but sometimes over tills. Aeolian loam to silt loam was deposited over some of the high ridges bordering wide Laurentian valleys; St. Jovite soils developed on one to three feet of aeolian material underlain by stony Laurentian till. In the Laurentian valleys, deposits of a few feet of sandy loam over lacustrine material are the parent materials of the Piedmont and Hull soils, and similar material of still finer texture, very fine sandy loam to loam and silt loam, is the parent material of the Brebeuf, Allumette and Demers soils. In the Ottawa Valley, sandy loam less than three feet thick over calcareous till is the parent material of the Chicot soils. Also in the Ottawa Valley, some clays are covered by 2 to 5 feet of very fine sandy loam and the Coteau and Soulanges soils have developed on these.

Finally, loamy alluvium deposited by modern rivers is the parent material of the Lachute soils.

Organic deposits accumulated in depressional areas complete the long list of unconsolidated surface materials from which the wide variety of soils found have developed.

SOIL DEVELOPMENT AND CLASSIFICATION

Soil development is determined by climate, vegetation, topography, drainage and parent materials. Parent materials are passive factors on which the others act to produce a specific kind of soil profile. A soil profile is a vertical section of a soil through all its horizons, or layers, and extending into the parent material.

The horizons vary in chemical composition, color, texture and structure. In the area surveyed the kinds of profiles produced on mineral soils are classified in the following great soil groups: Podzol, Brown Podzolic, Brown Forest, Gray Brown Podzolic, Gray Wooded, Dark Gray Gleysolic, Gleysol, Lithosol and Recent Alluvium. The soils produced on organic materials are classified by their degree of decomposition and are called muck, peaty muck and peat.

Podzol Group

Podzols are a group of well and imperfectly drained soils. The well-drained members have an intensely leached and ash-colored horizon (A_2) under the thin, raw humus layer (A_0) at the surface. Under this ash-colored horizon there is a uniform reddish-brown to yellowish-brown horizon (B_2). The Podzols (Figure 5) are acidic throughout their profiles. In the area surveyed, such profiles have formed on most of the well-drained sandy and loamy materials.

The imperfectly drained (gleyed) members, formerly called Ground Water Podzols, have the same sequence and number of main horizons as the well-drained Podzols, but are mottled throughout the profile. The mottling indicates imperfect drainage and aeration and consists of various-colored spots and streaks spread irregularly in the soil, such as gray in reddish-brown and yellowish-brown in grayish-brown. The imperfectly drained Podzols are acidic throughout the profile. They are widely represented in the area surveyed by such series as St. Jude, Achigan and Allumette as well as by nearly all the imperfectly drained sands and sandy loams.

FIGURE 5.—The Coulonge series is typical of the Podzol great soil group.

Brown Podzolic Group

Brown Podzolic soils are well drained, acidic, and of uniform color throughout their profiles. However, they lack the characteristic ash-colored horizon (A_2) of the Podzols below the raw humus layer (A_0), except for a faint indication of such a layer in some cases. In the area surveyed the most widespread Brown Podzolic soil is the Gatineau series.

Brown Forest Group

Brown Forest soils resemble Brown Podzolic soils in drainage and in the uniform distribution of brown color through the solum but differ in having an organic-mineral surface (A_1) in place of a raw humus layer. Brown Forest soils are neutral to alkaline at least in the lower part of the profile and the lower part contains free carbonates. In the surveyed area these soils have developed on calcareous, loamy tills and are very limited in extent. The St. Bernard series is the best example. Some profiles of the Larose land type also belong in this group.

Gray Brown Podzolic Group

Like Brown Forest soils, Gray Brown Podzolic soils (Figure 6) have developed from calcareous materials. However, the free carbonates have been leached out of the upper part of the profile, which has consequently become slightly acidic or neutral in reaction. The Gray Brown Podzolic profile consists

FIGURE 6.—The Oka series, developed on calcareous parent material, is typical of the Gray Brown Podzolic great soil group.

of a few inches of mineralized organic surface (A_1) over a yellowish-brown, noncalcareous layer (A_2) 10 to 30 inches thick that changes abruptly to a darker brown, more clayey horizon (B_2). The parent material (C), which is found immediately below this horizon, is calcareous. The gravelly Oka soil found north of Aylmer is an example. The gravelly Calumet soil also belongs to this group, but often in this soil a Podzol is beginning to form in the upper part of the Gray Brown Podzolic profile.

Gray Wooded Group

Gray Wooded soils have an organic surface layer usually one to three inches thick, underlain by a light-colored, leached horizon that rests on a darker-colored, more-clayey horizon. The parent material is generally basic in reaction. The Chapeau series is an example.

Dark Gray Gleysolic Group

All the Dark Gray Gleysolic soils in the surveyed area have developed on fine-textured materials with imperfect to somewhat poor natural drainage. They have a mineralized organic layer generally more than three inches thick over a thin irregular horizon that is weakly leached and mottled. This in turn rests upon a horizon distinguished from the parent material by considerable mottling or by minor differences in structure and color. The Ste. Rosalie and Dalhousie are two important soils of this group. The Montcerf has also been classed in this group but the humus layer of these soils is rawer than that of the other soils of the group.

Lithosol Group

The soils grouped under the name of Lithosol are the Farmington and Stonefield land types. These soils have formed on till deposits so shallow over bedrock that the soil profiles could not develop normally.

Gleysol Group

Gleysols have developed under very poor natural drainage. They consist of a very dark, generally black, rather raw humus surface layer four inches or more thick, over bluish-gray mineral soil that may be mottled. There is little profile development other than the gleyed layer caused by absence of air. Various types of materials under poorly drained conditions have produced Gleysols, among which are the Vaudreuil and Maniwaki soils.

Recent Alluvium

The Recent Alluvium consists of recent alluvial deposits that have not been in place long enough to acquire a definite profile. The Ottawa, Diable and Lachute soils belong to this group.

Classification into Series and Types

All the soils of the area were classified by using three criteria: the kind of parent material, the condition of natural drainage and the kind of profile development (soil group).

The *soil series* is the basis of the system of classification. All of the soils in each series were formed on the same kind of parent material under the same drainage conditions and have the same kind of soil profile. Each series is named. To the series name (Pontiac, for example) a textural name such as loam or clay loam is added to give the soil type, e.g., Pontiac loam, Pontiac clay loam. The

textural name refers to the texture of the upper part of the soil within plow depth. There are 12 recognized textural classes for soils (Figure 22 in Glossary): sand, loamy sand, sandy loam, loam, silt loam, silt, silty clay loam, silty clay, sandy clay loam, clay loam, sandy clay, and clay. Because each series is derived from one particular kind of parent material; it does not have the full range of textures but may have two or three adjoining textures such as loam, clay loam and silty clay loam. Appendix Table I gives the acreage of each soil and land type.

In the key given in Table 5, the soils are classed first on the basis of parent material, and second on the basis of soil drainage. The great soil group of each soil series is also shown, and in some classes it serves to separate different soil series with the same parent material and soil drainage conditions. For example, Gatineau series is a Brown Podzolic, and Ste. Agathe is a Podzol.

TABLE 5.—KEY TO THE SOILS OF GATINEAU AND PONTIAC COUNTIES

A. Soils Developed from Glacial Tills
- (a) Till derived from granite, gneiss, quartzite and other Precambrian rocks
  - Well drained
    - Gatineau sandy loam (BP)[1] ..... Gt[2]
    - Ste. Agathe sandy loam (P) ..... Ag
  - Imperfectly drained
    - Aumond sandy loam ..... Ao
- (b) Shallow till derived from gneiss, granite, quartzite and other Precambrian rocks
  - Well drained
    - Lakefield land type (BP-P) ..... Lk
  - Excessively to well drained
    - St. Colomban land type (P) ..... Cb
- (c) Shallow till and residual material derived from crystalline limestone, quartzite and gneiss
  - Well to excessively drained
    - Larose land type (BF-P-BP) ..... La
- (d) Till derived from Paleozoic calcareous rocks
  - Well drained
    - St. Bernard loam (BF) ..... Bn
  - Imperfectly drained
    - Matilda loam (BF) ..... Md
- (e) Very shallow till and residual material derived from Paleozoic calcareous rocks
  - Excessively to imperfectly drained
    - Farmington land type (L-BF) ..... F
- (f) Very shallow till and residual material derived from shaly noncalcareous rocks
  - Excessively to imperfectly drained
    - Stonefield land type (L-BP) ..... St

B. Soils Developed from Gravelly Materials
- (a) Materials containing shells and derived from calcareous Paleozoic rocks
  - Well drained
    - Oka loam to gravelly sandy loam (GBP-BF) ..... O
- (b) Material derived largely from crystalline limestone
  - Well drained
    - Calumet sandy loam (GBP) ..... Ca
- (c) Poorly sorted and bouldery material derived from Precambrian noncalcareous rocks
  - Excessively drained
    - St. Faustin gravelly sandy loam (P) ..... Ft
- (d) Well-sorted material derived from noncalcareous Precambrian rocks
  - Excessively drained
    - St. Gabriel gravelly sandy loam (P) ..... G
    - Mont-Rolland sandy loam (BP) ..... Mt
- (e) Well-sorted material from noncalcareous Precambrian rocks deposited over clay
  - Well drained
    - Lesage gravelly sandy loam (P) ..... Le

TABLE 5.—KEY TO THE SOILS OF GATINEAU AND PONTIAC COUNTIES
—Continued

C. Soils Developed from Clayey Deposits
- (a) Shallow clay loam over calcareous till
  - Well drained
    - Châteauguay clay loam (GBP) ..... Ch
- (b) Silty clay loams to silty clays
  - Well drained
    - Bouchette silty clay loam (P) ..... Be
      - loam to silt loam ..... Bel
  - Poorly drained
    - Montcerf silty clay loam to clay loam (GG) ..... Mf
  - Very poorly drained
    - Maniwaki silty clay loam (G) ..... Mw
- (c) Silty clay loam to silt loam over clay
  - Imperfectly drained
    - Baudette silty clay loam (GG) ..... Bd
- (d) Very shallow loam to silt loam over clay loams and clays
  - Well drained
    - Pontiac loam (P-BP) ..... Pcl
      - silt loam to silty clay loam ..... Pc
      - clay loam ..... Pch
- (e) Clay loams to clays
  - Well drained
    - Chapeau clay (GW) ..... Cp
  - Imperfectly drained
    - Dalhousie clay (GG) ..... Dh
      - clay loam ..... D
  - Poorly drained
    - Brandon clay (GG) ..... B
- (f) Clays to heavy clays
  - Imperfectly drained
    - Rideau clay (GG) ..... Ri
      - heavy clay ..... Rih
  - Poorly drained
    - Ste. Rosalie clay (GG) ..... R
      - clay loam ..... Rl
      - heavy clay ..... Rh
  - Very poorly drained
    - Laplaine clay to clay loam (GG) ..... Lp

D. Soils Developed from Water-laid Sands
- (a) Medium to coarse sands derived from Precambrian rocks
  - Excessively drained
    - Morin sand (P) ..... Mo
      - loamy sand ..... Mol
      - coarse sand ..... Moc
  - Imperfectly drained
    - Déligny sand (P) ..... De
- (b) Mixed coarse and fine loamy sands derived from Precambrian rocks
  - Well drained
    - Ripon loamy sand (P) ..... Rn
- (c) Fine sand derived from Precambrian rocks
  - Excessively drained
    - Ivry fine sand and loamy sand (P) I
      - very fine sand and very fine loamy sand ..... If
      - wind-eroded phase ..... Ie
  - Imperfectly drained
    - Bevin fine sand and loamy sand (P) ..... Be
      - sandy loam ..... Bel
- (d) Shallow sand over nonealcareous till or bedrock
  - Well drained
    - Guindon sand to loamy sand (P) ..... Gu
- (e) Medium sand over marine clay
  - Excessively drained
    - Uplands sand (P) ..... Up
  - Well drained
    - Ste. Sophie sand (P) ..... Sp
  - Imperfectly drained
    - St. Jude sand (P) ..... J
      - sandy loam ..... Jl

TABLE 5.—KEY TO THE SOILS OF GATINEAU AND PONTIAC COUNTIES
—Continued

(f)	Fine and very fine sand over marine clay	
	Excessively drained	
	St. Thomas fine and very fine sand (P)	Th
	Imperfectly drained	
	Achigan loamy fine sand (P)	Ac
	very fine sand to sandy loam	Acf
	Poorly drained	
	Vaudreuil very fine sand and fine loamy sand (G)	Vf
(g)	Shallow sand over calcareous till or bedrock	
	Well drained	
	St. Benoit loamy sand (BP)	Bt
(h)	Shallow sand over marine clay	
	Imperfectly drained	
	St. Damase sandy loam to loamy sand (P)	Dm
	Poorly drained	
	Courval sandy loam (GG)	Cv
(i)	Recently deposited alluvial sands	
	Excessively drained	
	Ottawa sand (A)	Ot
	Well drained	
	Diable loamy fine sand to sandy loam (A)	Di
E.	Soils Developed from Aeolian Deposits over Till or Precambrian Rocks	
	Well drained	
	St. Jovite very fine sandy loam (BP)	Jv
F.	Soils Developed from Water-laid Loamy Materials	
(a)	Fine sandy loam over gravel or coarse sand	
	Well drained	
	Coulonge fine sandy loam (P)	Cl
(b)	Sandy loam derived from Precambrian rocks	
	Well drained	
	Piedmont sandy loam (P)	Pm
	Imperfectly drained	
	Hull sandy loam (P)	H
(c)	Very fine sandy loam to silt loam derived from Precambrian rocks	
	Well drained	
	Brébeuf very fine sandy loam (P)	Bfs
	loam to silt loam	Bf
	Imperfectly drained	
	Allumette very fine sandy loam (P)	At
	loam to silt loam	Atl
	Poorly drained	
	Demers silt loam (GG)	Dr
(d)	Shallow fine sandy loam over calcareous till	
	Well drained	
	Chicot fine sandy loam (BP-GBP)	C
(e)	Fine sandy loam over marine clay	
	Well drained	
	Coteau fine sandy loam (P-BP)	Ct
	Imperfectly drained	
	Soulanges fine and very fine sandy loam (P)	S
(f)	Recent alluvial deposits	
	Well drained	
	Lachute silt loam (A)	Lc
	very fine sandy loam	Lcs
G.	Undifferentiated Land Types	
(a)	Landslides and gullies with clayey surface	X
	silty surface	Xl
	sandy or gravelly surface	Xs
(b)	Alluvial soils with clayey surface	Auh
	silty surface	Aul
	sandy or gravelly surface	Au

TABLE 5.—KEY TO THE SOILS OF GATINEAU AND PONTIAC COUNTIES
—Concluded

(c) Stony and rocky land	√
(d) Organic soils, poorly decomposed—Peat (O)	Pt
moderately well decomposed—Peaty Muck (O)	Tt
well decomposed—Muck (O)	Mk
(e) Swampy land	𝌆

[1]Soil group designation:

A	Recent Alluvium	GG	Dark Gray Gleysolic
BF	Brown Forest	GW	Gray Wooded
BP	Brown Podzolic	L	Lithosol
G	Gleysol	O	Organic
GBP	Gray Brown Podzolic	P	Podzol

[2]Soil series symbol.

DESCRIPTIONS OF SOILS

In the descriptions that follow, the soil color is followed by a set of symbols that designate the color in the Munsell system. Terms that may need explaining, i.e., structure, consistence, may be found in the glossary.

Soils Developed from Glacial Tills

Gatineau Series (Gt)

The Gatineau soils (Figure 7) are the most extensive in Gatineau County, where they cover 382,877 acres. In Pontiac County, they are the second most extensive with 113,677 acres. They are well-drained till soils derived from Precambrian rocks such as granite, gneiss, gabbro, anorthosite and crystalline limestone. They occur generally on rolling to mountainous land but also occasionally on gently rolling land. The till is usually from 4 to 12 feet thick, but in many places it is much thinner and the bedrock is exposed. These soils are generally excessively stony although there is a small percentage of moderately stony land.

The Gatineau soils belong to the Brown Podzolic group, whereas Ste. Agathe soils formed on the same type of till belong to the Podzol group. Gatineau soils are found mainly on low ridges (500 to 1,000 feet), on the edge of the Laurentian escarpment, or in the valleys. There are many areas where Gatineau and Ste. Agathe soils occur together.

Gatineau soils are rapidly permeable and this, together with the relatively short slopes, reduces the hazard of erosion. The soil erodes severely, however, if it is cultivated up and down the slope. Since the cleared land is used mostly for pastures, there is little serious erosion. The virgin land is covered mainly by deciduous trees such as sugar maple, red oak, beech, basswood, white ash and elm.

Gatineau soils vary only slightly in texture and all were mapped as sandy loam. A cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Dark yellowish brown or dark-brown (10YR4/4)[3] fine sandy loam; fine granular structure; very friable and permeable; pH 5.6 to 5.9.
B_2	6-17	Yellowish-brown (10YR 5/4 to 5/6) fine sandy loam; very fine granular structure and single grains; very friable and permeable; pH 5.6 to 5.9.

B_3	17-24	Olive (2.5Y 4/4) sandy loam; very fine granular to angular blocky structure; friable; pH 5.6 to 5.9.
C	24+	Olive-gray to gray unweathered loam till; many gravelly fragments and stones of different sizes; pseudo-laminated to subangular blocky or massive structure; compact pH 5.6 to 6.0.

Under forest cover the soil profile has a surface litter of leaves and twigs about 1 inch thick, over yellowish-brown sandy loam similar to the B_2 horizon described above.

Agriculture

Most of the Gatineau soils are wooded because their stoniness and topography hinder their use for agricultural purposes. Most of the cleared land is used for unimproved pastures and the acreage cultivated is negligible when compared with the extent of these soils.

Generally it is not economical to clear the stones and boulders for cultivation. Where there are enormous boulders or where outcrops are frequent they can be removed only with dynamite.

For maximum production the land must be limed, fertilized with complete fertilizers and manured. Manure is very beneficial as it improves the moisture-holding capacity and nutrient level.

Gatineau soils are comparatively early and, when cultivated, should be seeded as soon as possible in the spring, while moisture is available.

Ste. Agathe Series (Ag)

Ste. Agathe soils are found in the northern part of the surveyed area and cover 121,683 acres in Gatineau County and 217,532 acres in Pontiac County. Like the Gatineau series they are well-drained till soils derived from Precambrian rocks such as gneiss, granite, gabbro and anorthosite, but the Ste. Agathe soils are Podzols rather than Brown Podzolics.

Ste. Agathe soils are rolling to mountainous. They were formed on sandy loam till about 4 to 12 feet thick. Large stones and boulders are numerous and rock outcrops are common on the summits of hills.

The external drainage of Ste. Agathe soils is very rapid and the internal drainage is moderate. The solum is rapidly permeable but has fair moisture-holding capacity. The parent material is much less permeable and prevents the rapid percolation of water. Surface water erosion is considerable wherever the soil is not forested or protected by grass. Most of the Ste. Agathe soils are in forest and the cover is mainly sugar maple, yellow birch and beech; fir and white spruce occur occasionally.

The profile under virgin conditions is typical of the Podzol group and is described as follows:

Horizon	*Depth Inches*	
A_0	2- 0	Very dark brown organic matter and roots; fine crumbs; very friable and permeable; pH 4.0 to 4.6.
A_2	0- 1½	Light-gray leached fine sandy loam to loam; very friable and permeable; pH 4.6 to 5.2.
B_{21}	1½- 6	Reddish-brown to brown fine sandy loam; fine granular structure and single grains; very friable and permeable; a few gravelly fragments; pH 5.0 to 5.4.
B_{22}	6-20	Brown to yellowish-brown sandy loam; some gravel and some stones; fine granular, subangular blocky and single-grain structure; very friable and permeable; pH 5.0 to 5.4.

[8] Munsell color notation, Munsell Color Company Inc., Baltimore 2, Maryland, U.S.A.

B_3	20-28	Light yellowish brown to light brownish gray sandy loam on gravelly sandy loam, spotted with gray and yellowish brown; very firm to compact till breaking in irregular fragments; pH 5.2 to 5.6.
C	28+	Brownish-gray to gray or olive-gray gravelly sandy loam or sandy loam till, containing many stones and breaking in irregular fragments; firm to compact; pH 5.4 to 6.0. Stones and gravelly fragments are more numerous in the lower than in the upper part of the profile.

The cultivated surface soil is dark yellowish brown or dark-brown fine sandy loam or loam, and is underlain by brown to yellowish-brown sandy loam similar to horizon B_{22} described above.

Agriculture

Ste. Agathe soils are best suited to forestry. They occur on steep slopes and are excessively stony. Many boulders are too large and too deeply imbedded in the till to be easily removed. Only on the most gentle slopes can cultivated crops be grown without risking serious erosion. Hoed crops must be cultivated along the contours to prevent erosion.

On gently sloping and relatively stone-free areas, cultivated crops give fair yields if the soil is limed and fertilized with manure and complete fertilizers.

Very stony and steeply sloping Ste. Agathe soils should remain in or be returned to forest. Some areas may be used for permanent pasture if grass cover is maintained. The smooth, gently sloping land, a very small percentage of these soils, may be used for cultivated crops and hay or pasture.

Aumond Series (Ao)

The Aumond series (Figure 7) is the imperfectly drained associate of the Gatineau and the Ste. Agathe series. These soils cover 3,334 acres in small, scattered areas north of Maniwaki. They are found on smooth, fairly long slopes receiving seepage water from the till soils situated above them. Most of the land is moderately stony but there are some excessively stony areas.

Water percolates rapidly through the solum but seeps laterally over rather than through the sloping parent material, which is somewhat compact till. These soils are somewhat better drained on the upper part of the slopes than in the lower.

Aumond sandy loam is the only type mapped. It belongs to the Podzol (gleyed) group. A cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 5	Very dark grayish brown sandy loam (10YR 3/2); granular structure; friable and permeable; pH 5.3 to 5.6; pockets of A_2 horizon occasionally found below cultivated layer.
B_2	5-12	Dark yellowish brown sandy loam with spots of dark reddish brown (5YR 3/4) and of grayish brown (2.5Y 5/2); fine granular to subangular blocky structure; very friable and permeable; pH 5.6 to 5.9.
B_g	12-24	Grayish-brown (2.5Y 5/2) sandy loam with coarse mottles of olive (2.5Y 4/4) or dark grayish brown (10YR 4/2); subangular blocky structure; friable and permeable; pH 5.6 to 5.9.
C	24+	Olive-gray (5Y 4/2-4/3) sandy loam till with common medium, distinct mottles of grayish brown and dark yellowish brown; massive structure; firm to compact; pH 5.8 to 6.2.

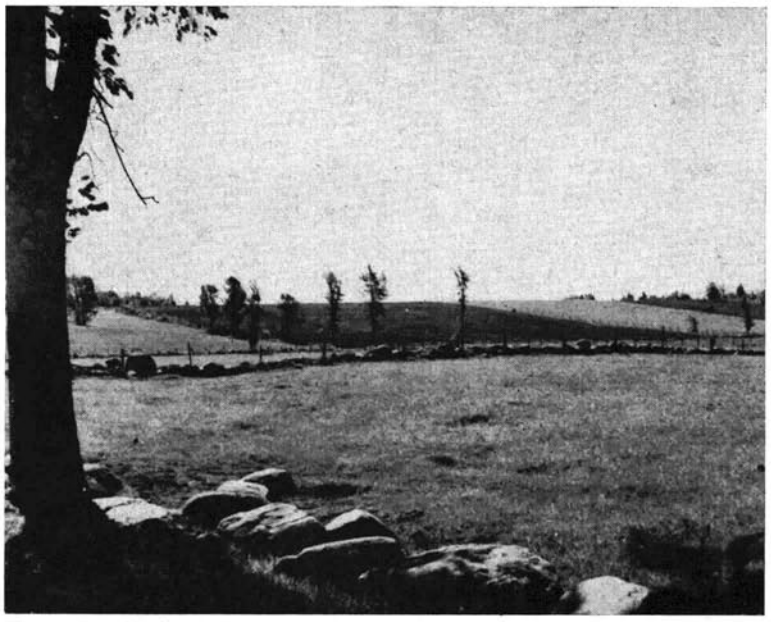

FIGURE 7.—On land such as this near Bois Franc, Gatineau soils cover well-drained ridges (background) and Aumond soils the imperfectly drained slopes below.

The soil profile under forest cover has a surface litter several inches thick, underlain by a 2- to 4-inch grayish mineral horizon (A_2) that is strongly leached and that extends in pockets into the underlying brownish B_2 horizon.

Agriculture

Most of the Aumond soil is cleared and used for pastures or cultivated crops. Yields are fair where the soil is well managed. Cultivation up and down the slope causes erosion.

Tile drains across the slopes, immediately above the ill-drained areas, would be the most efficient means of draining. If surface drainage is used, the channels should be dug across the slopes to cut off seepage water and avoid erosion. These ditches must be at least 30 inches deep to extend into the compact parent material.

Once proper internal drainage is secured these soils should respond well to lime, fertilizer and manure.

Lakefield Land Type (Lk)

The Lakefield soils cover 56,467 acres in Gatineau and 66,342 acres in Pontiac counties. They occur on rolling and mountainous land between the elevations of 600 and 1,300 feet. These soils are Brown Podzolic and thin or minimal Podzols on shallow, well-drained sandy loam glacial till. There also are swampy, poorly drained depressions and numerous rock outcrops. Though the Ste. Agathe and Gatineau till material is rather deep, the till of the Lakefield soil is so shallow that it has been weathered throughout to the underlying bedrock. There are boulders on the land surface as well as in the soil.

Only a limited amount of water can be stored above the bedrock in these thin deposits and the surplus gathers in the rocky depressions to form many swampy areas. The shallowness of some profiles and the variations in drainage

from the top of the undulations to the depressions causes variations in the Lakefield soils, which cannot be held within the definition of a series. For this reason these soils are referred to as a *land type*.

Most of the Lakefield land type is a well-drained permeable soil with moderate moisture-holding capacity. Generally sugar maple, red maple, spruce, cedar and white birch forest covers the land.

On virgin land, where the till is deep enough to permit a complete profile of the Podzol (Minimal) soil group, the soil characteristics are as follows:

Horizon	*Depth Inches*	
A_0	2- 0	Black humus layer of decomposing leaves, roots and some mineralized organic matter; very friable and permeable; pH 4.0 to 4.5.
A_2		A thin (one inch or less) gray leached layer sometimes present below the organic layer.
B_{21}	0- 8	Reddish-brown sandy loam; brown and yellowish-brown patches; friable and permeable; pH 5.0 to 5.4.
B_{22}	8-22	Light yellowish brown sandy loam; friable and permeable; a few stones and gravelly fragments; pH 5.0 to 5.6.
C	22-28	Light brownish gray sandy loam till only slightly weathered; very firm and slightly permeable; many stones and gravelly fragments; pH 5.1 to 5.8.

The C horizon is not always present; in many cases the brown solum rests directly on the bedrock.

Agriculture

A small proportion of the Lakefield soils have been cleared and are used mainly for pastures and hay crops. The many boulders and rock outcrops, the topography and the many small swampy areas discourage more extensive use of these soils.

Land between the outcrops and swamps has only moderate natural fertility. The solum is thin and may suffer from intermittent drought. The acidity is high. Liming and fertilization with complete fertilizer are necessary to obtain good yields.

The natural obstacles make the fields small and irregularly shaped. They are generally uneconomical and should be reforested. Trees do better than the meager shrubby pastures that are sometimes maintained on these lands.

St. Colomban Land Type (Cb)

St. Colomban soils are mainly in southern Gatineau County on 12,755 acres of the lower Laurentian ridges at elevations ranging generally between 300 and 900 feet. In Pontiac County there are 5,050 acres.

The parent material of St. Colomban soils, like that of the Gatineau and Ste. Agathe series, is a till derived from Precambrian rock such as gneiss or granite. However, the till of St. Colomban soils is more porous and more yellowish (more oxidized) than the other Laurentian tills. It frequently contains a very large amount of angular and subangular stones and gravelly fragments. The St. Colomban till is from an ablation moraine whereas the other tills are probably from ground moraines. Often it does not exceed 3 feet in depth over the bedrock.

The soils mapped as St. Colomban are referred to as a land type because the variations in the profiles are often wider than in a soil series. This land type includes Podzols developed on glacial till, outcroppings of bedrock that may cover as much as half of the land, and swamps or pockets of peat.

The external drainage is moderate and rain water percolates rapidly through the stony and gravelly materials to reach the impervious rock substratum, where it moves laterally to form swampy spots. The thin, discontinuous till has low moisture-holding capacity and often becomes very dry during the summer.

Most St. Colomban soils are wooded. The vegetation is sometimes discontinuous due to bands of bare rock, or mixed due to extreme variations in drainage. Maple and pine generally dominate the dry parts, while cedar and tamarack thrive in wet depressions.

The main characteristics of a virgin soil are as follows:

Horizon	*Depth Inches*	
A_o	1- 0	Black semidecomposed humus; roots abundant.
A_2	0- 2	Light brownish gray leached sandy loam; very friable and permeable.
B_{21}	2- 5	Reddish-brown sandy loam containing many stones and gravelly fragments; structureless and loose.
B_{22}	5-20	Yellowish-brown sandy loam to gravelly sandy loam; many sharp, angular stone fragments; loose and open.
B_3	20-30	Light yellowish brown to light brownish gray gravelly sandy loam till; firm; breaking into irregular fragments.
D	30+	Bedrock of Precambrian age.

The profile is very acid, generally ranging from pH 4.5 to 5.0 at the surface to pH 5.5 or 6.0 in the lower part of the subsoil.

Agriculture

St. Colomban soils are unfit for agriculture due to stoniness, rock outcrops and swamp. Sugar maple trees grow well on the deepest and driest parts of the land type. Many other kinds of trees could probably be grown with success and family orchards could be established on the deepest St. Colomban soils that are not too stony. Orchard trees would do better on these soils than on the surrounding imperfectly drained and stone-free soils.

Larose Land Type (La)

The Larose soils occupy 39,949 acres in Gatineau and 10,688 acres in Pontiac counties. The Larose land type includes soils developed on glacial till containing much crystalline limestone. There are Brown Forest, Brown Podzolic and Podzol soils. The Brown Forest type develops where limestone is present in the parent material. Where the parent material is low in limestone, either Brown Podzolic or Podzol soils develop. The land type also includes outcrops of limestone of the Grenville formation, or other rocks. Boulders are fewer in the Larose soils than in the surrounding tills and are mainly gneiss, quartzite and granite.

The Larose soils occur on more or less rolling land having a broken microrelief due to the frequent occurrence of limestone outcrops. The land is excessively drained due to the rapid external drainage, and to the high permeability and low moisture-holding capacity of the subsoils. The underlying crystalline limestone breaks readily into coarse crystalline gravel.

The virgin Larose soils support mainly sugar maple and red oak, with some white cedar. The white cedar is especially abundant on areas once cleared and then abandoned. Poison ivy is particularly abundant along the roads on this land type.

There are many variations in the profiles of the Larose land type. The main characteristics of virgin profiles developed from crystalline limestone and forming a Brown Forest type of soil are as follows:

Horizon	*Depth Inches*	
A_1	0- 2	Very dark reddish brown (5YR 3/2-2/1) organic sandy loam; crumb structure; very friable and permeable; pH 6.3 to 7.1. A leached layer may occasionally exist below the organic layer.
B_{21}	2- 5	Dark reddish brown (5YR 3/4-3/3) sandy loam; very fine granular structure and single grains of mica or of weathered crystalline limestone; very friable and permeable; pH 6.6 to 7.4.
B_{22}	5-22	Reddish-brown (5YR 4/4-5/4) coarse sandy loam; many angular fragments of crystalline limestone or calcite crystals; very friable and permeable; pH 7.4 to 7.6.
B_3	22-30	Light reddish brown to pinkish-gray calcite crystals partly weathered and stained with sesquioxides; very permeable to air and water; pH 7.6 to 7.9.
CD		White crystalline limestone bedrock (or large boulder) having some vertical crevices through which water percolates.

The reddish color that prevails all through the Larose soils is a striking characteristic that helps to distinguish these soils from the surrounding till soils.

Agriculture

The Larose soils make poor agricultural land. Cultivated crops grow poorly because of dryness and a low level of plant nutrients. Much of the cleared land has been cropped out and the yields are low. Deep-rooted plants like alfalfa are adapted to the Larose soils. If alfalfa does not grow well, potash and phosphorus are likely to be deficient in the soil.

Cleared areas that cannot be farmed successfully should be reforested. Reforestation of the upper slopes will assist in regulating runoff on the land as a whole. The Larose soils are warm, deep and naturally well suited to sugar maple and red oak. Many other trees could probably be grown with success.

St. Bernard Series (Bn)

St. Bernard soils occupy a total of 5,389 acres and occur mainly near Aylmer in Gatineau County and near Portage du Fort in Pontiac County at elevations ranging from 300 to 400 feet. These soils have formed on till derived from dolomite and dolomitic limestone. Free carbonates are present in the parent materials. The soil surface was originally stony but in cultivated fields many of the stones have been removed.

St. Bernard soils have good natural drainage and moderate moisture-holding capacity. The solum is permeable and absorbs rainfall fairly rapidly so that erosion is likely only on the steepest cultivated slopes.

The original tree cover was mainly sugar maple and beech.

This series belongs to the Brown Forest group of soils. The common characteristics of a loam (Bn) under cultivation are as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Very dark brown (10YR 2/2) loam with some gravelly fragments and small stones; well-developed granular structure; friable and permeable; pH 6.7 to 7.4.

B_{21}	6-12	Dark reddish brown (5YR 3/4-3/2) loam; some gravelly fragments and a few stones; well-developed granular and subangular blocky structure; friable and permeable; pH 7.2 to 7.4.
B_{22}	12-18	Brown to dark-brown (10YR 5/3-4/3) loam; many gravelly fragments and some angular stones; subangular blocky structure; less friable than above; moderately permeable; free carbonates sometimes detected; pH 7.5 to 7.7.
C	18+	Grayish-brown to dark yellowish brown (10YR 5/2-4/4) gravelly loam to sandy loam till; faint mottling and partly weathered stones, giving more variation in color than in above horizons; effervescence with dilute acid rather slow at start but developing gradually and lasting for a long time.

Agriculture

St. Bernard soils can grow successfully most of the plants adapted to the region as a whole. Since the land is well drained and warms up rapidly in the spring, it is frequently used for market and home gardening (Figure 8). Orchards grow well in these deep soils although fruits may develop "corky core". This, and brown heart in turnips, is prevented by applications of boron. Most field crops do well on this soil, which is one of the best for silage corn. It is the best in the surveyed area for alfalfa and other legumes.

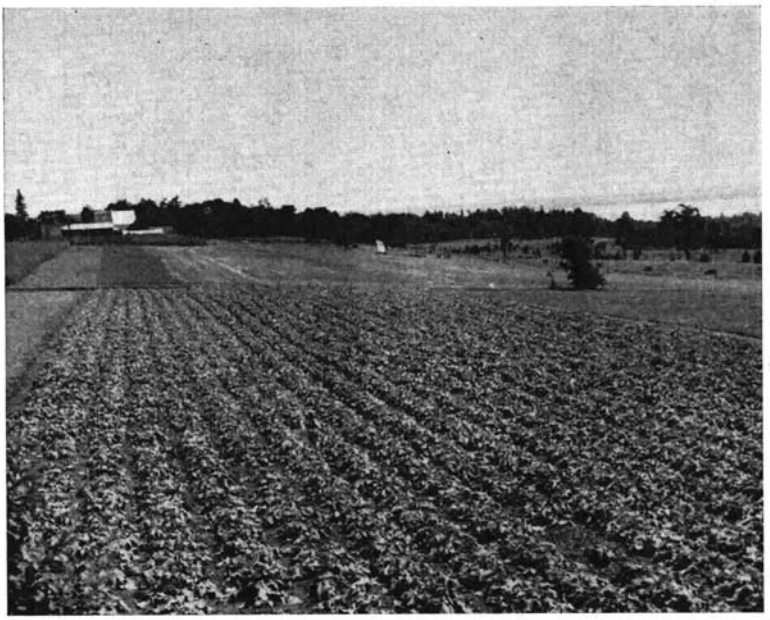

FIGURE 8.—The St. Bernard series is ideally suited to market gardening.

St. Bernard soils need protection from water erosion. The natural fertility can be maintained or increased by using chemical fertilizers and barnyard or green manures. Lime is not needed.

Matilda Series (Md)

Matilda soils cover 1,878 acres near Aylmer and are associated with St. Bernard soils. They occur on the slopes of till ridges that receive seepage water and are imperfectly drained. They are moderately permeable and contain some stones and gravel. This series belongs to the Brown Forest (gleyed) group.

The texture of the Matilda series varies from loam to sandy loam (Md) but these were not mapped separately. The most common characteristics of a cultivated soil are described as follows:

Horizon	*Depth Inches*	
A_e	0- 7	Dark-brown (7.5YR 3/2) loam to sandy loam; granular structure; some stones and gravelly fragments; friable and permeable; pH 7.0 to 7.6.
B_{21}	7-13	Brown (10YR 3/2) loam to sandy loam containing stones; granular structure; slight mottling; friable and permeable; occasionally calcareous; pH 7.0 to 7.7.
B_{22}	13-21	Yellowish-brown sandy loam with pockets of loam; distinct mottles of light-olive, gray and strong-brown (10YR 5/4-5/6) and (2.5Y 5/4-6/2); calcareous; pH 7.4 to 7.8.
C		Light brownish gray (10YR 6/2) sandy loam to loam till containing about 20 percent of gravel and many stones; calcareous; pH 7.4 to 8.0.

Agriculture

Matilda soils are almost entirely cleared and are used partly for cultivated crops and partly for pasture land. They are not well suited to early crops, orchards or alfalfa, but they are well suited to cereals and forage production, particularly for pasture. Where the natural drainage has been improved artificially, alfalfa may be grown and yields of crops compare well with those obtained on St. Bernard soils. However, removal of excess water from the Matilda soils is generally difficult because the free water moves laterally over the subsoil and requires deep ditches or underdrainage to collect it.

Farmington Land Type (F)

Farmington soils occupy 6,611 acres in Gatineau County and 17,901 acres in Pontiac County, mainly near Aylmer, Bristol Mines, Portage-du-Fort and on Allumette Island.

The Farmington land type (Figure 9) includes all the very shallow till soils over calcareous bedrock. In the area surveyed these soils vary in depth from a few inches to about 15 inches above rock; the bedrock is exposed over a large proportion of the ground. The soil profiles range in character from Lithosols to Brown Forest.

The land is generally flat but sometimes it is undulating. The natural drainage of these shallow soils varies from moderately good on the nearly level areas to excessive on the undulations and imperfect in the depressions. The soil has low moisture-holding capacity and during the summer becomes very dry.

Since the soil is very shallow, it is likely that the tree growth was never dense, although there are some fair stands of sugar maple. Many sections, probably once cleared, are now parklike; open areas, covered by grass and juniper, are interspersed with groves of elm or cedar.

Most Farmington soils have a dark grayish brown loam surface of granular structure and nearly neutral reaction, and underlain by partly weathered calcareous rock or by dark-brown loam containing many limestone fragments.

Agriculture

The Farmington land type is mostly nonarable because of frequent exposures of bedrock or shallowness. Stones are generally small and few although there are local accumulations of large, ice-rafted boulders.

FIGURE 9.—The Farmington land type consists of shallow till over limestone with many rock outcrops.

Most of the land is forested or unimproved pasture; only a very small portion can be used for cultivated crops. The soil warms up rapidly in the spring and early crops have more chance of success than late ones. Generally grass grows well during the spring but poorly during summer droughts. Alfalfa sometimes does moderately well, probably because its roots can penetrate cracks in the bedrock and draw moisture unavailable to shallow-rooted plants.

Stonefield Land Type (St)

There are 2,464 acres of the Stonefield land type (Figure 10) in Gatineau County along the Ottawa River between Deschênes and Breckenbridge. This land type includes Lithosols and Brown Podzolic soils developed on very shallow tills over soft noncalcareous shales.

Stonefield soils are generally undulating but sometimes they are fairly steeply sloping. The soil is droughty although the mapping unit does include some small wet spots. The shale beds are generally very permeable and the moisture-holding capacity in the upper foot of soil is very low. Shallow-rooted plants cannot survive summer drought. Sugar maple, butternut, beech and basswood are the dominant trees on these soils.

The thickness of till over the bedrock seldom exceeds two feet and is generally less than one foot. The shale bedrock disintegrates easily, and sometimes is the parent material; then the soil is called semiresidual (developed mainly from bedrock).

A deep, cultivated Stonefield soil has the following characteristics:

Horizon	*Depth Inches*	
A_c	0- 6	Very dark grayish brown (10YR 3/2) sandy loam to gravelly (shaly) loam; granular structure; friable and very open; pH 5.8 to 6.2.
B_2	6-12	Dark-brown (7.5YR 4/2) gravelly loam (shaly); very open; pH 6.2 to 6.6.
B_3	12-24	Dark grayish brown (2.5Y 4/2) gravelly loam (shaly); permeable; pH 6.4 to 6.8.
CD	24+	Bedrock breaking into shaly fragments.

FIGURE 10.—This profile of the Stonefield land type represents the Lithosol great soil group.

The B_3 horizon may be much thinner than 12 inches or entirely missing.

The Brown Podzolic profile occurring under forest cover has one to two inches of organic litter over dark-brown gravelly loam similar to the B_2 horizon described above.

Agriculture

Since the Stonefield soils are shallow, droughty and low in natural fertility, they are seldom used for cultivated crops. Most of the cleared land is used for pastures, which may give fair yields in the spring but which dry out rapidly in summer. Some early market crops are grown because the soil warms up rapidly, but the land is not suitable for late market crops unless irrigation can be provided. Alfalfa is probably adaptable if the soil acidity is corrected by liming according to local needs. Liming, fertilization with manure and complete fertilizers, and occasional irrigation are required for satisfactory yields on these soils.

Oka Series (O)

There are 986 acres of Oka soils near Aylmer. They are well-drained undulating soils formed on calcareous gravelly materials derived from local tills or Paleozoic rock fragments. The parent materials were more or less sorted by wave action and range from a well-graded loamy gravel many feet deep to a poorly sorted till-like material containing occasional gravelly layers. Shells may be found in these materials.

Most Oka soils are associated with St. Bernard soils and could not generally be separated on the scale of mapping used.

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Profiles of the Oka soils vary according to the degree of sorting in the parent materials. Some profiles contain large proportions of shingly limestone fragments or of shells, whereas other profiles do not. The main characteristics of a cultivated Oka soil, belonging to the Gray Brown Podzolic group, are as follows:

Horizon	*Depth Inches*	
A_c	0- 8	Dark-brown to very dark brown (7.5YR 3/2-10YR 3/2) sandy loam to gravelly loam; granular structure; many calcareous stone fragments; pH 7.0 to 7.6.
A_2	8-22	Brown to yellowish-brown (7.5YR-10YR4/4) gravelly loam; granular structure; sometimes containing numerous flat limestone fragments lapped one over the other; shells sometimes found, in variable quantity; pH 7.0 to 7.4.
B_2	22-32	Reddish-brown (5YR 4/4-4/3) with spots of dark reddish brown (5YR 3/3-2/2) loam to gravelly loam; subangular blocky structure pH 7.0 to 7.4.
C	32+	Grayish-brown (10YR 5/2) gravelly loam; sometimes resembling glacial till and sometimes composed of flat fragments of limestone ranging in size from 1 inch to about 5 inches; occasional shells; fairly open and permeable; strongly calcareous; pH 7.4 to 7.8.

Under forest vegetation the profile has a granular mineral–organic surface horizon of very dark brown color and about three to five inches thick. This is underlain by the lighter-colored A_2 horizon described above.

Agriculture

Compared with the St. Bernard soils, with which they are often associated, the Oka soils are more permeable, drier, less loamy and lower in moisture-holding capacity. However, these two soils have other characteristics in common and they can be handled similarly. Oka soils, like the St. Bernard, are suitable for a wide range of crops, including field crops, market crops and tree fruits. They are particularly well suited to alfalfa and other legumes.

Soils Developed on Gravelly Materials

Calumet Series (Ca)

Calumet soils cover a total of 1,216 acres in the two counties. Their parent material is a gravelly deposit composed largely of crystalline limestone and Precambrian rock fragments. This material is very porous and can hold little moisture. The land is generally undulating and excessively drained and has very few or no boulders.

Many profiles show a Podzol formed over a Gray Brown Podzolic soil, but in the cultivated soil described as follows the features of the Podzol have been obliterated:

Horizon	*Depth Inches*	
A_e	0-7	Dark grayish brown (10YR 4/2) sandy loam; some gravelly fragments; pH 5.5 to 6.5.
B_2(P)	7-24	Pale-brown to brown (10YR 6/3-5/3) light fine sandy loam containing some gravel; pH 5.8 to 6.5.
B_2(GBP)	24-36	Dark-brown (7.5YR 3/2) gravelly or coarse sandy loam; pH 6.2 to 7.2.
C	36+	Gravel made up of many fragments of light-colored crystalline limestone and some noncalcareous Precambrian rocks; strong effervescence; pH 7.4 to 7.8.

The horizon below the plow layer may range from 4 to 30 inches thick and the dark-brown layer above the parent material may range from 2 to 20 inches thick.

Under forest cover the profile has a thin forest litter over a mineral—organic horizon two to three inches thick, of dark color and sandy loam texture. Immediately under this there is a light-colored, leached layer about one inch thick and underlain by pale-brown to brown sandy loam similar to the B_2(P) horizon described above. This B_2(P) is also interpreted as the A_2 horizon of the Gray Brown Podzolic sequum.

Agriculture

Calumet soils have little agricultural importance, because of their small extent and because most of the gravelly deposits are used for roads and other engineering purposes.

Where these soils are farmed, they are best suited to deep-rooted plants, especially alfalfa. Crops should be seeded as early as possible to escape summer drought. For normal growth the land needs manure and complete chemical fertilizers. It may be necessary to lime the surface soil since shallow-rooted plants cannot reach the abundant lime in the parent material.

St. Faustin Series (Ft)

St. Faustin soils occupy 24,986 and 15,341 acres in Gatineau and Pontiac counties respectively. They occur in the valleys at elevations ranging generally between 600 and 800 feet on undulating to gently rolling land, often in the shape of kames.

The parent material is a fluvioglacial deposit, generally of poorly sorted gravels, sometimes bouldery and often very cobbly. Many of these deposits are more than 30 feet thick. The materials are derived from the various kinds of Precambrian bedrock. Rounded boulders and cobbles sometimes occur on the surface as well as through the deposit.

St. Faustin soils are excessively drained because of the rapid permeability of the profile. The moisture-holding capacity is fair in the solum but low in the parent material. Consequently, there is little possibility for upward capillary movement from the deep water table.

The virgin land supports a good growth of sugar maple, aspen, beech, white pine and fir.

A virgin soil, belonging to the Podzol soil group, is described as follows:

Horizon	*Depth Inches*	
A_0	2- 0	Dark-brown raw humus and roots; pH 4.5 to 5.0.
A_2	0- 2	Light-gray leached sandy loam.
B_2	2- 8	Dark-brown to brown sandy loam containing some gravel; single-grain structure; a few cobbles or stones; loose and very open; pH 5.9 to 5.4.
B_{22}	8-16	Yellowish-brown sandy loam to gravelly sandy loam or loamy gravel; single-grain structure; pH 5.2 to 5.4.
B_3	16-24	Light yellowish brown gravel and sand; pH 5.4 to 5.6.
C	24+	Light brownish gray gravel, cobbles and stones; pH 5.6 to 6.0.

Agriculture

St. Faustin soils are not well suited to farming. They are not excessively stony but their moisture-holding capacity and their fertility are too low to produce good crop yields. Some areas have broken relief, which may cause difficulties in using farm machinery.

The cleared land is used almost exclusively for pastures, on which the grass is generally very thin and of poor quality. Crops, if grown at all, must be seeded as early as possible after the risk of frost has passed. Lime, complete fertilizer and manure are required. As there is danger of considerable leaching in these soils it is advisable to fertilize lightly and often. St. Faustin soils are very acid and repeated applications of lime will be needed. The more loamy of these soils on smooth topography might justify improvement for agricultural use, but the dry, gravelly and steep ridges should be forested.

St. Gabriel Series (G)

St. Gabriel soils cover 8,435 acres in Gatineau County and 19,878 acres in Pontiac County, at elevations ranging from 500 to 700 feet. They are formed on gravelly glacial outwash in the valleys of the mountainous area. These gravelly deposits are made up largely of quartzitic, granitic and gneissic materials, moderately well to well sorted and generally free of cobbles and boulders. They vary in thickness from a few feet to more than 10 feet and rest on till or bedrock.

The land has undulating to level topography but, in spite of this smoothness, the soils are excessively drained. This is because their moisture-holding capacity is very low and the parent material is very permeable. The rapid permeability permits very rapid percolation of water, which accumulates in low areas and produces swampy conditions. This association of very dry and very wet soils is unfavorable for farming.

On strongly undulating land, away from streams and swampy areas, hard maple, white pine and white birch are the most common trees; on low, flat land, white spruce, aspen and cedar are more frequent.

The main characteristics of a virgin soil, belonging to the Podzol group, are as follows:

Horizon	*Depth Inches*	
A_0	2- 0	Very dark gray to very dark brown organic matter; some sandy mineral matter; pH 4.5 to 5.5.
A_2	0- 2	Light-gray or light brownish gray leached sandy loam to loamy sand; some gravelly fragments; pH 4.5 to 5.0.
B_{21}	2- 5	Dark reddish brown to reddish-brown sandy loam to loamy sand with some gravel; single grains; generally loose and open but occasionally cemented with organic matter and iron; pH 4.8 to 5.5.
B_{22}	5-16	Strong-brown to yellowish-red loamy gravel or sandy gravel; loose and open; pH 4.9 to 5.9.
B_3	16-28	Yellowish-brown to light yellowish brown, with streaks of dark-brown, gravelly sand or gravel; single grains; loose and open; pH 5.0 to 5.9.
C	28+	Light yellowish brown gravel with occasional bands of sand or of cobbly gravel; loose and open; pH 5.6 to 6.2.

The cultivated soil is dark-brown sandy loam to loamy sand 6 inches thick and is underlain by the strong-brown sandy loam B_{22} horizon described above.

Agriculture

A large proportion of St. Gabriel soils have been cleared and cultivated. The clearing was relatively easy on these well-drained, stone-free soils, but drouthiness and low fertility make the farmland low in value. Most of the cleared land is now abandoned or used for very poor hay fields or pastures.

These dry soils are not suited to shallow-rooted plants. Alfalfa and other deep-rooted plants will not grow well unless acidity is corrected and the nutrient level improved considerably. Except for some special crops, farming on these soils is not profitable and the land should be reforested.

Mont-Rolland Series (Mt)

Mont-Rolland soils, in the southern part of the Upland area, occupy a total of 13,424 acres. They are formed on outwash and deltaic gravelly deposits with undulating to nearly level topography. They are derived from parent materials very similar to those of the St. Gabriel series, but Mont-Rolland soils have a Brown Podzolic profile whereas St. Gabriel soils are Podzols.

Mont-Rolland soils have very low moisture-holding capacity and high porosity, so that the land is excessively drained. The characteristics of a cultivated soil are as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Brown gravelly sandy loam; cobbles sometimes present; very friable and open; pH 5.2 to 5.6.
B_{21}	6-12	Reddish-brown gravelly sandy loam; very open and permeable; pH 5.2 to 5.6.
B_{22}	12-30	Dark yellowish brown gravelly sandy loam; cobbles sometimes numerous; very open and permeable; pH 5.2 to 5.6.
C	30+	Gravel or gravel and sand derived from granite, gneiss and quartz; loose and open; pH 5.5 to 6.0.

Under undisturbed forest a leafmat lies directly on the brown B horizon and the characteristic ashy-gray A_2 horizon of the St. Gabriel soils is absent.

Agriculture

A large proportion of the Mont-Rolland soils have been cleared and are used for field crops and pastures, although their droughtiness and low natural fertility make them unsuitable for extensive farming. These dry soils warm up rapidly in the spring and crops seeded very early may mature before the land gets too dry. Crops should be well fertilized to stimulate rapid growth before the onset of drought. In pastures, low yields of grass can be expected during the dry period.

Mont-Rolland soils are very acid throughout their profile and should receive repeated applications of lime. Deep-rooted plants will make better use of fertilizer and available moisture than shallow-rooted plants. Cleared areas that are not productive should be reforested.

Lesage Series (Le)

There are 5,483 acres of the Lesage soils on undulating land in southern Gatineau County on the east side of Gatineau River at elevations of 250 to 600 feet.

The parent material is a gravelly deposit resting on clay from 2 to 10 feet below the surface. The upper part of the deposit varies from sandy loam to gravelly sandy loam. The soil surface and the solum are free of boulders but cobbles may be numerous.

Lesage soils are naturally well drained. An impervious clay substratum reduces the percolation rate so that they are not as dry as St. Gabriel and Mont-Rolland soils.

The trees are mainly sugar maple, red maple, red oak and beech.

The main characteristics of a cultivated soil, a Podzol, are as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Dark-brown sandy loam; fine granules among single grains; very friable and permeable; pH 5.0 to 5.4.
B_{21}	6-10	Strong-brown sandy loam with variable amount of gravel; mainly single grains; loose and permeable; pH 5.2 to 5.4.
B_{22}	10-20	Brown sandy loam to gravelly sandy loam; single grains; loose and permeable; pH 5.2 to 5.6.
C	20+	Light brownish gray gravel; rapidly permeable; pH 5.4 to 5.8.

Along the slopes there may be some small wet spots where the clay substratum is near to or exposed at the surface. Under forest the soil has a dark-brown, semidecomposed organic layer about two inches thick which is underlain by about two inches of light-gray friable sandy loam.

Agriculture

Most of the Lesage soils have been cleared and are used for general field crops. Large areas have been used as gravel pits for various uses. After the gravel has been taken off, the clay is exposed or is very close to the surface. Areas that are large enough could be reclaimed by levelling the land and providing suitable drainage outlets. Legume crops would probably grow well on these reclaimed areas; they are rich in available plant nutrients except nitrogen, which is practically absent.

The normal Lesage soils are acid; liming is necessary for most farm crops, especially legumes. By using lime, manure and complete chemical fertilizer, they can be made fertile, especially the shallower types over clay. They warm up early in the spring and may be seeded as soon as danger from frost has passed. They are moderately well suited to most farm crops but especially to deep-rooted plants, which are able to make better use of the soil moisture.

Soils Developed from Clayey Deposits

Châteauguay Series (Ch)

A few small areas of Châteauguay soils (262 acres) were mapped in Gatineau County near Deschênes and Breckenridge. These soils have developed from clay loam to clay material underlain by calcareous till at depths of two to five feet. They occur on convex slopes and are moderately well drained.

Châteauguay soils belong to the Gray Brown Podzolic soil group. When cultivated the surface soil (about seven inches thick) is a dark grayish brown clay loam that is granular and friable and has a pH ranging from 6.2 to 6.6. It is underlain by dark grayish brown to brown clay loam to clay (A_2), which contains pockets of sand, is about 22 inches thick and has a pH of 6.2 to 6.5. The A_2 is in turn underlain by a B_2 horizon that is dark-brown to brown clay to clay loam, generally of subangular blocky structure and with pH 6.4 to 6.8. There may be pockets of coarser material in this B_2 horizon. There is a calcareous glacial till horizon (D) at an average depth of three feet.

Under undisturbed forest the mineral-organic surface horizon (A_1) is dark-brown granular clay loam about four inches thick. It is underlain by the A_2 horizon described above.

Agriculture

Because the Châteauguay soils have good natural drainage and aeration, excellent moisture-holding capacity and fair natural fertility, they are excellent for any crop adapted to the climate of the region.

Bouchette Series (Bc, Bcl)

The Bouchette soils occupy 21,363 acres on the floors of narrow valleys in the northern part of Gatineau County, at elevations ranging from 500 to 700 feet. The land is stone-free, gently undulating and somewhat dissected by gullies. The natural drainage is good. The upper part of the solum is very permeable, so that aeration and moisture distribution are favorable. The subsoil is massive and only slowly permeable to air and water.

In the parent material the silt content ranges between 50 and 60 percent; the clay content seldom exceeds 40 percent and usually is less than 30 percent.

This high proportion of silt is characteristic of the lacustrine deposits of the upper Laurentian valleys, in contrast to the high proportion of clay characteristic of the lacustrine deposits of the Lowlands. The silty parent material of the Bouchette soils is varved or laminated and breaks easily along horizontal planes but is practically impermeable to the downward movement of water and deep roots.

The main texture of the Bouchette series is silty clay loam (Bc) and nearly all the soils were mapped as this soil type although some areas may have a slightly coarser or finer texture. Also mapped is a loam type (Bcl) that has the solum appreciably deeper and somewhat coarser than average. This loam apparently formed where the lacustrine deposits were covered by a thin layer of material derived from the surrounding till ridges.

The cultivated soils, belonging to the Podzol group, are described as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Dark grayish brown to brown (10 YR 4/2-4/3) or 2.5Y 4/2) silty clay loam to loam; very fine granular to crumb structure; very friable and permeable; pH 5.4 to 5.8. A virgin soil usually has a podzol leached layer ¼ to 1 inch thick.
B_2	6-10	Dark yellowish brown to olive-brown (10YR 4/4-2.5Y 4/4) silty clay loam to silt loam; fine granular and crumb structure; very friable and permeable; pH 5.5 to 6.0.
B_3	10-22	Olive (5Y 4/3-5/3) silty clay loam; laminated or vesicular massive structure, lamina about 3 mm. thick; slight mottling; firm and much less permeable than material above; pH 5.6 to 6.2.
C	22+	Gray to light-gray (2.5Y 7/2 and 5Y 5/1-7/2) silty clay to silty clay loam; olive-yellow mottles; the color and the texture varying within the laminations; material very firm in place and resistant to water and root penetration; laminations breaking apart very easily when material is dug out; pH 6.5 to 7.0.

Agriculture

Bouchette soils are probably the best in the upper Laurentian valleys. All the accessible areas of these soils are cleared and used for dairying and mixed farming. On many farms, this series occupies only a small acreage among stony and mountainous soils and this condition makes the exploitation of these lands somewhat more difficult and costly than where all the land can be farmed.

The laminated parent material does not allow free movement of water in the subsoil and these soils enter winter in a saturated condition. When the ground freezes the water held between the laminations of the subsoil expands considerably and the soil heaves roots of plants, fence posts and roads.

The improvement of subsoil drainage would probably correct the unfavorable conditions. But deep open ditches close to one another would dissect the fields too much, and the more efficient tile drainage would probably be too costly. Subsoiling to break the laminations and create drainage channels may be the most satisfactory alternative.

The organic matter content of the surface soil is rather low and any increase in soil humus would probably increase crop yields. These soils are suitable for most farm crops commonly grown and respond well to application of manure, lime and complete fertilizers. They should be protected against water erosion. With the present type of farming erosion has been moderate.

Montcerf Series (Mf)

The Montcerf soils are the imperfectly or somewhat poorly drained catenary associates of the Bouchette soils. They cover 18,675 acres at elevations of 500 to 700 feet on level land or in slight depressions. Montcerf soils have the same laminated parent material (Figure 11) as the Bouchette soils but lack the

friable and permeable upper solum. Such conditions are unfavorable to moisture distribution through the soil. The land absorbs and distributes the rain water slowly during prolonged periods of rain; the plants tend to drown out. The soils do not store enough moisture for periods of drought. Erosion is negligible since the topography is nearly level. The natural vegetation is mainly coniferous trees, white spruce being dominant.

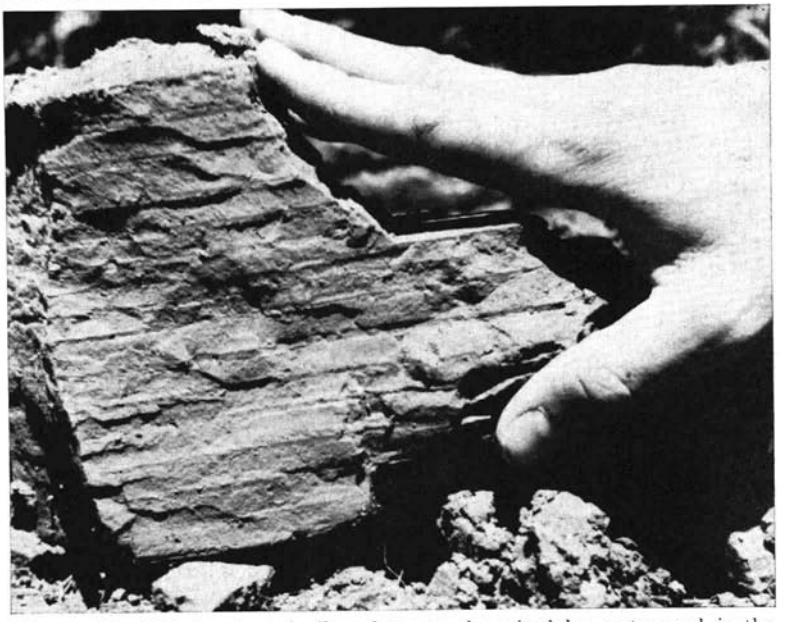

FIGURE 11.—This laminated silty clay was deposited by water and is the parent material of the Montcerf series.

Cultivated Montcerf soils generally have a silty clay loam surface. All the land was mapped under this textural class although there are some small areas of loam or silt loam. This soil belongs to the Dark Gray Gleysolic group. The characteristics of a cultivated soil are:

Horizon	*Depth Inches*	
A_c	0- 7	Grayish-brown to dark-gray (2.5Y 5/2-10YR 4/1) silty clay loam or sometimes silt loam; granular structure unstable and tending to pack when wet and become hard when dry; friable when freshly cultivated, becoming firm after long periods without cultivation; pH 5.4 to 6.2. In virgin conditions an olive-gray to light olive gray layer spotted with white (10YR 8/1), one to four inches thick, under the organic layer; platy or laminated vesicular structure; laminae about 2 mm. thick.
B_g	7-20	Light brownish gray to olive-gray and olive (2.5Y 5/2-6/2 and 5Y 5/2-5/3-6/3) silty clay loam to silt loam, light-olive and light olive gray (2.5Y 5/4-5Y 6/2) mottles; laminated material containing some blocky aggregates; laminae 3 to 5 mm. thick; very firm in place but breaking easily along the horizontal plane when dug out; vertical penetration of water, air and roots impeded by the dense barrier of each lamina; pH 5.7 to 7.1.
C	20+	Olive-gray (5Y 5/2) silty clay loam to silty clay or sometimes silt loam; light-olive (2.5Y 5/4) mottles; laminae varicolored and acting as barriers to the vertical movement of water and roots; very firm in place; laminae 2 to 8 mm. thick; pH 6.6 to 7.1.

There are variations in texture in all horizons of the profile, but these variations do not affect the management of the cultivated soil and did not warrant separate mapping units. Variations in organic matter content and structure of the upper solum of some soils affected areas too small to warrant separate mapping units. These soils are on sloping land, at the feet of hills consisting largely of crystalline limestone, and resemble Montcerf soils but are richer in organic matter and have a more strongly granular and more rapidly permeable subsoil. These occasional narrow bands of soils are included with the Montcerf series but are more productive than average for the series.

Agriculture

Montcerf soils are nearly all cultivated for common field crops. Their inherent fertility is generally good but they are difficult to handle. They must be adequately drained before profitable yields can be expected; on many farms the artificial drainage provided is inadequate for most crops.

Most precipitation must run off on the surface or evaporate. Ridge plowing speeds up removal of surface water but it appears impossible to solve the problems of surface drainage and of moisture storage except by improving the structure of the subsoil. The mechanical breaking of the subsoil laminae appears to be the most practical modification. Subsoiling to a depth of about 18 inches should increase the storage of usable water and permit deeper root penetration.

The organic matter content of Montcerf soils is rather low and contributes to poor surface structure. The surface soil can be very finely fragmented by cultivating at a suitable moisture level but the fragments revert rapidly to hard, massive lumps. Use of organic amendments should help to maintain a granular structure in the surface soil.

Liming should also improve this acid soil and promote better growth of most cultivated plants, especially clovers. Alfalfa will not last because the soil lacks subsoil drainage and aeration.

The response to chemical fertilizers will depend on the tilth, artificial drainage and climatic conditions. The physical condition of the land should be improved as much as possible before chemical fertilizers are used heavily.

Maniwaki Series (Mw)

Maniwaki soils cover only 4,518 acres, in the very poorly drained areas of the Bouchette-Montcerf catenary association. They are transitional soils between the Montcerf soils and the organic deposits frequently found in depressed areas. In the natural state, these wet lands are covered with fir, spruce, alder, cedar, tamarack, elm and black ash. The basin topography causes the land to receive an excess of water that cannot drain away. The problem of subsoil impermeability and drainage is even more crucial in this soil than in the Bouchette and Montcerf series on the same parent material.

The virgin Maniwaki soil, classified as a peaty Gleysol, has a raw organic matter surface 6 to 10 inches thick. After clearing and draining the land, this organic surface shrinks considerably. Then plowing and cultivation modify the appearance of the surface soil by mixing with it some of the fine-textured gray mineral material of the subsoil. A cultivated silty loam is described as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Very dark grayish brown (2.5Y 3/2) silty clay loam; medium granular structure; friable; slightly plastic when wet; pH 6.0 to 6.3.
B_g	7- 9	Gray to dark-gray (5Y 5/1-4/1) silty clay loam; some angular blocky structure among massive laminated material; slightly plastic and sticky when wet; firm when dry; pH 6.4 to 6.8. There is often some humus carried down into this horizon.

C_g	9-20	Gray to light olive gray (5Y 6/1-6/2) silty clay loam; a few strong-brown (7.5YR 5/5-5/8) mottles; structure and consistency as in B_g horizon; pH 6.6 to 6.9.
C	20+	Olive-gray to light-olive (5Y 5/2-2.5Y 5/4) silty clay loam to silty clay; massive laminated material; slightly plastic and sticky; permeable; pH 6.8 to 7.2.

Agriculture

About half of the Maniwaki soils are used for farm crops, especially hay and pasture. Grain is seldom grown because the land is too late and usually too poorly drained. Meadows and pastures generally contain undesirable water-loving plant species, which can not be eliminated except by improving the drainage. Reed canary-grass is probably best adapted and most productive under the natural drainage conditions.

The response to liming and to chemical fertilizers is not known. The organic matter content is apparently adequate but it decomposes very slowly because drainage and aeration are poor. Under these conditions farm manure would not be as helpful as on the well-drained soils.

Baudette Series (Bd)

There are 1,797 acres of Baudette soils, mainly north of Quyon. These soils are formed from silty deposits on flat marine clay. The land is level to gently undulating and has imperfect natural drainage. Rain water is practically all absorbed by the permeable silty deposit but cannot move downward freely because of the impermeable clay substratum.

The texture of the Baudette profile may vary from silt loam to silty clay loam with layers of very fine sandy loam. The silty deposit over the clay is from 2.5 to 4 feet thick. The main characteristics of the cultivated soils, Dark Gray Gleysolics, are as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Grayish-brown silty clay loam to silt loam; granular structure; friable; pH 5.6 to 6.2.
B_{g1}	7-28	Grayish-brown silty clay loam to silt loam; light brownish gray and brown mottles; generally laminated, often having thin layers of fine sandy loam; friable and of low plasticity; pH 5.8 to 6.4.
B_{g2}	28-40	Silty clay loam to silt loam with thin laminations of very fine loam; light brownish gray with dark yellowish brown mottles; pH 5.8 to 6.4.
C	40+	Gray marine clay; very plastic and impermeable; pH 6.6 to 7.2.

Agriculture

Once improved by artificial drainage and liming, Baudette soils make good agricultural land. They are used for all the main field crops and produce good yields. As with the Ste. Rosalie soils their management requires artificial drainage, lime, phosphorus and possibly subsoiling.

Pontiac Series (Pc, Pch, Pcl)

Pontiac soils occupy a total of 33,317 acres in Gatineau County and 22,585 acres in Pontiac County. They are at elevations of 350 to 550 feet, the highest levels at which the clays were deposited in the Ottawa and Gatineau valleys. The upper part of the clayey deposit is often loamy, and the soils range from loam to silt loam or silty clay loam. The continuous gradation in texture from

the clay to the overlying loamy material indicates continuous deposition under very different conditions. When the medium-textured surface deposits were laid down the water must have been shallow and turbulent, in contrast with the deep, calm stage during the deposition of clay. The greater thickness of the loamy surface deposits near the till ridges suggests that some of this material was derived from them.

The Pontiac soils are well drained and stone-free. They occur on convex, smooth gentle slopes. These soils are very permeable and readily absorb normal rainfall during the growing season. When the soil is frozen there may be considerable runoff and erosion (Figure 12) during heavy rains or after rapid thaws. The gradual change from the medium-textured surface to the underlying clay creates favorable soil-moisture relationships.

Pontiac soils were mapped in complexes with Dalhousie soils. On the average, the Pontiac soils are coarser in texture than the Dalhousie soils. The few small areas of Pontiac soils still forested support red maple, sugar maple, white birch, white pine, fir, hemlock, elm and beech.

Three types were mapped in the Pontiac series: loam (Pcl), clay loam (Pch) and silt loam to silty clay loam (Pc). The silt loam to silty clay loam types (Pc) were mapped as one unit and are the most extensive. Their cultivated layer contains from 20 to 30 percent sand, 40 to 60 percent silt and about 20 percent clay. At the few remaining virgin sites the Pontiac soils have either a Brown Podzolic or a thin (minimal) Podzol profile. The general characteristics of a cultivated silt loam (Pc) are:

Horizon	*Depth Inches*	
A_c	0- 8	Dark grayish brown to dark-brown (10YR 4/2-4/3) silt loam to silty clay loam; fine granular structure; very friable and permeable; pH 5.1 to 6.0.
B_2	8-12	Brown to dark yellowish brown (10YR 4/4-5/3 or 7.5YR 4/4) silt loam to silty clay loam; fine granular structure; very friable and permeable; horizon darker in the upper part and grading to the texture, structure and color of the horizon below; transition to the lower horizon often of an olive color (2.5Y-5Y 4/4), sometimes showing some faint-brown mottles; pH 5.1 to 6.2.
CD	12-24	Grayish-brown (2.5Y 5/2) clay loam to clay; moderate fine and medium, subangular, blocky structure; firm and moderately permeable; pH 5.6 to 6.8.
D	24+	Olive-gray (5Y 5/2) clay; structure varying from coarse blocky to massive or laminated; slightly permeable; pH 6.8 to 7.2.

Agriculture

Practically all Pontiac soils are cultivated and used for dairying and field crops. These soils are suitable for a wide range of crops. Their natural fertility is fair to good and can be improved, but they are acid and need liming for most field crops, especially legumes. The moderate aeration of the solum makes it possible to grow good crops of alfalfa and other legumes.

The high silt content makes the soil surface very soft during wet spring weather and it cannot support very heavy machinery or cattle tramping. When fully saturated with water or when frozen, the surface soil is susceptible to water erosion. This hazard is slight during the growing season if row crops are not grown up and down the slope.

The crop yields vary widely according to management and use of lime, fertilizer and manure.

FIGURE 12.—This gully erosion on a Pontiac soil began from plowing up and down the slope. Proper management prevents such erosion.

Chapeau Series (Cp)

Small areas of Chapeau soils (738 acres) were mapped in northern Gatineau and in western Pontiac counties. These soils have formed on clays that are generally laminated and occur on undulating topography where runoff is rapid.

Chapeau soils are practically all cultivated. In small areas where the land is still in the virgin state, the profile has a very dark gray or very dark brown humus layer which is rather raw and 1 to 2 inches thick. The humus layer is underlain by a leached, light brownish gray (2.5Y 6/2) horizon (A_2) 2 to 5 inches thick, which in turn is underlain by somewhat darker colored and somewhat heavier clay. The virgin profile resembles that of a Gray Wooded soil. A cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Dark grayish brown to gray (2.5Y 4/2-5/1) silty clay to clay; subangular blocky and granular structure; very firm when dry and sticky when wet; pH 5.3 to 5.5.
B_1	7-13	Grayish-brown (2.5Y 5/2) clay to silty clay; hard medium to coarse, subangular, blocky structure; plastic when wet; pH 5.5 to 5.7.
B_2	13-17	Dark grayish brown or grayish-brown (10YR 4/2-5/2) clay; very firm, medium, blocky structure; very hard when dry and plastic when wet; pH 5.5 to 5.8.

B_3	17-24	Grayish-brown to dark grayish brown (2.5Y 5/2-4/2) clay; sometimes laminated; pH 5.8 to 6.2.
C	24+	Grayish-brown to light grayish brown (2.5Y 5/2-6/2) clay; sometimes massive and of uniform color, sometimes laminated with color tones varying from light to dark within the laminae; pH 6.8 to 7.2.

Agriculture

Chapeau soils are used for all common field crops. Yields are generally fair in years of moderate, well-distributed rainfall but crops are sometimes impaired by the droughty conditions of the land.

The surface soil has a low organic matter content that makes it difficult to handle. Also, the range of moisture at which the soil can be cultivated with ease is very narrow if good soil structure is to be maintained. The benefits that would follow the use of lime or chemical fertilizers are not known.

Dalhousie Series (D, Dh)

Dalhousie soils (Figure 13) cover 19,732 acres in Gatineau County and 18,573 acres in Pontiac County, generally between 350 and 550 feet elevation. The clays deposited at these levels are commonly coarser in texture and more variable in composition than those deposited at lower elevations.

Frequently Dalhousie soils are found in narrow, V-shaped valleys between stony till ridges. Much of the drainage water from higher lands runs over or through the Dalhousie soils before reaching the natural drainage outlets. Since the land is smooth and gently sloping and the soil permeable, the erosion hazard is very low. The moisture-holding capacity is high and the drainage imperfect to somewhat poor.

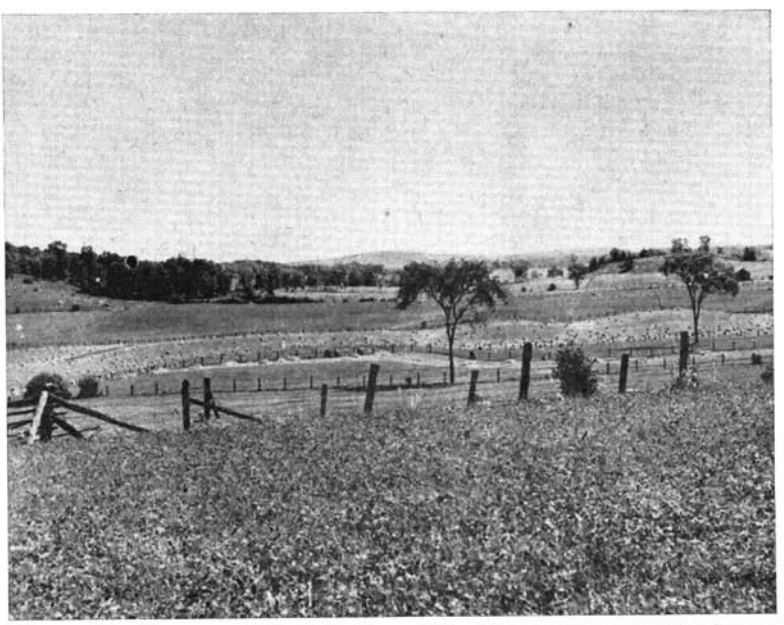

FIGURE 13.—The smooth basin in the middle distance is covered by loamy and clayey water-laid deposits on which the Pontiac and Dalhousie series have developed, and the undulating ridges are covered by glacial till on which the Gatineau series has developed.

Most Dalhousie soils have a clay loam surface texture, shown on the map by the symbol D. However, some areas have a clay surface texture and wherever they could be mapped separately from the clay loam they were shown on the map by the symbol Dh. Except for the difference in texture of the surface, the profiles of the clay loam and of the clay are similar. A cultivated Dark Gray Gleysolic clay loam is described as follows:

Horizon	*Depth Inches*	
A_c	0- 8	Very dark grayish brown (10YR 3/2) clay loam; strong granular structure; firm, moderately plastic and sticky when wet; pH 5.3 to 6.3.
B_g	8-30	Dark grayish brown to olive-gray or dark olive gray (2.5Y-5Y 4/2-5/2) silty clay to clay; fine and medium subangular blocky structure; brown mottles inside the aggregates (scraped profiles appear mottled, but natural aggregates show only very faint mottling on the outside); firm aggregates; plastic and sticky when wet; pH 6.2 to 7.0.
C	30+	Olive-gray to dark-gray (5Y 5/2-4/1) clay; moderate medium structure or sometimes laminated; plastic and sticky when wet; pH 6.4 to 7.4.

Agriculture

Dalhousie soils are practically all under cultivation and are used mostly for field crops such as grain, hay, silage corn, roots and pasture. These stone-free soils make excellent farm land. Generally, they are easy to drain.

The high moisture-holding capacity and the moderately well developed granular structure favor deep rooting of plants growing on this soil. Thus crops are more resistant to drought than on any other soil of the surveyed area.

Dalhousie soils are among the best in the area for cereals as well as for mixed hay and pasture. Alfalfa grows moderately well under average conditions. The longevity of the stands could be increased by improvements in drainage and by liming. The soil has good natural fertility, easily maintained or increased by moderate applications of complete fertilizer with manure and lime. The effects of fertilizers and amendments should be prolonged because the elements added will not easily wash away.

Brandon Series (B)

Brandon soils occupy 3,962 acres in the area surveyed. They have developed from clays, which are often laminated. The natural drainage is poor because the land is flat or slightly depressed and water percolates very slowly through the fine-textured materials.

The only type mapped in the series is clay. The characteristics of the cultivated soil, a Dark Gray Gleysolic, are as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Very dark grayish brown clay to silty clay (2.5Y-10YR 3/2); firm, granular and medium, subangular, blocky structure; pH 5.4 to 6.4.
B_{g1}	7-12	Light brownish gray (2.5Y 6/2), somewhat mottled clay to silty clay; blocky and pseudo-platy structure; pH 5.4 to 6.4.
B_{22}	12-30	Olive-gray to gray (5Y 4/2-5/1) clay with dark yellowish brown (10YR 4/4) mottles; sometimes having moderately developed subangular blocky structure and sometimes exhibiting laminations; plastic and sticky when wet; pH 5.6 to 6.6.
C	30+	Gray clay (5Y 5/1), generally laminated; laminae about 4 mm. thick and often separated by silty material; pH 6.8 to 7.2.

Agriculture

Brandon soils are all under cultivation and are used for all the common field crops and pasture. They have very high natural fertility, smooth topography and no stones.

The soils generally benefit greatly from liming. Successful farming depends mainly upon the efficiency of artificial drainage. This is generally difficult to achieve because these are bottom soils that receive drainage waters from surrounding higher land.

Brandon soils are not well adapted to deep-rooted plants; alfalfa is grown only in mixtures with clover since it does not last long and needs to be reseeded often.

Rideau Series (Ri, Rih)

Rideau soils occupy a total of 6,676 acres in the two counties, north of Hull and near Luskville. They occur at elevations ranging from 150 to 300 feet, on gentle undulations or on nearly level land dissected by gullies. These soils have developed from deep marine clay deposits that are generally uniform throughout and do not show any varving or lamination.

The moisture relationships are rather complex in Rideau soils because of high moisture-holding capacity, slow rate of moisture movement, considerable swelling on wetting, and variable percolation rate. After the snow melts there is generally an excess of moisture in the soil and aeration is at a minimum due to the full expansion of the clay. In this state the soil cannot absorb any more water and all the rain falling on it runs off and may cause erosion. Once wet the soil loses moisture very slowly because the structure is poor and internal aeration is lacking. Moisture is lost mainly through evaporation and on drying the soil cracks and bakes. When dry the soil takes up moisture very slowly and water from brief summer rains may run off or evaporate before becoming available to plants. This explains why crops on Rideau soil often suffer from drought though moisture is adequate elsewhere. Sheet, rill or gully erosion frequently occurs on Rideau soils. The heavy clay (Rh) occupies only a small acreage. The Dark Gray Gleysolic clay (Ri) is the main type mapped in the series, and the cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Grayish-brown (10YR-2.5Y 5/2) clay; granular and subangular blocky structure; firm to hard under average moisture conditions; plastic and sticky when wet; tendency to form large hard clods; moderately permeable and aerated under average moisture conditions; pH 5.5 to 6.2.
A_2	7- 9	Olive-gray to light brownish gray (5Y 5/2-2.5Y 6/2) clay; faint mottles; pH 5.5 to 6.0.
B_g	9-24	Olive-gray to brownish-gray (5Y-2.5Y 5/2) clay; faint mottles; very poorly aerated, slowly permeable, plastic and sticky when wet; moderately aerated and permeable when slightly moist or dry; blocky structure; pH 5.8 to 6.4.
C	24+	Olive-gray to gray (5Y 4/2-5/1) clay; massive when moist or wet; shrinking considerably on drying and forming very hard, coarse, angular blocks; pH 6.6 to 7.3.

Agriculture

Rideau soils are all under cultivation and are best suited for the production of hay, grain and pasture. The land is not suited to orchards, potatoes or most garden crops. The surface soil contains a relatively low percentage of humus and for this reason is more difficult to cultivate than Ste. Rosalie or Laplaine soils.

Although some difficulty may be experienced in establishing alfalfa stands, when the upper solum has been limed, aerated and fertilized the alfalfa generally gets a fair start and the plants can reach the rich subsoil. Alfalfa then resists summer drought and uses the untapped mineral reserves of the clay subsoil, requiring little additional fertilization.

On most common crops lime, manure and phosphate fertilizers give the most significant yield increases. Where manure is not available, nitrogen fertilizer should be used on most field crops except well-established legume stands.

Particular care is required to prepare a good seedbed on Rideau soils. If the soil is worked when too wet, large hard clods will form. When the soil is too dry, the clods resist fragmentation and much power is needed for cultivation.

Farmers should try to prevent gully erosion along drainage channels. Once gullying starts on the embankments along which these soils are frequently found, it is difficult to stop. To prevent such destructive erosion, steep slopes should not be used for cultivated crops, grass strips should protect the edges of fields above steep embankments, and furrows should not discharge directly along the banks.

Ste. Rosalie Series (R, Rl, Rh)

Ste. Rosalie soils (Figure 14) occupy 13,779 acres near Hull, Luskville and Quyon, at elevations ranging from 150 to 350 feet. The land is flat and stone-free. The profile is developed on deep, gray marine clay deposits. Runoff is very slow because of the flatness of the land and the internal percolation is extremely slow because of the massive clay. On the other hand, the flat topography helps rain water penetrate the soil and this favors crops in the dry periods of the vegetative season. During this period, as on Rideau soils, there is little loss of moisture.

FIGURE 14.—The Pontiac series covers the well-drained undulations and the Ste. Rosalie series to poorly drained, lower area.

Three types were mapped in the Ste. Rosalie series: heavy clay (Rh), found on the lower, eroded terrace; and clay (R) and clay loam (Rl), generally found on the upper, non-erroded terrace. These types differ mainly in the texture of the surface soil. However, the mottling or rusty color of the subsoil is more

intense in the clay loam than in the clay and more intense in the clay than in the heavy clay.

West of Eardley, some red clay is mixed with the gray clay of the Ste. Rosalie heavy clay. The reaction of these heavy clays is somewhat above the average for the series and the structure is better developed than usual. These characteristics suggest that some of these areas have been affected by landslides that have been completely levelled by the waters of the Ottawa River.

This series belongs to the Dark Gray Gleysolic group. The cultivated clay is as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Very dark grayish brown (10YR 3/2) clay; moderate, medium, granular structure; firm when dry; moderately plastic and sticky when wet; permeable and aerated; pH 5.5 to 6.0.
A_{2g}	7- 8	Dark grayish brown clay (2.5Y 4/2); slightly mottled with yellowish-brown (10YR 5/4); coarse, subangular, blocky structure; pH 5.5 to 6.0.
B_{g1}	8-18	Brown (rusty) clay (7.5YR 4/4); common, medium, distinct mottles of grayish brown (2.5Y 5/2); fine block aggregates, separated with difficulty; plastic and sticky when wet; poorly aerated under average conditions; pH 5.5 to 6.3.
B_{g2}	18-24	Gray clay (5Y 5/1); coarse, distinct dark yellowish brown (10YR 4/4) mottles; fine to medium blocky aggregates that separate fairly easily; very plastic and sticky when wet; pH 6.5 to 6.8.
C	24+	Gray clay; dark grayish brown (2.5Y 4/2) discolorations along root channels; massive to coarse blocky structure; very plastic and sticky; pH 6.7 to 7.3.

Agriculture

Ste. Rosalie soils are entirely under cultivation and are used for field crops and for pasture. The best features of the land are flat topography, freedom from stones, a granular organic surface, high natural fertility, and ease of cultivation and maintenance of good tilth. However, the rusty layer that underlies the organic surface has massive structure and acts as a barrier to the passage of water, air and plant roots.

Most of these soils have been used for cash crops of grain and hay. The soil has resisted many abuses, but its fertility has declined, sometimes enough to be unprofitable for cropping. Fortunately these lands have a reserve in their fertile subsoil. This has hardly been tapped by cropping because most crops have been shallow-rooted and therefore largely supported by the surface layer. With efficient surface drainage, liming and sometimes subsoiling, the subsoil may be aerated to make it suitable for deep-rooted crops.

Since available mineral nutrients are plentiful in the subsoil, yields of crops can be increased simply by deepening the plant feeding zone. The most efficient way to do this is through tile drainage, a costly improvement for large farms. Ridge plowing has been used to improve the surface drainage, and also improve the internal drainage enough to permit alfalfa to grow.

When moisture conditions are right the use of subsoilers to break up the rusty layer has improved the aeration of the subsoil. Further investigation of this practice is needed.

Lime helps to improve the physical condition of the soil. The surface is acid and lime increases yields. After drainage and aeration of the subsoil and liming of the surface, the most important need is phosphorus. The very low content of available phosphorus in the surface soil, as in most other soils of the region, is mainly because of continuous cropping without adequate fertilization.

If the aeration is improved to the point where good alfalfa crops will grow and feed in the more fertile subsoil, fertility should not be a problem.

Laplaine Series (Lp)

Laplaine series is the poorly drained catenary associate of the Rideau and Ste. Rosalie soils. It covers a total of 998 acres, mainly near Hull and Luskville.

The profile, developed from gray marine clay, has formed under ponded drainage conditions on slightly depressed, stone-free land. The surface is highly organic and in some areas the soil grades into a deep organic deposit. The original vegetation was mainly cedar, ash and elm.

The profile of the average cultivated Laplaine soil, which belongs to the peaty Dark Gray Gleysolic group, is as follows:

Horizon	*Depth Inches*	
A_c	0- 8	Black clay (5YR 2/1), high in organic matter; granular and sub-angular blocky aggregates; slightly firm when moist; slightly plastic and sticky when wet; permeable; pH 5.8 to 6.7.
B_g	8-12	Gray heavy clay (5Y 5/1); fine yellowish-brown (2.5Y 5/4) mottles; weak, coarse, blocky structure; very hard when dry and very plastic and sticky when wet; poorly aerated and very slowly permeable; pH 6.2 to 6.8.
C	12+	Gray and olive-gray clay (5Y 5/1-5/2); faint olive mottles (5Y 5/3); coarse blocky structure in the upper part, changing to massive material with depth; nonaerated; sticky and plastic; free carbonates occasionally present; pH 7.0 to 7.6.

Agriculture

Laplaine soils were the last of the Lowland clay soils to be brought under cultivation because extensive drainage was necessary before they were suitable for cultivated crops. They have a great reserve of fertility because they have been only slightly leached and are rich in organic matter. But good yields cannot be expected unless the subsoil is well drained and aerated. The mixing of mineral subsoil with the organic surface material is an excellent practice. This improves the physical and chemical properties of the surface soil, which is high in total nitrogen but low in phosphorus and potash. This imbalance is responsible for late maturity and lodging of cereals. Manure, even when used in large quantities, cannot correct the imbalance of the three main plant nutrients. Chemical fertilizers rich in phosphorus and potash are used to bring about a better balance. The reaction of the cultivated surface soil may vary widely, so that liming may or may not be needed.

Laplaine soils are used for field crops and pasture. The land is seldom used for silage corn and it is better suited to the production of timothy and other grasses than to cereal grains and legumes.

Soils Developed from Water-laid Sands

Morin Series (Mo, Moc, Mol)

Morin soils (Figure 15) occupy 40,710 acres in Gatineau County and 54,942 acres in Pontiac County, on level to gently undulating land at elevations ranging from 400 to 900 feet. They have developed on medium to coarse sands which fill the floors of the Laurentian valleys or are along the northern rim of the Ottawa Valley. In both cases, the sand is derived from quartzitic, gneissic and granitic Precambrian rocks; it is free of cobbles and boulders but may contain a little gravel. The sand fraction is generally composed of 50 to 70 percent coarse and medium sand. The Morin soils are excessively drained because of the porosity of the sandy parent material and to its depth, which often exceeds 10 feet.

FIGURE 15.—In this region near Ireland Lake the sequence of soils from the ridge in the foreground through the valley to the far ridge is: Mont-Rolland, Piedmont and Pontiac on slopes, swamp in depression, Morin on flat terrace, and Gatineau.

The uncleared land is covered mainly by white pine, red pine, white spruce, fir and hemlock. There are also white birch, yellow birch and sugar maple.

Three types were mapped in the Morin series: sand (Mo), coarse sand (Moc) and loamy sand (Mol). These textural differences occur in the surface soil and do not affect the appearance of the profile. Morin soils belong to the Podzol group. The loamy sand (Mol) is described as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Brown to dark-brown (10YR 4/3-7.5YR 3/2) loamy sand; single grains and fine granules; loose; rapidly permeable; pH 5.0 to 5.3.
A_2	6- 8	Remnants of gray, leached layer.
B_{21}	8-18	Strong-brown to yellowish-red (7.5YR 5/8-5YR 4/8) sand; gravel sometimes evenly distributed among the sand; single grains; very loose, open and permeable; pH 5.2 to 5.5.
B_{22}	18-30	Yellowish-brown (10YR 5/5-5/8) sand, sometimes with small amounts of gravel distributed through the whole horizon; single grains; very loose, open and permeable; pH 5.4 to 5.6.
B_3	30-45	Brownish-yellow (10YR 5/6-5/8) sand; other properties as in horizon B_{22}.
C	45+	Pale-yellow (10YR 7/4-8/4), medium to coarse sand with or without gravel beds; readily permeable; pH 5.6 to 6.0.

Under forest the A_2 horizon lies immediately below a leaf mat and is four to six inches thick.

Agriculture

On farms where better soils were available, the Morin sands have generally been left wooded; but in areas where they were the only stone-free, well-drained

and smooth land, considerable acreages have been cleared. Some of these soils have been used for potato growing but none have been satisfactory for general field crops.

Lime, manure and sometimes irrigation must be used to produce good potato crops. In general, satisfactory fertility levels can only be maintained by intensive practices. Areas that cannot be farmed profitably should be returned to forest.

Déligny Series (De)

Déligny soils occupy a total of 2,528 acres, mainly near Bristol Ridge in Pontiac County. They have formed on the same type of sand as Morin soils but are imperfectly drained. Déligny soils are extremely permeable and consist of medium to coarse sand, often containing a little gravel. The drainage is imperfect because of a high water table, the sand being shallow over impervious material such as bedrock or clay. The land is nearly level, but is slightly depressed as compared with the Morin soils. The two soils usually form a natural pattern in which the Déligny soils occupy narrow, slightly depressed areas and the Morin soils occupy the undulating, well-drained areas. The two series were generally mapped as a complex.

Déligny soils belong to the gleyed Podzol group. Under undisturbed forest there is an organic mat about 2 inches thick underlain by a grayish, leached sand horizon (A_2) about 12 inches thick. This is underlain by a mottled yellowish-brown sand horizon (B_{2g}). The cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Black (2.5Y 2/0) sand to loamy sand rich in organic matter; single grains; very permeable; pH 5.0 to 5.4.
A_2	6-12	Grayish-brown (10YR 5/2) leached sand in pockets with some of the material described below; pH 5.0 to 5.4.
B_{2g}	12-24	Yellowish-brown (10YR 5/4) coarse and medium sand with small amounts of gravel; brownish-gray mottles; single grains; rapid permeability; pH 5.4 to 5.8.
C_g	24+	Light-olive (2.5Y 5/4) coarse and medium sand with small amount of gravel; single grains; rapidly permeable but unaerated because of the presence of free water most of the time; pH 5.4 to 5.8.

Agriculture

Déligny soils are partly cultivated and partly forested. Their natural fertility is low and they require lime and complete fertilizers to produce farm crops. They are cold soils in which there is an excess of free water during a part of the vegetative season, especially during the spring. For this reason they cannot be seeded early and growth starts slowly.

Artificial drainage would lower the free water level but this increases the risk of lowering it beyond the reach of many plants.

Ripon Series (Rn)

Ripon soils occupy 8,595 acres in Gatineau County and 4,122 acres in Pontiac County. They are generally found along streams in the valleys, on level to gently undulating topography. The parent material is loamy sand, generally 4 to 8 feet thick above materials of relatively low porosity such as silt, clay or fine sand laminated with clay and silt. The sand fraction consists of nearly equal proportions of fine to very fine sand and of medium to coarse sand. These materials are porous, aerated and well drained.

A cultivated Podzol loamy sand (Rn), the only type mapped in the series, is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Dark grayish brown to dark-brown (10YR 4/2-5/3) loamy sand; very fine granular structure among single grains; very friable and permeable; pH 5.4 to 5.6.
B_{21}	8-14	Dark yellowish brown to brown loamy sand to sand; single grains; loose, open and well aerated; pH 5.4 to 5.8.
B_{22}	14-24	Light yellowish brown to pale-brown or light-olive (2.5Y 6/4-5/4 to 10YR 6/3), coarse to very fine sand; loose, open and well aerated; pH 5.4 to 5.8.
B_3	24-38	Light-olive to olive (2.5Y 5/4-4/4) sand and loamy sand with spots and streaks of fine-textured material; consistence varying from loose to very firm; some faint mottling; moderately permeable; pH 5.6 to 5.8.
C	38+	Gray to light gray (10YR 4/1-7/2) sand laminated with silt or clay; the clay sometimes nearly continuous and massive instead of being laminated; slow permeability; pH 5.6 to 6.2.

Under undisturbed forest the soil has a forest litter 2 to 3 inches thick over a grayish, leached mineral horizon 2 to 3 inches thick; this in turn is underlain by the brownish B_{21} horizon described above.

Agriculture

Most of the Ripon soils have been cleared and are used for general farming and some special crops such as potatoes. There are better crops on the Ripon soils than on the other sandy soils in the surveyed area. This is apparently due to the good drainage and deep aeration, which permit deep development of roots, and to a weak capillary upward movement of water, which keeps the lower subsoil slightly moist.

Crops on Ripon soils respond well to lime, manure and complete fertilizers. The soils are suited to row crops in rotation with legumes on land adequately limed and fertilized. They are not well suited to shallow-rooted grasses. Most crops, especially cereals, should be seeded as early as possible to take advantage of the excellent moisture conditions in this early soil during the spring.

Crop yields vary widely. On unlimed and unfertilized land, the yields are poor but with good care satisfactory yields can be maintained.

Ivry Series (I, If)

Ivry soils (Figure 16) occupy 38,357 acres in Gatineau County and 41,465 acres in Pontiac County, on undulating to rolling land at elevations ranging between 400 and 800 feet. The profile has developed from stone-free, fine and very fine sands, which in many instances have been wind-blown and duned. In many places the sand is more than 20 feet deep. The fine and very fine sand fractions are generally about 70 to 80 percent of the total soil. The parent material is sometimes nearly uniform in composition, but more often it contains some thin, horizontal layers of very fine sand and silt. The soils are excessively drained because the porosity of the sand allows fairly rapid percolation through the solum and the parent material.

The natural tree vegetation is mainly white and red pine, white spruce, fir, aspen, white and yellow birch, sugar and red maple.

Two types were mapped in the Ivry series: fine sand (I) and very fine loamy sand (If). Areas in which the soils have been severely eroded by wind were mapped as the eroded phase (Ie). Such areas have loose sand dunes as well as truncated and buried profiles.

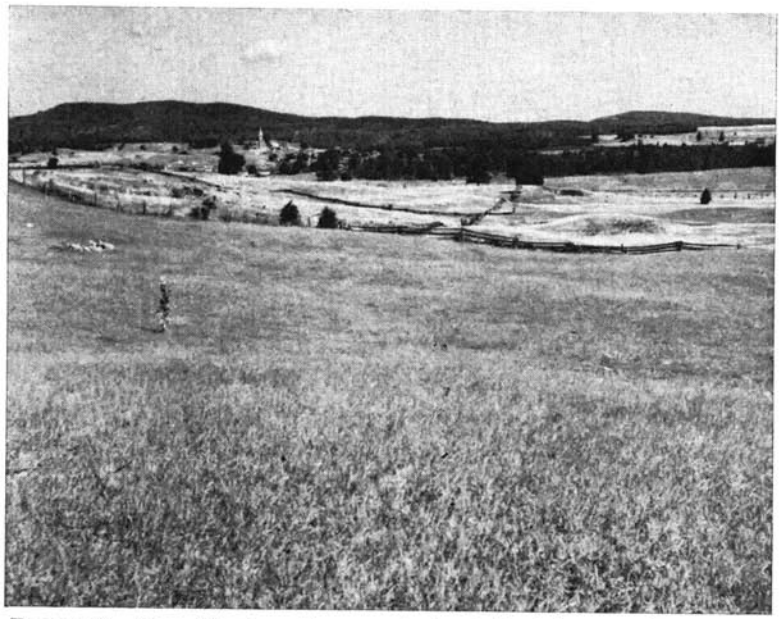

FIGURE 16.—Near Messines the excessively drained Ivry sands occur on undulations and the imperfectly drained Bevin sands in depressions.

Much of the Ivry soil is cultivated. The six-inch cultivated layer is dark grayish brown to dark-brown, very fine sand to fine sand and is underlain by yellowish-brown fine sand. A virgin Podzol profile on fine sand (I), the most common type in the series, is described as follows:

Horizon	*Depth Inches*	
A_o	1½- 0	Very dark grayish brown to very dark brown (10YR 3/2-2/1) raw humus; very friable and permeable; pH 4.5 to 5.0.
A_2	0- 1	Pinkish gray to light brownish gray (7.5 YR-10YR 6/2), leached very fine sand; friable and permeable; pH 5.0 to 5.2.
B_{21}	1- 6	Yellowish-brown to dark-brown fine sand; single grains; ortstein rare; very porous and permeable; pH 5.2 to 5.6.
B_{22}	6-12	Strong-brown (7.5YR 5/6-5/8) fine sand; single grains; loose and permeable; pH 5.4 to 5.6.
B_3	12-18	Yellowish-brown to pale-yellow (10YR 5/6-5Y 7/4) fine sand; other properties as in horizon above.
C_1	18-30	Light brownish gray (2.5Y 6/2) fine sand; well packed; permeable; pH 5.4 to 5.8.
C_2	30+	Light-olive to light brownish gray (2.5Y 5/4-6/2) fine sand and very fine sand; sometimes with loamy or silty horizontal layers; generally tightly packed; permeable; pH 5.6 to 6.2 in the upper part of the parent material.

The very fine loamy sand differs from the above mainly in the texture of the upper 6 to 10 inches.

Agriculture

Ivry soils are best suited to intensive farming and need fairly large quantities of fertilizers and irrigation. A large proportion of the soils have been cleared and are used for general farming. However, the low fertility and the droughty condition of the land have resulted in low yields.

These soils warm up rapidly in the spring and could be worked and seeded much earlier than they generally are. This would enable plants to use the moisture available during the early part of the vegetative season. In some sections, special crops such as potatoes have been grown with success. The land should be treated with lime to correct the natural acidity and to provide the calcium necessary to plant growth. When potatoes are grown, the lime is generally applied after digging the potato crop. Besides lime and fertilizer the soils also require protection against wind erosion, particularly on large cultivated fields. The areas most susceptible to wind erosion should not be cultivated but should be left wooded or reforested. Wind breaks should also be planted along fields to reduce wind velocity. Large areas of these soils are under forest and this is probably their best use when not otherwise well managed.

Bevin Series (Be, Bel)

The Bevin soils occupy 8,640 acres in Gatineau County and 5,785 acres in Pontiac County on level to depressed topography. Like the Ivry soils, they have developed on fine sand. The water table is only a few feet below the land surface and this causes imperfect drainage of the soil profile. The high water table may be due to the proximity of soils to streams and lakes or to the presence of impervious unconsolidated material, or bedrock, a few feet below the surface.

The natural vegetation on Bevin soils is mostly spruce, fir, cedar, tamarack and some deciduous trees such as red maple and elm.

The series includes sandy loam (Bel) and loamy sand to sand (Be). It belongs to the Podzol (gleyed) group. The main characteristics of a cultivated loamy sand to sand (Be) are as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Very dark gray (5YR 3/1) loamy sand to sand; fine granules among single grains; very permeable; pH 5.0 to 5.4.
A_2	6- 7	Gray, fine loamy sand; remnant of a leached layer 2 to 4 inches thick in virgin profiles.
B_{21}	7-16	Strong-brown to reddish-brown (7.5YR 5/6-5YR 5/4) sand to loamy sand; yellowish-brown (10YR 5/8) and grayish-brown (10YR 5/2) mottles; single grains; very permeable but imperfectly aerated when subsoil is saturated with water; pH 5.3 to 5.8.
B_{22}	16-20	Sand to loamy sand; mottled with grayish brown, dark yellowish brown and yellowish red (10YR 6/2-4/4, 2.5Y 5/2, 5YR 4/8); permeable; saturated with water almost permanently; pH 5.6
C	20+	Olive-gray to olive (5Y 5/2-5/3) mottled material, consisting of uniform sand or sand laminated with silt or clay; slowly permeable; saturated with water almost permanently; pH 5.6 to 6.0.

Agriculture

Most of the Bevin soils have been left wooded but some areas have been cleared and are used for general farming. Crops are usually fair to poor. The land can be improved for crops by adequate artificial drainage, liming and use of complete fertilizer and manure.

Bevin soils are late and not suited to crops requiring a long vegetative season. Legumes do not survive unless the acidity has been corrected and the drainage considerably improved. Grain may not always mature unless the drainage is improved. With row crops and field crops, the quality and yield depend considerably upon efficiency of artificial drainage and on adequate liming and fertilization. In general, yields are highest in dry years and lowest in wet years.

Guindon Series (Gu)

A total of 16,556 acres of Guindon soils (Figure 17) are distributed about equally between the counties of Gatineau and Pontiac. They occur at elevations between 500 and 900 feet on sloping to gently rolling land. The profile has developed in two to five feet of sandy material covering the till or bedrock of the Laurentian hills. This material, superimposed on the till or the Precambrian bedrock, has produced a land surface smoother than the usual till topography, but the deposit is not thick enough to completely cover the larger boulders or prominent outcrops. Guindon soils are not entirely free of stones, like the Ivry soils, but they are much less stony than the Gatineau or Ste. Agathe till soils. Small loose boulders are usually absent but some larger boulders from the underlying till protrude through the shallow soils.

The natural drainage is good. The solum is rapidly permeable, but the till or the bedrock under the relatively shallow sandy deposit impedes the subsoil movement of water. Occasionally there may be mottling in the subsoil on slopes that receive seepage water from higher land.

This series belongs to the Podzol soil group, and the cultivated layer is dark brown. The main characteristics of the virgin soil are as follows:

Horizon	*Depth Inches*	
A_0	4- 0	Black (10YR 2/1) organic matter; rather raw humus; very absorbent and very permeable; pH 3.8 to 4.2.
A_2	0- 4	Pinkish-gray (7.5YR 6/2) leached loamy sand; pH 4.0 to 4.4.
B_{21}	4-26	Yellowish-red (5YR 4/6-5/6) sand; single grains; rapidly permeable; pH 4.8 to 5.2.
B_{22}	26-36	Strong-brown to yellowish-brown, slightly mottled (7.5YR 5/6, 10YR 5/4-5/6) loamy sand to sand.
D	36+	Light brownish gray stony till.

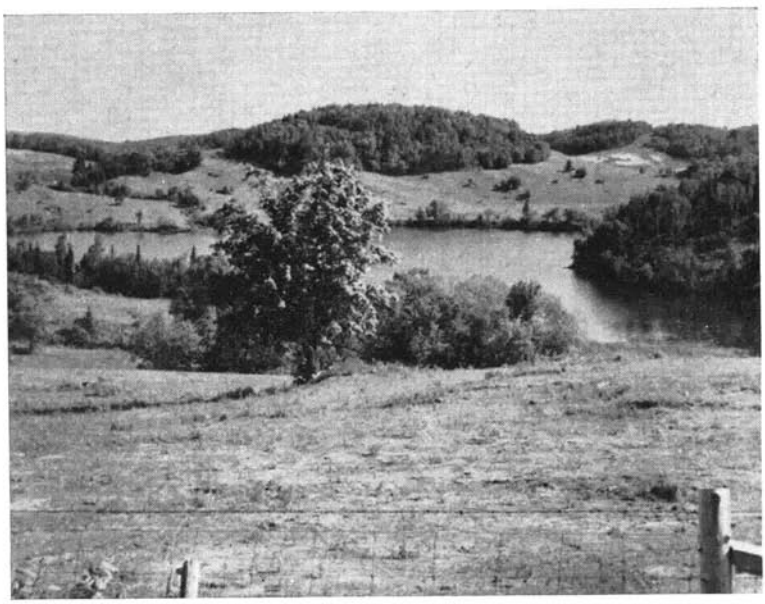

FIGURE 17.—The Lakefield land type covers the stony ridges beyond the lake, and is surrounded by sandy soils such as the Guindon, Ivry and Morin series.

Agriculture

Because they are much less stony than the surrounding till soils, a large proportion of the Guindon soils have been cleared and are used for cultivated crops or for pastures.

Crop yields are generally low because the natural soil fertility is low and the necessary plant nutrients have not been added. Fair yields could be obtained if the land were limed, fertilized and well managed. Since the upper soil is generally dry and the subsoil holds some moisture, deep-rooted plants are better adapted to this soil.

On long slopes, precautions must be taken to avoid water erosion. The land that cannot be farmed properly should be reforested, and reforestation, especially of the upper slopes, would help somewhat in regulating the soil moisture on the lower slopes.

Uplands Series (Up)

Uplands soils occupy a total of 2,720 acres in the two counties. They are found between Hull and Aylmer and between Quyon and Shawville at elevations of 250 to 450 feet. The parent material is a medium to fine sand, often more than 10 feet thick, over marine clay. Because of the high porosity of the sand, most of the precipitation percolates very rapidly through the profile until it is beyond the reach of most cultivated plants. The resulting droughty conditions favor wind erosion, which takes place readily where the land is not protected by vegetation.

The trees on these soils are mainly white pine, red pine, white birch, red oak, sugar maple and beech.

The Uplands series belongs to the Podzol group. The profile of the cultivated sand (Up), the only type mapped in the series, is as follows:

Horizon	*Depth Inches*	
A_c	0- 8	Dark-brown (10YR 4/3) medium and fine sand; rapidly permeable; pH 5.2 to 5.8.
B_{21}	8-12	Dark yellowish brown (10YR 4/4) medium and fine sand; rapidly permeable; pH 5.4 to 6.2.
B_{22}	12-18	Yellowish-brown (10YR 5/6) medium sand; single grains; rapidly permeable; pH 5.4 to 6.2.
B_3	18-36	Yellowish-brown to brownish-yellow (10YR 5/8-6/6) medium sand; single grains; rapidly permeable; pH 5.4 to 6.4.
C	36+	Light yellowish brown (10YR 6/4) medium sand; single grains; very permeable; pH 5.4 to 6.4.

Under forest a light-gray leached layer, 1 to 4 inches thick, is found immediately below a thin leaf mat.

Agriculture

A small proportion of the Uplands soil is under cultivation and is used for general field crops. Most of the land is wooded or reverting to forest after unsuccessful cultivation. Farming fails because of the very low natural fertility and the droughtiness of the soil. Plant nutrients can be supplied by fertilizers, and irrigation can provide the necessary moisture, but the cost would usually be prohibitive for general farm crops. For some cash crops, fertilization and irrigation may be profitable.

With the low rates of fertilizer generally applied, yields of field crops are low and unprofitable. Therefore, the land should be reforested. Trees protect the land from wind erosion and use the soil moisture more effectively because they have deep, extensive roots and the shade greatly reduces evaporation of moisture from the soil surface.

Ste. Sophie (Sp)

Ste. Sophie soils cover 2,784 acres in the lowland area. They occur mainly in Pontiac County near Quyon and Shawville in association with the Uplands soils. Ste. Sophie soils are derived from medium to fine sands deposited over clays; the thickness of the sandy deposit seldom exceeds eight feet and is usually four to five feet.

The land is usually undulating, well drained and permeable to a depth of about three feet. Rain water percolates rapidly through the upper part of the soil but its downward movement is checked by the underlying slowly permeable clay.

This series belongs to the Podzol group. A virgin profile of the sand (Sp) type, the only one mapped in the series, is described as follows:

Horizon	*Depth Inches*	
A_o	2- 0	Very dark brown to black raw humus and roots with some sand; fine granular structure; very friable and permeable; pH 4.5 to 5.0.
A_2	0- 1	Light brownish gray, leached sand to loamy sand; loose and rapidly permeable; pH 5.0 to 5.5.
B_{21}	1- 8	Reddish-brown sand to loamy sand; single grains; permeable; pH 5.0 to 5.5.
B_{22}	8-18	Yellowish-brown sand to loamy sand; single grains; permeable; pH 5.0 to 5.8.
C	18+	Light yellowish brown to light-brown or strong-brown mottled sand; single grains; pH 5.0 to 6.0.

When cultivated the surface soil is dark-brown sand and is underlain by the reddish-brown sand (B_{21}) described above.

Agriculture

Most Ste. Sophie soils are used for general farm crops and pastures. Although these soils are acid and of low natural fertility, they make fair farming land because they respond moderately well to good management and liming, fertilizing and manuring. Without lime and fertilizer, yields of all crops are low. The land is suitable for garden crops and deep-rooted plants. Although the land is not excessively droughty, crops would benefit from irrigation, especially those of shallow-rooted plants.

St. Jude Series (J, Jl)

St. Jude soils cover a total of 6,535 acres. Like the Uplands and Ste. Sophie soils, they are derived from medium to fine sand over clay and they occur mainly in the lowland area extending from Quyon to Shawville in Pontiac County.

The topography is level and the land is free of stones. The solum is imperfectly drained during spring and periods of high rainfall. Precipitation is readily absorbed by the porous sandy material, but a few feet below the land surface the clay subsoil impedes moisture movement. Since the solum itself has very low moisture-holding capacity, most of the water moves slowly laterally through the sand above the flat impermeable clay. Soil drainage can be speeded up considerably by digging deep drainage channels. The wooded soils are covered mainly with red maple, hemlock, white birch, aspen, fir and spruce.

The series includes fine sand (J) and sandy loam (Jl). Both types belong to the Podzol (gleyed) soil group and have the same general characteristics. The virgin profile of the sand type (J) is described as follows:

Horizon	*Depth Inches*	
A_o	2- 0	Black raw organic material with some sand; pH 5.0 to 5.4.
A_2	0- 2	Light-gray, leached fine sand to loamy sand; pH 5.0 to 5.4.
B_{g1}	2- 8	Reddish-brown fine to medium sand or loamy sand; some mottling; generally friable but locally indurated into ortstein; pH 5.6 to 6.0.
B_{g2}	8-18	Strongly mottled yellowish-brown and light yellowish brown medium to fine sand; pH 5.8 to 6.2.
C	18+	Light brownish gray medium to fine sand; some gray and strong-brown streaks; single grains; pH 6.0 to 6.8.

Agriculture

St. Jude soils are partly wooded and partly used for general field crops and pastures. Usually these soils are used only when better land is not available on the farm or when artificial drainage is easy to achieve because deep natural drainage channels are near. In most cultivated fields, yields are low. In pastures that are not well managed, weeds of all kinds, spirea and gray birches tend to crowd out the grasses. In this way some fields, once cultivated, have reverted to bush land containing very few trees of commercial value.

Efficient drainage, proper liming and fertilization are necessary to make good use of the land. The land remaining under natural vegetation is more productive than land cleared, undrained, unlimed and unfertilized.

These soils are slow to warm up in the spring because of water-logging and imperfect drainage. The land is very soft and does not support heavy machinery or the tramping of cattle when the subsoil is saturated with water. The need for artificial drainage, especially in the spring, to allow early cultivation, germination, and rapid plant growth is great.

St. Thomas Series (Th)

St. Thomas soils occur in Pontiac County (7,014 acres) and Gatineau County (1,382) along the north shore of the Ottawa River, mainly between Portage-du-Fort and Luskville. The elevation of this area is about 300 to 400 feet. The land surface is generally undulating and sometimes dissected by gullies.

The parent material is fine to very fine sand overlying marine clay at a depth usually exceeding eight feet. In these deposits more than 80 percent of the sand fraction is fine and very fine. The soil materials vary less than those of the Ivry soils, which the St. Thomas series resembles.

The fine-textured material of these soils is very permeable and rapidly absorbs precipitation. The solum is excessively drained. Soil moisture percolates quickly downward and soon escapes the reach of plant roots. Most of the water accumulates over the impermeable clay substratum and eventually moves laterally to lower land.

The soil has a slightly higher moisture-holding capacity than Uplands sand but is still subject to drought. The hazard of wind erosion is even greater than on Uplands soil because the sand is so fine.

White and red pine, red oak, beech and sugar maple are the main trees found. Under forest a light-gray, leached mineral layer, 1 to 4 inches thick, lies immediately below a thin leaf mat. These soils belong to the Podzol group. The

profile of the cultivated fine to very fine sand (Th), the only type mapped in the series, is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Dark reddish brown (5YR 3/3) fine to very fine sand; single grains; very friable and permeable; pH 5.0 to 5.8.
B_{21}	8- 9	Reddish-brown (5YR 4/3) fine to very fine sand or loamy sand; single grains; rapidly permeable; pH 5.0 to 5.8.
B_{22}	9-24	Strong-brown (7.5YR 5/8) fine to very fine sand or loamy sand; single grains; rapidly permeable; pH 5.2 to 5.8.
B_3	24-30	Yellowish-brown (10YR 5/8) fine or very fine sand; single grains; rapidly permeable.
C_1	30-42	Light yellowish brown (10YR 6/4) very fine sand; single grains; slightly firm in place.
C_2	42+	Pale-brown (10YR 6/3) fine and very fine sand; single grains; slightly firm in place, but rapidly permeable; pH 5.7 to 6.7.

Agriculture

Only a small portion of the St. Thomas soils are cultivated, because of the low natural fertility and the droughty nature of the land. In general, the yields of cultivated crops are very low because of lack of fertilizer and moisture. These soils are not suitable for extensive farming but they may be used profitably for cash crops that repay frequent fertilization.

For most cash crops, irrigation is very beneficial. If irrigation is not used, seeding or planting should be done as early as possible to take advantage of the better moisture conditions that usually prevail during the early part of the growing season.

Successful management of St. Thomas soils requires liming, the use of complete fertilizers and manure, irrigation and conservation of soil moisture.

Achigan Series (Ac, Acf)

The imperfectly drained Achigan soils occur in association with the excessively drained St. Thomas soils. They are found mainly between Portage-du-Fort and Luskville at elevations of 300 to 400 feet. Their total extent in the area surveyed is 8,333 acres. The land is level or slightly depressed and free of stones. The parent material is fine to very fine sand 3 to 8 feet thick over clay.

Nearly all the precipitation percolates through this very permeable soil and accumulates above the impervious clay substratum. This wet subsoil may also receive some water that has seeped over the clay from soils at a slightly higher elevation. The soil has more favorable moisture relationships than St. Jude soil, because of finer texture and a somewhat greater depth of sand over the clay.

The wooded soils support mainly red maple, hemlock, fir, white spruce and white pine.

The series, which belongs to the Podzol (gleyed) group, was mapped as two types, loamy fine sand (Ac) and loamy very fine sand to sandy loam (Acf). The virgin loamy fine sand is described as follows:

Horizon	*Depth Inches*	
A_o	2- 0	Very dark brown to black humus; pH 4.5 to 5.0.
A_2	0- 2	Light-gray, leached loamy fine sand; pH 5.0 to 5.5.
B_{21}	2- 5	Reddish-brown fine sand; faintly mottled with yellowish-brown streaks; single grains; ortstein rare; friable and permeable; pH 5.4 to 6.0.

B_{g2}	5-15	Yellowish-brown fine to very fine sand; mottled with strong brown and light yellowish gray; uniform texture but variable amount of mica, giving horizontal dark streaks; pH 5.6 to 6.2.
B_{g3}	15-30	Light yellowish brown or brownish-yellow fine or very fine sand; patches and streaks of strong-brown color; rather firm in place but breaking easily into single grains when dug out; fine particles of mica abundant; very gradual change of colors in the lower part of the profile; pH 5.8 to 6.2.
C	30+	Light brownish gray fine to very fine sand; slightly mottled; much mica in horizontal streaks 1 to 2 mm. thick and alternately light and dark in color; pH 6.0 to 6.5.

The profile of the loamy very fine sand to sandy loam is the same as above except for a large proportion of very fine sand and silt in the upper part of the profile. The cultivated layers are brown to dark brown (7.5YR 4/2) when moist and a pH ranging from about 4.9 to about 5.9. The A_2 horizon is not seen in cultivated fields, except as isolated pockets.

Agriculture

The natural productivity of Achigan soils is not very high but it can be brought up by drainage improvements, liming, manuring and applications of complete fertilizer. Artificial drainage should not be overdone; the depth and distance apart of the ditches should be regulated so as to remove free water rapidly from the solum but not from the parent material. The subsoil normally tends to keep moist even during dry summer periods. Yields are usually higher in years when weather is drier than average.

The land is not suited to deep-rooted plants, and alfalfa would require very efficient artificial drainage of the lower solum. However, with moderate improvements in drainage and fertility it should be possible to grow good crops of red, alsike and ladino clover as well as most of the common field crops. The land is suitable for row crops and small fruits.

Lime should be used on Achigan soils to provide calcium and to raise the pH to a more favorable level. Besides suitable drainage, adequate fertilization with complete commercial fertilizers and manure is necessary.

Vaudreuil Series (Vf)

Vaudreuil soils occupy only 851 acres in the area surveyed and are found almost exclusively near Beechgrove in Pontiac County. This series is the very poorly drained member of the St. Thomas–Achigan catena. It occurs in depressed areas where a very high water table is maintained for prolonged periods. The downward percolation of water is absent or very slow because there is impermeable clay a few feet from the surface. The trees are mainly tamarack, cedar, white spruce, red maple and elm.

The series was mapped as very fine sand to loamy fine sand (Vf). The virgin profile, a Gleysol, has a black organic surface layer four to six inches thick over gray poorly aerated very fine sand or fine loamy sand. Although the gray color is predominant in the subsoil, there is some yellowish-brown mottling. The pH is about 5.5 at the surface and 6.5 at a depth of two feet. The soil structure, consistence and permeability are the same as those of the Achigan soil.

Agriculture

Most of the Vaudreuil soils are wooded. Considerable artificial drainage was provided on the cleared areas to make them suitable for cultivated crops. These soils are very cold and late and in wet springs they are usually too late for planting.

The land is not suitable for common field crops; the soil is too late and cold for corn, it is too poorly drained for legumes, and cereals lodge and ripen late. Pastures and hay fields are often invaded by sedges and rushes. The land is better suited to late market crops such as lettuce, cabbage, green beans, strawberries and carrots. Even when artificially drained, the organic surface layer retains a considerable amount of moisture that is available to shallow-rooted plants.

After the soil has been properly drained, applications of lime and chemical fertilizers rich in phosphorus and potash are needed. The use of manure alone will not correct the imbalance of plant nutrients in the surface soil.

St. Benoit Series (Bt)

St. Benoit soils occupy 576 acres in small, scattered areas near Aylmer in Gatineau County. The topography is generally undulating and there are a few scattered boulders on the surface of virgin land. The natural tree cover is sugar maple and beech.

The profile has developed in sandy material that covers calcareous till to an average depth of three feet. The solum is well drained and very permeable but has low moisture-holding capacity. Precipitation is rapidly absorbed by the soil and has little chance to cause erosion.

The St. Benoit series belongs to the Brown Podzolic group. The only type mapped is loamy sand (Bt), which under cultivation has the following appearance:

Horizon	*Depth Inches*	
A_c	0-6	Dark-brown, medium to fine loamy sand; some very friable and fine granules among single grains; pH 5.6 to 6.3.
B_{21}	6-18	Yellowish-red to strong-brown (5YR-7.5YR 5/6) medium to fine loamy sand to sandy loam; very fine granular structure and single grains; pH 5.8 to 6.6.
B_{22}	18-26	Dark yellowish brown to light-olive (10YR-2.5Y 5/4) medium loamy sand; single grains; pH 6.6 to 7.2.
C	26-42	Light yellowish brown to light-olive medium sand; some grayish-brown patches of finer material; friable and permeable; pH 6.6 to 7.4.
D	42+	Grayish-brown calcareous till; pH 7.5 to 7.8.

Under forest the soil has a thin leaf litter underlain by granular fine sandy loam of yellowish-red to strong-brown color.

Agriculture

St. Benoit soils have rather low natural fertility but they respond very well to fertilization. They are suited to a wide range of crops but are particularly useful for orchards and early market crops. Alfalfa does well when the soil has been limed and fertilized.

Good management practices on these soils include conservation of soil moisture, building up organic matter, liming, generous use of manure and frequently repeated, small doses of complete fertilizers.

St. Damase Series (Dm)

St. Damase soils occur as small areas scattered through the lowlands, where they cover a total of 1,907 acres in Gatineau County and 621 acres in Pontiac County. They consist of rather narrow bands of medium to fine sandy alluvial material covering clay to a depth of less than four feet. The land is stone-free, slightly convex or nearly flat and imperfectly drained.

Precipitation is absorbed rapidly by the soil and percolates freely through the upper part of the solum. However, its downward movement is checked by a nearly impermeable clay substratum. Thus the excess water accumulates in the subsoil unless it is artificially removed. The moisture-holding capacity of the solum is low but there is little loss of moisture because of the impervious substratum.

The St. Damase series belongs to the Podzol (gleyed) group of soils. The only unit mapped was sandy loam to loam sand (Dm), which under cultivation has the following main characteristics:

Horizon	*Depth Inches*	
A_e	0- 8	Dark reddish brown (5YR 2/2) sandy loam to loamy sand; weak granular structure; very friable and permeable; pH 4.8 to 5.6.
B_2	8-30	Sandy loam to loamy sand, yellowish red (7.5YR 4/8) in the upper part of the horizon and grading in the lower part to yellowish brown (10YR 5/4); grayish-brown (10YR 5/2-5/3) and yellowish-red (5YR 4/8) mottles; single grains with some very fine crumb structure; pH 5.2 to 5.8; lower boundary abrupt.
D	30+	Clay, massive and impervious.

Under forest cover the surface organic litter is 1 to 2 inches thick, and is underlain by a grayish, leached layer ½ to 1½ inches thick, over yellowish-red sandy loam.

Agriculture

St. Damase soils are partly cultivated and partly used for woodlots. The cultivated areas are used for field crops, row crops and gardening. The soil is low in natural fertility but it responds moderately well to fertilization with manure and complete chemical fertilizers. It should be limed to provide calcium for the plants and correct soil acidity for the crops generally grown. This soil is better for intensive than for extensive farming because it needs frequent applications of fertilizer to maintain production. St. Damase soils usually occur as narrow bands between clay soils and for this reason they are commonly farmed with the surrounding clay soils.

Courval Series (Cv)

Courval soils occur as small, scattered areas (a total of 1,549 acres) in the lowlands of the two counties. They are level, stone-free soils formed on 8 to 14 inches of sandy material over clay.

They readily absorb most of the precipitation. The flat topography and the impermeability of the underlying clay may hold excess water in the soil for prolonged periods. This poor natural drainage causes poor aeration of the land.

Courval soils belong to the Dark Gray Gleysolic group. The cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_e	0-10	Grayish-brown sandy loam; fine granular structure among single grains; very friable and permeable; pH 5.6 to 6.2.
B_g	10-16	Gray clay; strong-brown mottles; weak blocky to massive structure; plastic and sticky when wet; slowly permeable; pH 5.8 to 6.4.
C	16+	Gray clay; massive to blocky structure; sticky and plastic; slowly permeable; pH 6.8 to 7.3.

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Agriculture

Like the surrounding clay soils, Courval soils are cleared and used for pasture and general field crops. Their profitable use for farm crops depends primarily on effective artificial drainage and also on liming and fertilization with complete fertilizers. The natural fertility of the surface soil is low. It can be improved by deep plowing, which will mix the clay, rich in plant nutrients, with the surface sand. Besides improving the fertility of the surface soil, deep plowing will improve the moisture-holding capacity, soil structure and aeration as well as moisture distribution and exchange between surface and subsoil.

Ottawa Series (Ot)

Ottawa soils occupy a total of 7,808 acres. They occur only in Pontiac County on the shore of the Ottawa river, mainly between Quyon and Portage-du-Fort, at the northern end of Calumet Island and also on the southeastern side of Allumette Island. These soils are derived from sandy alluvial material deposited very recently by the Ottawa River. The deposits are mainly very porous, excessively drained medium sand. The profile apparently is developing toward a Podzol but only traces of the leached horizon are visible. The tree cover is mainly gray pine together with some aspen and a few white or red pine.

The virgin profile of Ottawa sand (Ot) belongs to the Alluvial group and has the following characteristics:

Horizon	*Depth Inches*	
A_0	1½-0	Raw organic matter; very dark brown sand containing numerous white grains; very friable and permeable; pH 4.3 to 4.6.
B_2	0-12	Yellowish-brown (10YR 5/5-5/6) sand containing coarse, medium and fine particles in about equal amounts; loose; permeable; pH 5.0 to 5.2.
B_3	12-22	Light yellowish brown to yellowish-brown (10YR 6/4-5/4) sand; other properties as in B_2 horizon.
C	22+	Pale-brown to light yellowish brown (10YR 6/3-6/4) sand; loose; extremely porous and rapidly permeable; pH 5.2 to 5.6.

Agriculture

Ottawa soils are seldom cultivated. Any type of farming would be impractical except with irrigation and very frequent fertilization.

The best use for this soil is forestry, and pine seems to be well suited to it.

Diable Series (Di)

In Pontiac County, Diable soils occupy 2,099 acres at the confluence of the Black and Ottawa rivers near Waltham and Fort Coulonge. In Gatineau County, these soils (1,766 acres) occur along the Desert and Eagle rivers.

Diable soils have formed on fine and very fine sandy material, apparently derived from Ivry sand, which has been recently redeposited in flood plains by the present rivers. The land has an overall horizontal plane but has many undulations, generally narrow curved bars, old levees, and bow-shaped depressions or ponds, which may be connected with or cut off from the present river. These bow-shaped depressions or ponds are the remnants of stream channels.

The land is flooded in the spring. Although the depressions may be under water for longer periods, most of the land seldom remains under water for more than a few days or a week. As soon as the rivers return to their normal level after flooding, the excess water is rapidly removed from the very permeable soil and the land may then be considered well drained over most of the area.

The moisture-holding capacity of the solum is rather low but the plants do not suffer from lack of moisture because the ground-water level is not far below the surface. These soils belong to the Alluvial group. Profile development on most of the soils is very weak but in a few places, where flooding is infrequent or absent, a weakly developed Podzol occurs.

The surface layer varies from fine loamy sand to sandy loam. These two types are intermingled and were mapped as one cartographic unit (Di). The cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_c	0- 8	Brown fine sandy loam to loamy sand; fine granular structure and single grains; very friable and permeable; pH 5.2 to 5.4.
B_2	8-14	Strong-brown loamy sand to sandy loam; single grains; loose and rapidly permeable; pH 5.4 to 5.6.
B_3	14-26	Yellowish-brown fine loamy sand; single grains; loose and rapidly permeable; pH 5.4 to 5.6.
C	26+	Light yellowish brown fine sand to loamy fine sand; single grains; moderately porous and permeable; sometimes mottled; pH 5.4 to 5.8.

Agriculture

The Diable soils are stone-free, nearly level, permeable, easily worked and suited to a wide range of garden and field crops. They respond well to manure, lime and complete chemical fertilizers. However, flooding of the land may in some years retard the seeding and destroy legumes. The land is very useful for summer pastures because of the proximity of water. Grasses rather than legumes should be grown in pastures and hay fields to avoid the risk of destroying legumes by flooding.

Manure is the only fertilizer commonly used and yields could be raised considerably if complete fertilizers were used fairly generously. Lime should be applied to reduce the acidity of the soil and to provide calcium to plants.

Irrigation would be particularly easy and cheap, since water is available anywhere a few feet below the surface as well as in the numerous ponds and adjacent streams. With liming, fertilization and irrigation, it would be possible to maintain the productivity of the land at a high level.

Soils Developed from Aeolian Deposits

St. Jovite Series (Jv)

In the area surveyed, St. Jovite soils (Figure 18) occupy 7,046 acres at elevations of 800 to 1,000 feet. They occur mainly in Pontiac County near Thornby and north of Danford Lake. They have formed on very fine sandy loam to silt loam aeolian material deposited on rolling topography. The silt fraction is generally from 30 to 60 percent of the total soil. Of the total sand fraction, very fine sand makes up from 60 to 90 percent. The aeolian material is two to four feet thick and rests directly on stony till or on Precambrian bedrock. Frequently the deposits are not thick enough to cover the boulders or outcrops and the land may be moderately stony.

In spite of the steep slopes, moisture relationships generally are excellent and the soils are moderately well drained. Since the solum is permeable and has a moderately high moisture-holding capacity, the danger of runoff and erosion on moderate slopes is low but on steep slopes the erosion hazard is much greater.

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FIGURE 18.—Near Thornby the wind-deposited St. Jovite soils partly cover the boulders in the underlying glacial till.

St. Jovite soils belong to the Brown Podzolic group and have generally a very fine sandy loam texture at the surface as well as through the solum although occasionally the texture may be silt loam. All these soils were mapped under the same soil type (Jv). The cultivated soil is described as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Very dark grayish brown (10YR 3/2), very fine sandy loam; fine crumb structure; very friable and permeable; pH 5.4 to 5.6.
B_{21}	6-16	Dark yellowish brown (10YR 4/4-5/4) to yellowish-brown, very fine sandy loam or occasionally silt loam; very fine crumb structure; very friable and permeable; pH 5.6 to 5.9.
B_{22}	16-28	Olive brown (2.5Y 4/4) to yellowish-brown, very fine sandy loam; very friable and permeable; pH 5.6 to 5.9.
C	28-38	Olive (5Y 4/3-2.5Y 4/4), very fine sandy loam; pH 5 6 to 5.9.
D	38+	Dense stony till of acid reaction or Precambrian bedrock.

There are no abrupt changes in color throughout the profile and all colors and horizons merge very gradually into one another so that separation into definite horizons is difficult or arbitrary. Small boulders and gravelly fragments are usually absent in the solum but some big boulders of the underlying till are concealed in the solum or protrude above ground surface.

Agriculture

Practically all St. Jovite soils have been cleared and are used for hay, pasture and field crops. Their main undesirable feature is the steepness of many of the slopes. The few boulders protruding from the soil also cause some difficulty in the use of farm machinery. However, the soil is deep and permeable and has fair to good natural fertility. It has very desirable texture and good moisture-holding capacity and it should respond to lime and fertilizer.

The land should be protected against erosion, which results in a considerable loss of natural fertility and in the thinning of the solum. Cultivation should be restricted to the smoothest land and across the slope. The land should be kept in grass as much as possible and the steepest slopes should not be cultivated but kept under grass or trees.

Liming is necessary to raise the pH of the soil above 6.0 and to provide the calcium needed for normal plant growth. Care should be taken to conserve and, if possible, to increase the organic matter content of the soil.

Soils Developed from Loamy Water-laid Materials

Coulonge Series (Cl)

Coulonge soils occupy 1,370 acres in Gatineau County and 6,003 acres in Pontiac County. They are formed on broad gravelly outwash plains that were covered by loamy alluvial material 1½ to three feet thick. The land is nearly level to gently undulating, well to excessively drained and stone-free. White pine, red pine, fir, white and gray birch are the main trees found on virgin land.

This soil belongs to the Podzol group. The main characteristics of the cultivated fine sandy loam (Cl), the only type mapped in the series, are as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Brown to dark-brown or dark grayish brown (7.5YR-10YR 4/2), very fine sandy loam; crumb structure; very friable and permeable; pH 5.4 to 5.8.
B_{21}	6- 9	Strong-brown (7.5YR 5/6), very fine sandy loam; crumb structure; very friable and permeable; pH 5.8 to 6.2.
B_{22}	9-18	Yellowish brown (10YR 4/4-6/4), very fine sandy loam with some fine gravelly fragments; crumb structure among single grains; very friable and permeable; pH 5.8 to 6.2.
CD	18+	Yellowish-brown (10YR 4/4) gravel with or without stratification of coarse sand, or coarse sand with or without stratification of gravel; loose; extremely permeable; pH 5.8 to 6.2.

A light grayish brown, leached layer ½ inch thick to 1 inch thick is generally found in the virgin state but is absent in cultivated fields.

Agriculture

Most Coulonge soils are cultivated and are used for common field and row crops. They are very easy to cultivate and manage. Under average management the yields of crops are low, apparently because of the lack of liming and fertilization. These two practices should be repeated at frequent intervals because the soil is very permeable and the added nutrients that are not absorbed by plants are quickly leached downward. The land is suitable for an intense type of farming rather than for field crops.

The moisture supply is generally excellent during the spring and early summer but the land often becomes excessively dry during midsummer and late summer. Consequently, crops have more chance to produce good yields if they are seeded early and if early types and varieties of crops are grown.

Piedmont Series (Pm)

In Pontiac County, Piedmont soils occupy 15,130 acres, mainly between Bryson and Onslow Corner at elevations of 500 to 600 feet. In Gatineau County they occupy 6,925 acres along the lower part of the Gatineau Valley between Low and Chelsea at elevations of 500 to 600 feet. Piedmont soils are developed from two to six feet of alluvial sandy loam resting on fine-textured material. They are moderately well drained and the solum is permeable and has fair moisture-holding capacity. The land is generally undulating and is often dissected by gullies.

This soil belongs to the Podzol group. The cultivated sandy loam (Pm), the only type mapped in the series, is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Dark-brown (10YR 4/3-3/2) sandy loam to fine sandy loam; weak granular structure; very friable and permeable; pH 5.4 to 5.7.
B_{21}	8-24	Yellowish-brown to strong-brown (10YR 5/6-7.5YR 5/8) fine sandy loam; weak crumb structure; very friable; permeable; pH 5.6 to 5.9.
B_{22}	24-32	Yellowish-brown (10YR 5/4-4/4) fine loamy sand or sandy loam with occasional strong-brown and light-olive mottles; firm and moderately permeable; pH 5.6 to 5.9.
C	32-54	Layers of clay loam alternating with some fine sand; yellowish brown to light yellowish brown; some mottling; very firm and slowly permeable; pH 5.6 to 5.9.
D	54+	Grayish-brown clay to clay loam, often laminated.

Agriculture

The Piedmont soils are all under cultivation and are used mostly for field crops and to some extent for row crops. They are not very high in natural fertility but can be easily built up because they retain moisture and plant nutrients well. Under average management, yields of common crops are only fair. Manure is often the only fertilizer used but the land responds very well to lime, complete chemical fertilizers and manure. Clovers and alfalfa grow moderately well on limed and fertilized land. When potatoes are grown, the lime is applied after the potato crop.

These soils are suited to a wide variety of crops and their productivity depends considerably on fertilization. The land is early, stone-free, very easy to work and naturally well drained. Care should be taken to prevent water erosion along the steepest slopes.

Hull Series (H)

Hull soils occur in catenary association with the Piedmont soils and occupy a total of 1,050 acres in the area surveyed. They occur on long slopes where considerable seepage water infiltrates through the subsoil from higher land, which often belongs to the Piedmont or Gatineau series.

As in the Piedmont series, there is two to six feet of sandy material over clay in the Hull series. These are imperfectly drained because of the seepage water, the amount of which varies according to season and precipitation.

These soils belong to the Podzol (gleyed) group. The cultivated sandy loam (H), the only type mapped in the series, is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Brown to dark-brown sandy loam; granular structure; very friable and permeable; pH 5.4 to 5.6.
B_{21}	8-28	Yellowish-brown sandy loam; mottling of strong brown and pale brown; very friable and rapidly permeable; saturated during spring and periods of heavy rainfall; pH 5.4 to 5.6.
B_{22}	28-40	Dark yellowish brown sandy loam mottled with grayish brown; friable and moderately permeable; saturated during a large part of the vegetative season; poorly aerated; pH 5.6 to 5.8.
CD	40+	Clayey material of massive character or laminated with loamy or sandy materials; very slowly permeable vertically, permeable along the horizontal laminations when present.

Agriculture

Hull soils are practically all cleared and are used mainly for general field crops and pastures. They are stone-free, easy to cultivate and moderately fertile. Their slopes present some special problems. Row crops must be grown across the slopes to control erosion although the problem is not critical as long as the land is used for hay and pasture. The control of seepage water is more difficult and probably could not be solved adequately except by tile drains across the slopes. Deep ditches across the slopes could cut off a considerable amount of seepage and may be satisfactory for common field crops. Generally, the soil remains excessively moist and cool for a long time at the beginning of the vegetative season. The land surface is then very soft and unable to support heavy machinery.

With improved drainage, liming and application of manure and complete chemical fertilizers, the Hull soils should make good grassland, capable of producing green forage nearly throughout the summer. Cereals and row crops could also be grown profitably once drainage has been improved.

Brébeuf Series (Bf, Bfs)

Brébeuf soils (Figure 19) occupy 20,813 acres in Gatineau County and 21,331 acres in Pontiac County. They occur on undulating land at elevations of 400 to 600 feet. Their stone-free parent material is a fine sandy loam to loam or silt loam alluvial deposit, resting usually on laminated lacustrine materials. The upper alluvial deposit is rapidly permeable, allows free water percolation through the solum and has fair to good moisture-holding capacity. The laminated substratum is slowly permeable and slows the rapid downward movement of water. The combination of permeable loamy material and convex slopes produces good natural drainage in these soils. Harmful water erosion is a hazard whenever the subsoil is saturated or frozen but erosion is generally slight under present farming conditions.

Brébeuf soils belong to the Podzol group. Two types were mapped: loam to silt loam (Bf) and very fine sandy loam (Bfs). The latter is the more important type and when cultivated is described as follows:

Horizon	*Depth Inches*	
A_e	0- 6	Dark-brown to brown (10YR 4/3-5/3), very fine sandy loam; fine granular structure; rapidly permeable and friable; pH 5.3 to 6.0.
B_{21}	6-14	Yellowish-brown to strong-brown (10YR to 7.5YR 5/6-5/8), very fine sandy loam; fine crumb structure; very friable; permeable and well aerated; pH 5.4 to 6.0.
B_{22}	14-24	Light yellowish brown to light-olive (10YR to 2.5Y 6/4-5/4), very fine sandy loam; crumb structure among single grains; very friable and permeable; pH 5.6 to 6.2.
C	24+	Olive-gray to light brownish gray bedded (5Y 5/2 to 2.5Y 6/2-7/2) silt loam to sandy loam or silty clay loam; very firm in place and only slowly permeable vertically; some mottling; pH 5.6 to 6.4.

Agriculture

Brébeuf soils are practically all cleared and cultivated. They are used mainly for general field crops but are suitable for others, including most garden crops. They have only fair natural fertility but respond very well to lime, manure and complete chemical fertilizers. The water relationships are about optimum through the cultivated soil.

FIGURE 19.—These narrow terraces along the Gatineau River are covered by the Brébeuf and Pontiac series.

It is possible to grow alfalfa on these soils after liming and fertilization with phosphate and potash. However, very little lime and fertilizer have been used on them in the past and this explains, in part, why legume stands are only mediocre. Legumes are better adapted to them than grasses because of their more extensive root systems. The land is best suited to intensive farming although extensive farming can also be successful.

Most Brébeuf soils have smooth topography and can be used for many crops without great danger of water erosion. However, the steepest slopes should remain in grass or be protected by grass strips along the contours.

Yields vary considerably on these soils, depending mostly on management. Being well drained and aerated, they warm up rapidly during the spring and can be worked or seeded early. Failure to take advantage of the earliness and excellent moisture conditions during the first part of the vegetative season may mean a considerable reduction in the yield of cereal crops and in the catch of legumes.

Allumette Series (At, Atl)

Allumette soils occupy a total of 13,588 acres, almost equally divided between the two counties. The land is slightly depressed or level but may have an uneven surface. The alluvial parent material is very fine sandy loam to loam or silt loam over laminated lacustrine deposits that are generally finer in texture than the alluvial surface layer.

All precipitation is readily absorbed by the permeable solum and accumulates over the slowly permeable substratum. This is responsible for the imperfect natural drainage and for the poor aeration of the solum, especially during the spring and in rainy periods.

The Allumette soils belong to the Podzol (gleyed) group. Two types were mapped; very fine sandy loam (At) and loam to silt loam (Atl). The very

fine sandy loam is the more common type and when cultivated is described as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Dark grayish brown (10YR 4/2), very fine sandy loam; fine granular structure; very friable and permeable: pH 5.0 to 5.5.
A_2	6- 8	Remnants of light brownish gray (10YR 6/2), leached layer mixed with some material of the underlying horizon.
B_2	8-24	Yellowish-brown (10YR 5/4-5/6) fine sandy loam; mottled with light olive (2.5Y 5/4) and reddish brown (5YR 5/4); single grains; sometimes laminated in the lower part of the horizon; friable and permeable; pH 5.0 to 5.6.
C	24+	Light brownish gray (2.5Y 6/2) material; yellowish-brown streaks (10YR 4/4-5/8); laminated material ranging from fine sandy loam to silt loam or silty clay loam; firm in place; slowly permeable; pH 5.4 to 6.0.

The undisturbed soil under forest has two to three inches of organic litter on the surface, above six to eight inches of light brownish gray fine sandy loam (A_2).

Agriculture

A large proportion of the Allumette series has been cleared and is used for general field crops. Artificial drainage is necessary to get rid of excess water as quickly as possible; otherwise the growth of plants is retarded by the cool, poorly aerated soil. The drained land responds moderately well to lime and complete fertilizers.

The land is better suited to forages than to cereals. Alfalfa will not grow unless the drainage and reaction are considerably improved. Clover grows well on land properly drained, limed and fertilized with phosphate and potash. The yields of crops are commonly low but increase remarkably under good management. The best yields are obtained in years of relatively low rainfall. Dry weather, especially during the spring, favors early seeding on these imperfectly drained soils.

Demers Series (Dr)

In the area surveyed, Demers soils occupy a total of 3,942 acres on the same type of materials as the Brébeuf and Allumette soils. These poorly drained soils occur on low-lying or depressed land where water collects from the surrounding higher land. The impermeable, laminated materials are very close to the surface and obstruct drainage and aeration.

The series belongs to the Dark Gray Gleysolic group. The cultivated silt loam (Dr) is the only type mapped, and is described as follows:

Horizon	*Depth Inches*	
A_c	0- 6	Grayish-brown silt loam; granular aggregates among irregular fragments; moderately friable and permeable; pH 4.7 to 5.7.
A_2	6-12	Light-gray silt loam; platy or pseudoplaty structure; friable and permeable; pH 5.4 to 6.0.
B_g	12-24	Grayish-brown to olive, laminated, very fine sandy loam, silt loam or silty clay loam; mottling of yellowish brown and light gray; firm in place, friable when dug out; slowly permeable to vertical water movement; pH 5.5 to 6.3.
C	24+	Grayish-brown, varved or laminated silt loam to silty clay loam or fine sandy loam; mottling of yellowish brown and olive; firm to friable, breaking easily along the horizontal plane; resistant to the vertical movement of water; pH 6.0 to 6.8.

Under natural conditions the soil has a peaty surface 3 to 12 inches thick, underlain by three to four inches of a very dark grayish brown mineral–organic horizon (A_1). When the soil is cultivated the peat and A_1 horizon are mixed with the underlying A_2 horizon.

Agriculture

Most of the Demers soil is cleared and used mainly for forage crops. Sedges and rushes grow naturally in pastures and hay fields, unless the natural drainage has been considerably improved. The land is cold, poorly drained and among the last of the cultivated soils to be ready for spring seeding. Cereals are grown only where soil drainage has been much improved. Once improved by drainage and liming, the soil has a fair capacity for production, especially for forages. The drainage and aeration could be improved by ditching, and by subsoiling to break the impervious laminations.

Chicot Series (C)

Chicot soils occupy 387 acres near Aylmer, Gatineau County. They occur on undulating, moderately well drained and relatively stone-free land at elevations of 250 feet. The profile has developed in very fine sandy loam to very fine sand above calcareous till at an average depth of three feet. The solum is permeable and has moderate moisture-holding capacity. Runoff during heavy rains may cause some water erosion, especially when the subsoil is frozen in early spring.

The upper profile has the characteristics of the Brown Podzolic group and the lower profile those of the Gray Brown Podzolic group. The only type mapped in the series is fine sandy loam, which under cultivation is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Dark-brown (7.5YR 3/2) fine sandy loam; very fine granular structure; very friable and permeable; pH 5.8 to 6.5.
B_2(BP)	8-30	Pale-brown to brown (10YR 6/3) fine sandy loam to loamy fine sand; very friable and permeable; pH 6.5 to 7.0.
B_2(GBP)	30-36	Very dark grayish brown (10YR 3/2) sandy clay loam; firm; medium, subangular, blocky structure; pH 6.8 to 7.2.
CD	36+	Calcareous till.

Under natural vegetation the brown B_2(BP) horizon is immediately under the surface organic litter.

Agriculture

The Chicot soils may be used for gardening, for orchards and for practically any field crop. Alfalfa may be grown successfully after liming if necessary. The natural fertility of the soil is not very high and all crops benefit from applications of manure and complete commercial fertilizer. Natural drainage is good enough for most field crops, but for early garden crops and for orchards underdrainage would probably increase yields. As these soils occur near expanding urban centers they will probably be taken out of cultivation in the near future.

Côteau Series (Ct)

Côteau soils occupy 2,195 acres in the lowlands of the two counties. They occur on undulating land at elevations of 250 to 350 feet. Their parent material is an alluvial fine sandy loam 4 to 6 feet thick deposited on clay. The natural drainage of the land is good, partly because of the relief and partly because the permeability of the profile allows moderately rapid percolation.

The series belongs to the Podzol group. Fine sandy loam (Ct) is the only type mapped, and under cultivation is described as follows:

Horizon	*Depth Inches*	
A_e	0- 7	Brown (10YR 4/3) fine sandy loam; fine granules among single grains; very friable and permeable; pH 5.3 to 5.8.
B_{21}	7-14	Yellowish-brown (10YR 5/8) fine sandy loam; fine granules among single grains; very friable and permeable; pH 5.3 to 6.0.
B_{22}	14-30	Light-olive (2.5YR 5.6) fine sandy loam; single grains; rapidly permeable; pH 5.3 to 6.3.
C	30-48	Light brownish gray to olive (2.5Y 6/2-5Y 5/3) fine sandy loam to fine loamy sand; pH 6.2 to 6.7.
D	48+	Clay.

Agriculture

All the Côteau soils are cleared and used for general farm crops. Their natural fertility is only moderate but they respond very well to lime, manure and complete fertilizers. They can be used for a great variety of crops but they are particularly well suited to early market garden crops. Yields obtained with field crops and garden crops vary considerably according to management and amount of fertilization. Irrigation could be used to raise the yields to a still higher level.

Soulanges Series (S)

Soulanges soils occur in catenary association with Côteau soils. They occupy a total of 2,132 acres at elevations of 250 to 350 feet. They are found on level or nearly level land with imperfect to somewhat poor natural drainage. The parent material is a fine to very fine sandy loam alluvial deposit 18 to 48 inches thick over level clay.

Only one type was mapped, fine to very fine sandy loam (S). When cultivated, the shallowest phase is described as follows:

Horizon	*Depth Inches*	
A_e	0- 8	Very dark grayish brown (2.5Y 3/2) fine to very fine sandy loam; fine granular structure; very friable and permeable; pH 5.2 to 5.9.
B_{g1}	8-12	Grayish-brown loam (2.5Y 5/2) to fine sandy loam; coarse mottling of dark yellowish brown (10YR 4/4); pH 5.8 to 6.2.
B_{g2}	12-24	Brown to yellowish-brown (10YR 5/3-5/4 sandy loam; medium sized mottles of strong brown and gray; poorly aerated; pH 6.0 to 6.4.
D	24+	Light brownish gray to brownish-gray (10YR 6/2-2.5Y 5/2) clay; fine mottling of yellowish red or reddish yellow (5YR 5/6-7.5YR 6/6); very slowly permeable; pH 6.5 to 7.0.

Under natural vegetation the virgin Podzol (gleyed) profile has an organic litter 3 to 4 inches thick, over 4 to 6 inches of grayish, leached fine sandy loam. The B_{g1} horizon begins at a depth of 4 to 6 inches. When the clay horizon (D) is deeper than 24 inches, a layer of brownish-gray fine sand occurs just above the clay.

Agriculture

Soulanges soils are used for the common field crops. The natural fertility of the land is fair but the productivity can be considerably improved by drainage, liming and fertilization with manure and complete chemical fertilizers. Plowing in rounded ridges is generally the method used to improve the drainage and aeration.

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These soils are well suited to pasture and common field crops. Clovers grow well on land improved by liming and by artificial drainage. However, the aeration in the subsoil is seldom sufficient to grow alfalfa with success. The land surface is soft and rather slow to warm up in the spring, but the crops seldom suffer from drought during the summer.

Lachute Series (Lc, Lcs)

Lachute soils occur only in Gatineau County and occupy 7,200 acres. They are found on the narrow floodplains of the Gatineau River, between Rapides-du-Castor-Blanc and Kazabazua, as well as at the mouth of the river. The elevation of these soils ranges from 600 feet along the upper part of the river down to 150 feet at its mouth.

The parent material is silt loam to very fine sandy loam recently deposited by the Gatineau River. The land is still flooded annually and some deposition, or modification of the material already deposited, may still occur during periods of flooding. This takes place where the river has low velocity and meanders through flat land. When in flood, the river often changes its course and builds new levees or destroys existing ones. The numerous levees are roughly parallel to the stream.

Like most of the alluvial deposits, the parent materials of these soils are rapidly permeable, and this favors excellent water percolation and aeration. The moisture in the solum is controlled to some extent by the level of the water in the river because, after the spring flood, the excess water is drained rapidly from the soil. Because of good moisture-holding capacity, excellent percolation and capillarity, moisture conditions are optimum during most of the growing season and the land is not seriously affected by droughts.

Lachute soils belong to the Alluvial group. Two types were mapped: silt loam (Lc) and very fine sandy loam (Lcs). The latter type contains more very fine sand than the silt loam, not only at the surface but throughout most of the profile. The two types are often intermingled. A cultivated loam (Lc) is described as follows:

Horizon	*Depth Inches*	
A_c	0- 7	Very dark grayish brown to dark-brown (10YR 3/2-4/3) silt loam; fine granular structure; very friable and permeable; pH 5.5 to 6.2.
C_1	7-27	Olive to light-olive (2.5Y 4/4-5/4) silt loam; fine granular structure; very friable and permeable; pH 5.8 to 6.4.
C_2	27+	Light-olive to light brownish gray (2.5Y 5/4-6/2), structureless silt loam; slight mottling; very friable and permeable; pH 6.0 to 6.4.

Agriculture

Lachute soils are entirely under cultivation and they make excellent agricultural land for a wide variety of crops. The floods, which occur usually once a year in late April or early May, do not cause serious delay of the seeding operations. The land is ready to be worked immediately after flood waters have disappeared.

These soils have good natural fertility and respond very well to lime, manure and commercial fertilizers. The subsoil is porous, permeable and adapted to deep-rooted plants, but alfalfa may be killed when the water remains on the land for a prolonged period.

The land is used for all common field crops such as hay, grain, silage corn and roots. Yields obtained are among the highest in the surveyed area. Potatoes are the most common cash crop. The land produces good grass throughout the growing season. The free access to river water makes the land particularly useful for pasture.

Miscellaneous Land Types

Landslides, Gullies and River Embankments (X, Xl, Xs)

The areas affected by landslides, deep gullies and river embankments were mapped under three land types, on the basis of the surface texture, namely: clayey (X), silty (Xl) and sandy to gravelly (Xs). There are 31,629 acres of clayey, 8,198 acres of silty, and 9,479 acres of sandy to gravelly land in the area surveyed.

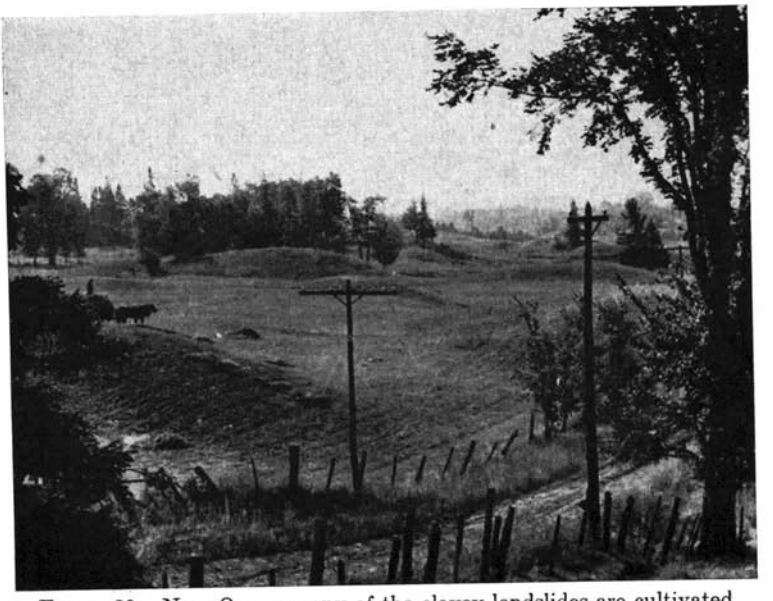

FIGURE 20.—Near Quyon many of the clayey landslides are cultivated.

The landslides (Figure 20) have occurred along the banks created by erosion during the lowering of Lake Champlain. Most of the banks consist of unstable marine clay and they may be covered by more recent loamy, sandy or gravelly deposits. The landslides vary widely in texture, topography, drainage and other important soil characteristics. The changes in the surface soil texture produced by landslides ranged from very marked to hardly noticeable.

Where the original land was clay to the surface, the slide material is similar in texture to the original land. Often, however, the original land had sandy or gravelly material at the surface; this became mixed with the large mass of marine clay during the process of sliding, and the present surface layer is largely clayey material. Because of tilting of the sliding land, the coarser material of the original land surface was completely or partly buried by the basal clay.

Where the original sandy surface material was 5 feet thick or less over the clay, the surface texture of the landslide is clayey. Where the original sandy surface material was 5 to 15 feet thick over the clay, the texture of the land-

slide is generally a half-and-half mixture of coarse and fine materials. Finally, where the original sandy surface material was thicker than 15 feet over the clay, the landslide surface texture is sandy or gravelly.

The topography resulting from slides may vary considerably, because of the various combinations of materials present on the original land surface, the moisture content of the clay, elevation and subsequent erosion. A fresh slide suggests an area turned by a huge plow, the thickness of the furrow-slices varying from a few feet to more than 30 or even 100 feet. Some of the land slices produced during the mud flow did not move far from their places of origin and were preserved as enormous angular blocks which produced high relief. Slices that traveled long distances, especially ones that moved across a river channel, were much disintegrated along the way and produced low relief. Almost invariably, the topography is increasingly rougher as one moves from the outer edge of a slide towards its place of origin.

The knob and kettle relief common to most landslides produces distinct differences in drainage from the tops of the undulations to the bottoms of the depressions, and these differences are repeated many times over short distances. These wet depressions were not originally linked by any natural drainage system as in normal landscapes and they are extremely difficult to underdrain. In some cases the permeability of the subsoil is sufficiently rapid to permit adequate drainage, and layers of sand or gravel, occluded in the clay, sometimes facilitate percolation, but generally the depressions hold swamps or ponds.

The pH of the landslide surface soil is generally higher than that of normal soils because the material exposed in clay slides is unweathered parent material. Some variations in pH are due to differences in soil material, drainage conditions and age.

The land use of the slide areas is governed mainly by soil texture and topography. Generally the slides with a sandy or gravelly surface have been left wooded, and those with a clayey to silty surface are cultivated except where the topography is extremely rough. Most of the rough slides are used for pasture. The smoothest clay slides are used for all common field crops and yields are generally as good as on the best fine-textured soils of the area, but the yields may vary considerably because of variations in drainage and texture. The best growth of alfalfa in the surveyed area is found on some of the fine-textured and well-drained undulations created by the slides.

Most of the embankments and gullies of clayey and silty surface texture have been cleared and are used for pasture. Where the land is very stable, this practice is warranted, but little grass is produced along many of these steep slopes and trees would be more profitable and provide more protection against erosion and small slides. Some south-facing slopes provide very early grass. Gullies and embankments of sandy and gravelly surface texture should be left wooded, because grass grows very poorly on such land and because forest cover protects the upper part of the embankment against wind erosion.

Undifferentiated Alluvial Soils (Au, Aul, Auh)

Some soils of alluvial origin vary greatly in their profile characteristics and could not be included in any of the series previously described. These soils were simply divided into three groups according to the surface texture: sandy to gravelly (Au), loamy (Aul) and clayey (Auh). The first group is the most extensive and includes 19,725 acres of land in Gatineau County and 23,078 in Pontiac County. The other two groups cover a total of 5,068 acres in Gatineau and 8,672 in Pontiac.

These soils have variable parent material. The subsoil texture often differs considerably from the surface texture. In most cases the natural drainage ranges from imperfect to poor. The land included in this land type is found commonly along streams and in some depressions.

Most of the alluvial soils have been left in their natural state, covered with trees, alder and shrubs. Some of these soils could be improved into good farming land if they occurred in sufficiently large areas, but many occur as very narrow strips in nonarable land. In some other cases the cost of drainage improvement is prohibitive because of the small extent of land affected or natural obstacles.

The cleared areas are mainly used for pasture and for hay. Cereals are seldom grown because these lands are late and sometimes inaccessible for heavy farm machinery. Some areas are first-class land but the acreages are too small to warrant full exploitation.

Undifferentiated Stony Land

Areas of rock outcrops, or areas that contain a large percentage of rock outcrop and in which the soil cover is very thin and exceedingly stony and bouldery, were mapped as undifferentiated stony land (√). There may be small swamp areas in the depressions. The vegetative cover is patchy and usually consists of stunted trees with a sparse understory of shrubs.

In estimating acreages, these areas were included with the associated stony soils, which they resemble.

Organic Soils (Mk, Tt, Pt)

Organic soils were mapped as three different types: muck (Mk), peaty muck (Tt) and peat (Pt). A total of 3,123 acres of muck and 1,113 acres of peat were mapped. The peaty muck was mapped only in Gatineau County, where it covers 7,181 acres.

The muck consists of well-decomposed black organic material that is generally $1\frac{1}{2}$ to 4 feet thick over mineral material.

The peaty muck consists of black, well-decomposed organic material and brown, semidecomposed woody residues. It is generally about 2 feet thick but sometimes is 3 or 4 feet thick over the underlying mineral material.

The peat consists of plant residues that are only slightly decomposed and are still fibrous. The peat deposits are generally more than 4 feet thick and sometimes may be more than 10 feet thick. The material is generally brown near the surface but becomes light yellowish brown lower down.

The organic soils are underlain by mineral material, which may be glacial till, marine clay, sands, or rock. It is poorly drained and usually is strongly gleyed. Marl is found under some organic soils and generally occurs immediately above the underlying mineral soil. The marl was formed by accumulation of shells from small organisms living in lake water. Such a deposit of marl occurs south of Blue Sea village.

The peats are usually very wet and are seldom cultivated. Parts of the mucks and peaty mucks have been cleared and are used for pastures or for the common field crops.

The natural productivity of organic soils is low. They are deficient in phosphorus and potash and often in minor elements. Without fertilization the land produces poorly, crops mature slowly and cereals are subject to lodging. Manure alone, even used in large quantities, cannot correct the lack of balance in the plant nutrients, and the best growth is obtained by the use of chemical fertilizers specially formulated for organic soils. These fertilizers are rich in potash and phosphorus whereas nitrogen is absent or low. Most of the cultivated organic soils are acid and should be limed for best results with cultivated crops. In this

regard, the marl sometimes present under the organic soil is useful in correcting soil acidity; these local marl beds contain 80 to 90 percent of calcium carbonate. When properly fertilized the organic soils may be used for a wide variety of crops but are particularly suited to garden crops.

Unlike most mineral soils, the organic deposits are extremely porous and all cultivation practices that may aggravate this condition should be avoided. Rather, the soil should be compacted to ensure better contact of the plant with the soil. For this purpose rollers and other compacting implements are most beneficial if used at the proper time.

Swampy Land

A total of 63,322 acres of swampy land were mapped in the two counties. This land type includes all the soils that are covered by water too long in the growing season to be useful as agricultural land. These swampy lands are commonly found in depressions with ponded drainage or along sluggish streams. Many small swampy areas occur among the till soils of the Lakefield series. It was impossible to show these wet spots separately but they were indicated on the soil map by the swamp symbol (Ⲙ) beside the symbol referring to the soil series.

The mineral material underlying the swamps is variable; it may be sandy, loamy or clayey, bouldery or stone-free. The organic matter found at the surface of the soil is often poorly decomposed and in content may only slightly exceed that of the surrounding mineral soils. The areas of swampy land cannot be used for farming unless their drainage is improved considerably through very extensive and costly works. These areas are generally a poor source of organic matter, unlike the areas mapped as muck, peaty muck or peat.

LAND USE

Settlement and Early Agricultural Development

Champlain and his party, in 1615, were the first white men to explore the Ottawa River. Nicolas Gatineau, in 1650, explored part of the river that now bears his name. For a century and a half after Champlain's explorations the 'great river' was used as a canoe highway by Indians, fur traders, explorers or the 'coureurs des bois', Portage-du-Fort and Fort-Coulonge serving as the main landings. During all that time the north shore of the Ottawa River, in the section now known as Gatineau and Pontiac counties as well as the opposite shore, remained completely virgin. In 1800 a New England farmer, Philemon Wright, with 35 men, 8 oxen and 5 families, settled on the present site of the city of Hull[4].

Although Wright's main activity was lumbering, agriculture developed rapidly as a necessary complement, so that by 1824 the founder of Hull owned four large farms that totaled 3,000 acres of cleared land. Following Wright's example, immigrants and veterans of the war of 1812 gradually cleared the arable land and developed the farming areas. The rush of land clearing was sustained by cash obtained for hardwood ashes and lumber. From 1840 to 1860 Canadian lumber exports grew enormously. This marked the period of very rapid expansion of population and wealth along the Ottawa and Gatineau valleys. The rural population reached its peak in 1875.

Present Land Use

From the beginning of settlement of the surveyed area, agriculture has been a secondary but essential industry. Development of the resources has been keyed to lumbering and hydroelectric power. The large proportion of nonarable

[4] The Storied Province of Quebec, Volume II, Bouchette, Toronto, 1931.

land and the increasing demand for lumber, pulpwood and plywood, make the area mainly useful for forestry, although its farmlands may provide more produce for the increasing population.

Agriculture in the surveyed area is based on the production of forage and grain for animal feed. Milk and meat are the main sources of farm revenue (Table 6). Forest products come immediately after cattle and milk as an important source of farm income. The revenue derived directly from cash crops is rather small because production is limited. Some potatoes are grown as a cash crop in the region of Messine in Gatineau County and on Ile-aux-Allumettes in Pontiac County. The only farms where market crops are important are along the Ottawa River west of Hull and at Eardly (Gatineau County) as well as in the southern part of Ile-aux-Allumettes (Pontiac County).

TABLE 6.—MAIN ITEMS CONTRIBUTING TO GROSS FARM REVENUE IN GATINEAU AND PONTIAC COUNTIES, 1951[1]

—	Gatineau		Pontiac	
	Farms reporting	Revenue $	Farms reporting	Revenue $
Cattle	1,373	917,279	1,432	1,075,665
Dairy products	1,261	900,051	1,373	789,978
Products consumed on farms	1,940	807,000	1,695	772,000
Forest products	866	524,873	743	386,671
Swine	921	298,511	1,059	403,830
Poultry and eggs	707	169,610	876	128,886
Hay and forage crops	351	122,370	132	37,958
Grains	287	81,997	252	99,987
Horses, sheep and wool	441	64,208	419	60,283
Potatoes, roots and other field crops	344	51,089	275	31,762
Vegetables	44	51,107	21	8,635
Maple products	36	7,948	62	6,037

[1]Census of Canada.

Table 7 shows the acreages of the land in farms, of improved land, of woodland and the main crops. Woodlands cover between 38 and 50 percent of the average farm. Pastures occupy 19 to 25 percent and hay about 17 percent of the farm land. Hay is the most widely grown of the field crops and is followed by oats (5 to 8 percent).

TABLE 7.—LAND USE IN GATINEAU AND PONTIAC COUNTIES, 1956[1]

—	Gatineau		Pontiac	
	Acres	Percentage of total	Acres	Percentage of total
Total farm area	379,301	100	298,554	100
Improved land	139,753	37	152,863	51
Unimproved land	239,548	63	145,691	49
Woodland	187,867	50	113,496	38
Improved pasture	44,060	12	60,499	20
Unimproved pasture	27,708	7	14,983	5
Under crops	86,836	23	86,686	29
Tame hay	59,480	16	53,998	18
Oats	20,081	5	24,754	8
Barley	519	.1	802	.2
Mixed grains	1,697	.4	2,034	.6
Corn for ensilage	1,126	.3	1,489	.5
Other fodder crops	1,240	.3	1,204	.5
Potatoes	1,274	.3	955	.3

[1]Census of Canada.

In Gatineau and Pontiac counties 52 and 49 percent respectively of the farms are larger than 180 acres (Table 8). However, the average farm has little improved land. The unimproved areas are mainly stony land unsuitable for farming or sandy land of very low natural fertility. Some farms, especially in the Gatineau Valley, are cut up by rough ridges of till and rock outcrops that make the fields difficult to reach.

TABLE 8.—SIZE OF FARMS IN GATINEAU AND PONTIAC COUNTIES, 1956[1]

Size of farm Acres	Gatineau		Pontiac	
	Number	Percentage of total	Number	Percentage of total
10– 69	121	7	79	5
70–129	505	28	443	30
130–179	217	12	216	15
180–239	382	21	314	21
240–399	365	20	281	19
400–559	136	8	113	7
560–759	38	2	19	1
760 or more	19	1	8	1
Total	1,809	100	1,482	100

[1]Census of Canada.

Because of this some farm buildings have been built far away from the public road, near the center of the best farming land. In regions where good farm land occurs as rather narrow strips among rough land (Figure 21), public and private services such as roads, schools, electricity, telephone, waterworks, house-to-house delivery and pickup are more expensive. The physiography of some areas would be better suited by a different farm division from the one imposed by the township layout. Also, the combining of two or three farms into one unit may permit more efficient use of the good land. The economic operation of farm land interspersed with rough land in narrow valleys is considerably different from that of lowland farms along the Ottawa River, where most of the land is suitable for farming.

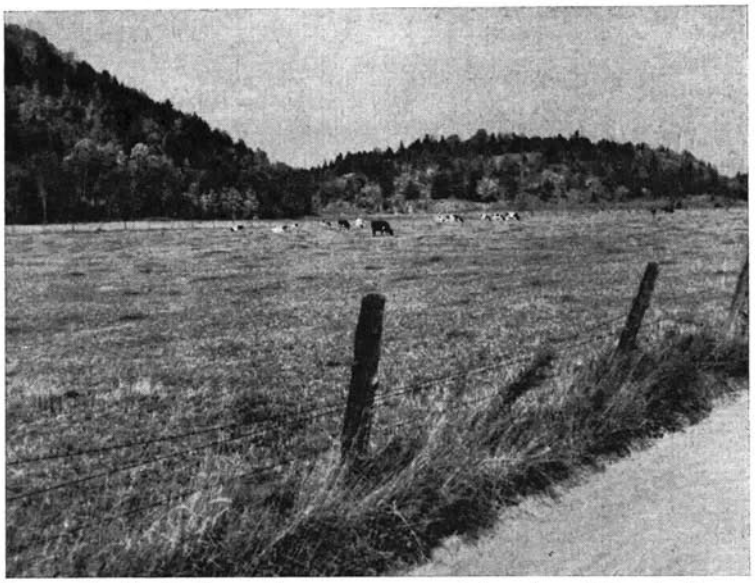

FIGURE 21.—In the Laurentian area, narrow strips of good farmland occur between stony hills. Dairying is the most common type of farming in this area.

In Gatineau County the most important farming areas are Eardly, Low and Wright each with more than 10,000 acres of improved land. In Pontiac County, Clarendon, by far the most important area, has more than 36,000 acres of improved land and is followed by Bristol, Litchfield and Onslow South. On Ile-aux-Allumettes there are more than 13,000 acres of improved land, and about half as many on Ile-du-Grand-Calumet.

Soil Ratings

The soils of the surveyed area may be placed in five different classes according to their suitability for farm crops. The grouping in Table 9 is based primarily on the range of suitability for different types of farming and, secondly, on the fertility under average management. In this grouping, the soils suited to the largest number of crops come first, and those with very restricted use or unsuited to farm crops come last. The ratings are based on information obtained from farmers and agronomists, and on the apparent natural capacities of the soil as judged by the pedologists. The pedologists' ratings apply mainly to garden crops, which are not grown to an appreciable extent.

Class I

Class I soils occupy 8.7 and 6.3 percent of the area surveyed in Gatineau and Pontiac counties respectively. All these soils are naturally well drained and loamy. Their natural fertility is not high but they respond very well to manure and complete chemical fertilizers. Cultivation is easy and the soil can be worked at a wide range of moisture conditions without damaging its structure. For these reasons, these soils are very well suited to row crops. Most of them need liming. Except the St. Bernard and St. Jovite soils, all have smooth topography and are free of boulders; farm machinery can be used with ease. Many of the soils are susceptible to water erosion, especially when they are used for hoed crops, but simple precautions such as planting the rows across the slopes are generally enough to prevent excessive erosion.

Class I soils should give good yields under usual climatic conditions and moderate fertilization. They are less affected by extremes than are the soils of the other classes. The organic matter supply is only moderate and should be maintained or, if possible, increased.

Class II

Class II soils occupy 8.9 and 4.8 percent of the area surveyed in Gatineau and Pontiac counties respectively. These soils are stone-free and have developed from fine-textured materials on level to nearly level topography. With a few exceptions, they should be drained artificially to grow farm crops. Many have a satisfactory subsoil structure that favors aeration, but others have massive subsoils impermeable to water, air and roots. Most of the soils have very high water-holding capacity and the distribution of moisture is slow. They should be worked only at a moisture level that preserves the desirable granular structure of the surface soil. Much power is required for cultivation but the use of farm machinery is facilitated by the smoothness of the land and the absence of stones. Good yields are more dependent upon favorable climatic conditions than for Class I soils.

Class II soils generally are better suited to field crops than to garden crops. They are good to very good for pastures, cereals and hay, but many are only fair to poor for alfalfa. The success of silage corn varies, depending upon climatic conditions, state of tilth and efficiency of artificial drainage. Although these soils have the highest natural fertility of all the soils listed, the average yields are not higher than those of the well-managed soils of Class I.

TABLE 9.—RATINGS OF SOILS IN SURVEYED AREA FOR FIELD AND GARDEN CROPS

Class	Series or land type	Special limitations and management requirements	Field crops					Garden crops					
			Clover and timothy hay	Alfalfa	Silage corn and roots	Oats and barley	Pastures	Sweet corn	Potatoes	Lettuce and cabbages	Tomatoes	String beans	Small fruits
I. Soils well suited to field crops as well as to garden crops.	Bouchette	L,[1]Fm,Fc	[2] 2	2	1-2	2	2	1	2	2-3	2	2-3	1
	Brébeuf	L,Fm,Fc	2	2	1-2	2	2-3	1	1	2-3	2	2-3	1
	Châteauguay		2-1	1	1	1	2-1	1	2	2-1	1	1	1
	Chicot	Fm,Fc	2-3	2	2-1	2	2	1	2	2-1	1	1	1
	Côteau	L,Fm,Fc	2-3	2	2	2	2-3	1	1	2-3	2-3	2-3	1
	Lachute	L,Fm,Fc	2	2	1	2	1-2	1	2	2-3	2-1	2-3	2
	Oka	Fm,Fc	2-1	1	2-1	2	2-3	1	2-3	2-3	2	1	1
	Pontiac	L,Fm,Fc	2-1	2	1-2	2-1	2	1	2-3	2-3	2	2	1
	St. Bernard	P,Fm	2	1	1	2	2	1	3-2	2-3	2	1	1
	St. Jovite	Pb,L,Fm,Fc	2	2	2-1	2	2-1	2-1	2-1	2	2	2-3	1
II. Soils better suited to field crops than to garden crops.	Baudette	D,L	2	3-2	2-1	1-2	2	2-3	3-2	3	2-3	3	2
	Brandon	D,L,G	1	3-4	2-3	1-2	1-2	3	4	3	3	3	3
	Chapeau	G,L	2	2-3	2-3	2	1-2	3	4	3	3	3	3
	Dalhousie		1	2	2-1	1	1	2	2-4	2-3	2	2	2
	Landslides (clayey or silty surface)		2	1-3	2	2-1	1	2-3	3-4	3	3-2	2-3	2-3
	Laplaine	D,Fc	1-2	3-4	4-3	3-2	2-3	3-4	3	2	2-3	3	3
	Maniwaki	D,Fc	2-3	3-4	4-3	3-4	3-4	3-4	3	2-3	3-2	2-3	2-3
	Matilda	D	1	2-3	2-3	2-3	1-2	2-3	3	2-3	2-3	2-3	2-3
	Montcerf	L,D,G	2	4	3	2-3	2-1	3	4	3	3	3	2-3
	Rideau	G,L	1-2	3	2-3	2	2-3	3	4	3-4	3-4	2-3	2-3
	Ste. Rosalie	D,L	1	3-4	2-3	1-2	1	3	4-3	3	3-2	2-3	2-3
III. Soils better suited to garden crops than to field crops.	Achigan	D,L,Fm,Fc	3	4	3	3-2	3	3	2-3	3	2-3	3-2	1-2
	Allumette	D,L,Fm,Fc	3	4	3	3-2	3	3	2-3	3	2-3	3-2	1-2
	Aumond	D,L,Fm,Fc	3-2	4-3	3	3-2	3-2	3	2-3	3	2-3	3-2	1-2
	Bevin	D,L,Fm,Fc	4-3	4	4	4	4-3	4	3-4	3	3-4	3-4	2
	Couval	D,L,Fc	3-2	4	3	3	3	3	3-4	3-2	3-2	3-2	3-2
	Coulonge	L,Fm,Fc	3-2	3-2	3	3	3-4	3-2	2-1	3	3	3-2	2-1
	Demers	D,L,Fc	2-3	4	3	3	3-2	3	3	3	3-2	3-2	3-2
	Diable	L,Fm,Fc	3-4	4	3	3	3-2	3-2	2-1	3-2	3-2	3-2	4-3
	Guindon	L,Fm,Fc	4-3	3-2	4-3	3-4	4-3	4-3	2	3-4	3-4	3	1-2
	Hull	D,L,Fc	3-2	3-4	3	3	3-2	3-2	3	3	3	3	2-1
	Lesage	L,Fm,Fc	3-2	3-2	4-3	3-2	3-2	3	2-3	3-4	3-2	3	1-2
	Muck	D,Fc	3	4-3	3	3	3	3-2	2-1	1	2	2	2

	Peaty Muck	D,Fc	3-4	4-3	3	3	3	3-2	2-1	2-1	2-3	2-3	2-3
	Piedmont	L,Fm,Fc	3	3-2	3-2	3	3	2	2-1	3	3	2-3	1-2
	Ripon	L,Fm,Fc	3	3-2	3	3-4	3-4	3-2	1-2	3-4	3-4	2-3	2-3
	St. Damase	L,Fm,Fc	3	3-2	3	3	3-4	2	2-3	3-4	3	3	2
	St. Jude	D,L,Fc	3	4	3-4	3	3	3	2-3	3	3	3	2
	Ste. Sophie	L,Fm,Fc	3	3	3	3	3	3	3	2-1	3	3	2
	Soulanges	D,L,Fc	3-2	3-4	3	3-2	3-2	3	2-3	3-2	3-2	2-3	3-2
	Vaudreuil	D,L,Fc	3	4	4	4	3	4	3	2-1	3-2	3-2	3-2
IV. Soils with very restricted suitability to farm crops.	Calumet	Fm,Fc	3	2	3-4	3-4	4	3	2	3	3	3	2
	Déligny	D,L,Fc	3-4	4	4	4	3-2	3-4	4	3	3-4	3-4	3-4
	Farmington	Fm,Fc	3-4	2-3	4	4	3-4	4-3	4	4	3-4	3-4	3-4
	Ivry	L,Fm,Fc,E,L	4	3	4-3	4	4	4-3	2	4	4	3-4	2
	Morin	L,Fm,Fc,I	4	3	4-3	4	4	4-3	2-3	4	4	3-4	2-3
	Mont-Rolland	L,Fm,Fc	3-4	3	3-4	3-4	4	3	3-2	4	4	4	3-2
	St. Benoit	Fm,Fc,I	3	2	3-4	3-4	3	3	2	4	3-4	3-4	2
	St. Faustin	L,Fm,Fc	4	3	4-3	3-4	4	4	3-4	4	4	4	3
	St. Gabriel	L,Fm,Fc	3	3-2	3-4	3-4	3-4	3	3-4	3-4	4	3	2
	St. Thomas	L,Fm,Fc,E,I	3-4	3	3-4	3-4	4	3	3	3-2	3-4	3-4	2
	Stonefield	Fm,Fc,L	4	3	4	4	4-3	4	4	4	4	4	3-2
	Undifferentiated alluvium	L,Fc,D	3-2	4	3-4	3-4	2-3	3-4	4	3-4	3-4	3-4	3-4
	Uplands	L,Fm,Fc,E,I	4	4-3	4	4	4	3-4	3-2	4	4	4	3-2
V. Soils unsuited to cultivated farm crops.	Gatineau	Note: For possible use of these soils refer to the general discussion of the group or to the individual soil descriptions.											
	Lakefield												
	Larose												
	Landslides (sandy to gravelly surface)												
	Ottawa												
	Peat												
	St. Colomban												
	Ste. Agathe												
	Swamp												

[1]Symbols: D, requires improvement of drainage; E, requires control of wind erosion; Fc, requires chemical fertilizer; Fm, requires barnyard or green manure; G, requires maintenance of granular structure; I, requires supplemental irrigation; L, requires lime; P, requires removal of stones; Pb, enormous boulders, outcrops and steep slopes.

[2]Symbols: 1, very good; 2, good; 3, fair; 4, poor.

Class II soils respond much less to fertilization than those of all the other classes. The use of manure is important in maintaining favorable soil structure and in returning as much nutrient as possible to the land. Except mainly in the Rideau, Monteerf and Chapeau soils, the organic matter content of the surface soil is high and is largely responsible for the high fertility and good structure. It is most important that the organic matter supply be maintained at high levels in these fine-textured soils; otherwise the physical condition of the soil will deteriorate and yields may decline rapidly.

Soils rich in humus require very little additional nitrogen for most field crops such as cereals, hay and pastures, especially if enough legumes are grown in the rotation. To avoid lodging of cereals, nitrogen applications should be light. The use of nitrogen fertilizers should, however, be profitable with row crops, which need a large supply of available nutrients. Excepting the Laplaine and Maniwaki series, the supply of potash is fair to good in Class II soils. Usually less of this element is needed in fertilizers for these soils than for those of the other classes. Unless the original organic material has been destroyed by burning or other abuses, Laplaine and Maniwaki soils could be treated like muck soil, which requires much potash.

Generally phosphorus is the nutrient most deficient in soils of the second class. Phosphorus fertilizer produces the most significant increases in crop yields when all the farm manure is returned to the land. Lime should be applied on all acid soils of the class before manure, fertilizers or organic amendments.

Class III

In the surveyed area, Class III soils occupy 6.2 percent in Gatineau County and 9.0 percent in Pontiac County. These soils have developed on sandy materials; loamy sand to fine sandy loam usually rests on fine-textured, impermeable substrata. This class also includes the well-decomposed organic deposits, muck and peaty muck.

Most of these soils have imperfect to poor drainage and occur on level to gently sloping, stone-free land. They are easy to cultivate, but on land saturated with water heavy machinery does not operate well and destroys the soil structure. When properly drained, and if necessary limed, the soils can be used for field crops. They are best suited to special cash crops or to garden crops if liberally fertilized. Legumes, especially alfalfa, are generally poor on imperfectly to poorly drained soils, but fair on well-drained land or where the poorly drained land has been underdrained.

The natural fertility of the Class III soils is low, and to produce normal yields all crops must be fertilized. Many areas on which fertilization has been neglected have rapidly reverted to wild vegetation after being abandoned. The need for liberal fertilization makes exploitation of these soils more expensive than for those of the first two classes. On farms with these soils only, dairying and general farming are not very profitable unless complemented by some special cash crops. Maximum benefit from fertilization will not be obtained unless the land is properly drained and limed. Manure is a very important booster of crops on these soils but it must be supplemented with complete commercial fertilizers.

Class IV

Class IV soils occupy 14.4 percent of the surveyed area in Gatineau County and 26.1 percent in Pontiac County. These soils are not suited to field crops in general but individual soils are more or less suited to some of the following crops: early pastures, alfalfa, small fruits, early market gardening crops, apples, potatoes and cigarette tobacco. Natural fertility is low to very low. The effect of fertilization with manure and chemical fertilizers is very marked but of short duration, so that applications must be frequent. In the natural state, the organic

matter content of the surface soil is very low. If the humus content of the surface is built up very considerably, productivity may be doubled because humus increases the moisture-holding capacity and the retention of plant nutrients in the soil. This extra fertility may be maintained only by careful management because the land tends to revert to low organic-matter content. Lime is necessary on most of the soils. Some of them are exposed to wind erosion.

Class V

Class V soils occupy 61.8 and 53.8 percent of the surveyed parts of Gatineau and Pontiac counties respectively. Most of these soils are very stony and have rough topography. In general they are not suited to agriculture and many areas that have been cleared and cultivated in the past have been abandoned and allowed to revert to forest. However, some small, isolated areas that are less stony and have moderately smooth topography are still under cultivation. They are used mainly for pastures or hay but the yields are generally poor to fair as the soils are acid and low in fertility. With only a few exceptions these soils should remain forested and the cleared areas should be returned to forest.

APPENDIX

TABLE 1.—ACREAGES OF SOIL AND LAND TYPES IN THE SURVEYED AREA AND PERCENTAGES OF THE TOTAL AREAS

Map symbol	Soil or land type	Gatineau		Pontiac	
		Acres	Percentage of total	Acres	Percentage of total
Ac	Achigan very fine sand	250	0.0	7,776	0.9
Acf	Achigan loamy very fine sand	262	0.0	45	0.0
Ag	Ste. Agathe fine sandy loam	121,683	11.6	217,532	24.8
Ao	Aumond sandy loam	3,334	0.3	.....	.....
At	Allumette very fine sandy loam	6,688	0.6	6,150	0.7
Atl	Allumette loam to silt loam	.....	.....	550	0.1
Au	Alluvial undifferentiated, sandy to gravelly surface	19,725	1.9	23,078	2.7
Auh	Alluvial undifferentiated, clayey surface	4,678	0.4	7,974	1.0
Aul	Alluvial undifferentiated, silty to loamy surface	390	0.0	698	0.1
B	Brandon clay	1,741	0.2	2,221	0.2
Bc	Bouchette silty clay loam	19,597	1.9	.....	.....
Bcl	Bouchette loam	1,766	0.2	.....	.....
Bd	Baudette silty clay loam to silt loam	171	0.0	1,626	0.2
Be	Bevin fine loamy sand	5,549	0.5	4,973	0.6
Bel	Bevin sandy loam	3,091	0.3	813	0.1
Bf	Brébeuf silt loam	3,219	0.3	7,405	0.9
Bfs	Brébeuf very fine sandy loam	17,594	1.7	13,926	1.7
Bn	St. Bernard loam	4,493	0.4	896	0.1
Bt	St. Benoit loamy sand	576	0.1	179	0.0
C	Chicot fine sandy loam	378	0.0	.....	.....
Ca	Calumet sandy loam	691	0.1	525	0.1
Cb	St. Columban land type	12,755	1.2	5,050	0.6
Ch	Châteauguay clay loam	262	0.0	.....	.....
Cl	Coulonge fine sandy loam	1,370	0.1	6,003	0.7
Cp	Chapeau clay	373	0.1	365	0.1
Ct	Côteau very fine sandy loam	787	0.1	1,408	0.2
Cv	Courval sandy loam	493	0.1	1,056	0.1
D	Dalhousie clay loam	18,458	1.8	18,573	2.2
Dh	Dalhousie clay	1,274	0.1	.....	.....
De	Déligny sand	128	0.0	2,400	0.3
Di	Diable fine sand	1,766	0.2	2,099	0.3
Dm	St. Damase loamy sand	1,907	0.2	621	0.1
Dr	Demers silt loam	1,056	0.1	2,886	0.4
F	Farmington land type	6,611	0.6	17,901	2.1
Ft	St. Faustin cobbly sandy loam	24,986	2.4	15,341	1.8
G	St. Gabriel sandy loam	8,435	0.8	19,878	2.3
Gt	Gatineau sandy loam	382,877	36.3	113,677	13.4
Gu	Guindon loamy sand and sandy loam	8,262	0.8	8,294	1.0
H	Hull sandy loam	890	0.1	160	0.0
I	Ivry fine sand	31,855	3.1	37,574	4.5
Ie	Ivry, wind-eroded phase	64	0.0	3,027	0.4
If	Ivry very fine loamy sand to sandy loam	6,438	0.6	864	0.1
J	St. Jude sand	858	0.1	4,992	0.6
Jl	St. Jude sandy loam	.....	.....	685	0.1
Jv	St. Jovite very fine sandy loam	960	0.1	6,086	0.7
La	Larose land type	39,949	3.8	10,688	1.3
Lc	Lachute silt loam	4,358	0.4	.....	.....
Lcs	Lachute very fine sandy loam	2,842	0.3	.....	.....
Le	Lesage gravelly sandy loam	4,134	0.4	1,349	0.2
Lk	Lakefield land type	56,487	5.4	66,342	7.7
Lp	Laplaine clay and clay loam	998	0.1	.....	.....
Md	Matilda loam	1,878	0.2	.....	.....
Mf	Montcerf silty clay loam	18,675	1.8	.....	.....
Mk	Muck	1,696	0.2	1,427	0.2
Mo	Morin sand	32,903	3.1	57,544	6.8
Moc	Morin coarse sand	3,757	0.4	6,022	0.7
Mol	Morin loamy sand	4,051	0.4	1,376	0.2
Mt	Mont-Rolland sandy loam	5,984	0.6	17,440	2.1
Mw	Maniwaki silty clay loam	4,518	0.4	.....	.....
O	Oka loam to gravelly sandy loam	986	0.1	.....	.....
Ot	Ottawa sand	.....	.....	7,808	0.9
Pc	Pontiac silt loam to silty clay loam	23,053	2.2	21,267	2.5
Pch	Pontiac clay loam	6,955	0.7	358	0.1
Pcl	Pontiac loam	3,309	0.3	960	0.1
Pm	Piedmont sandy loam	6,925	0.7	15,130	1.8
Pt	Peat	262	0.0	851	0.1
R	Ste. Rosalie clay	3,680	0.4	2,387	0.3

TABLE 1.—ACREAGES OF SOIL AND LAND TYPES IN THE SURVEYED AREA AND PERCENTAGES OF THE TOTAL AREAS—(*Concluded*)

Map symbol	Soil or land type	Gatineau		Pontiac	
		Acres	Percentage of total	Acres	Percentage of total
Rh	Ste. Rosalie heavy clay	5,344	0.5	787	0.1
Rl	Ste. Rosalie clay loam	1,581	0.2	.....	.....
Ri	Rideau clay	5,805	0.6	13	0.0
Rih	Rideau heavy clay	.....	.....	858	0.1
Rn	Ripon loamy sand	8,595	0.8	4,122	0.5
S	Soulanges very fine sandy loam	442	0.0	1,690	0.2
Sp	Ste. Sophie sand	346	0.0	2,438	0.3
St	Stonefield land type	2,464	0.3	.....	.....
Th	St. Thomas very fine sand	1,382	0.1	7,014	0.8
Tt	Peaty muck	7,181	0.7	.....	.....
Up	Uplands sand	749	0.1	1,971	0.2
Vf	Vaudreuil fine sand	13	0.0	838	0.1
X	Landslides and gullies with clayey surface	23,802	2.3	7,827	0.9
Xl	Landslides and gullies with loamy surface	2,278	0.2	5,920	0.7
Xs	Landslides and gullies with sandy surface	1,869	0.2	7,610	0.9
凹	Swampy land	29,178	2.7	34,144	4.0
	Total land area	1,047,188	100.0	851,488	100.0
	Lakes, ponds and streams (Ottawa River excluded)	87,622		35,686	
	Total area surveyed	1,134,810		887,174	

GLOSSARY

Aeolian deposit—Unstratified material, such as sand, silt and clay, moved and deposited by wind.

Aeration—The process by which air and other gases in the soil are renewed. The rate of aeration depends largely on the size and number of soil pores and on the amount of water clogging the pores. A well-aerated soil has many large pores; and a poorly aerated soil either has few large pores or has most of those present blocked with water.

Alluvial deposit—Material, such as sand, silt or clay, deposited by streams.

Available nutrients—Plant nutrients in soluble form, i.e., readily available for absorption by plant roots.

Consistence (soil)—The mutual attraction of the particles in a soil mass, or their resistance to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented.

Drift—Material of any sort moved from one position to another. The term is most commonly used of material deposited by glacial action. Glacial drift includes unstratified glacial till and stratified glacial outwash materials.

Glacial till—An unstratified mixture of stones, sand, silt and clay transported and deposited by glaciers.

Glaciofluvial deposit—Glacial material carried, sorted and deposited by water that originated mainly from the melting of glacial ice. These deposits are stratified and may be in the form of outwash plains, deltas, kames, eskers, or kame terraces.

Gley—A soil in which the material has been modified by a reduction process brought about by saturation with water from long periods in the presence of organic matter.

Gravel—Rock fragments from 2 mm. to 3 inches in diameter.

Horizon—A layer in the soil profile approximately parallel to the land surface with more or less well defined characteristics that have been produced through the operation of soil-forming processes. Surface organic horizons are measured *upward* from the surface of the uppermost mineral horizon; mineral horizons are measured *downward*. The horizon symbols used in this report are described as follows:

A_0—This is a surface horizon consisting of relatively fresh leaves, twigs and other plant remains, generally of the past year, and, near the bottom, of partly decomposed or matted plant remains.

A_1—This is a surface mineral soil horizon having a relatively high content of organic matter mixed with mineral matter, usually dark in color.

A_2—This is a surface or subsurface horizon. It is usually lighter in color than the underlying horizon and has lost clay minerals, iron, or aluminum, or all three, by leaching so that the more resistant minerals are more highly concentrated.

A_c—This is a plowed or otherwise disturbed surface horizon including some or all of the A_0, A_1, A_2 horizons, and sometimes part of the B horizon.

B_2—This is a horizon of (1) accumulation of clay minerals or of iron, aluminum and organic matter, or (2) development of blocky structure; or it may have characteristics of both. The horizon may be subdivided into B_{21} and B_{22} as appropriate.

B_3—This horizon is transitional to the C horizon, but more like B than C. When the B horizon is used without a subscript number or letter, it refers collectively to all the subhorizons in it. Commonly, the lower limit of the B horizon corresponds with the lower limit of the solum.

C—This is a layer of unconsolidated material relatively little affected by the soil-forming process; it is presumed to be the parent material from which at least a portion of the solum has developed.

D—This is a layer underlying the C, or the B if no C is present, that is unlike C or the material from which the solum has developed.

The subscript *g* is added to the A_2, B, B_2, B_3 or C horizon when it is gleyed.

Lacustrine deposit—Material deposited by or settled out of lake waters and exposed by lowering of the water or elevation of land. They are usually varved (have layered annual deposits).

Marine deposit—Material deposited by or settled out of sea waters and exposed by lowering of the water levels or elevation of land. They usually are not varved (lack layered annual deposits).

Mottles—Irregularly marked spots or streaks, usually yellow or orange, sometimes blue. Mottling indicates poor aeration and lack of good drainage.

Ortstein—A *B* horizon that has been irreversibly cemented with iron and humus.

Parent material—The unaltered or essentially unaltered mineral material from which the soil profile develops; the C horizon.

Peneplain—A land surface worn down by erosion nearly to a plain.

Percolation—Downward movement of water through the soil, especially the downward flow of water in saturated or nearly saturated soil.

pH—The intensity of acidity or alkalinity, expressed as the logarithm of the reciprocal of the hydrogen ion concentration. With this notation, pH 7 is neutral; lower values indicate acidity, higher values alkalinity.

Relief—The elevations or inequalities of the land surface when considered collectively. Minor surface configurations are referred to as microrelief.

Runoff—The flow of water over the surface of the soil; it includes rainfall as well as water flowing onto the soil from other soils.

Soil associate—*See* Soil series.

Soil group—All the soils within a great soil group are of the same genetic type and are similar in kind of horizons, color, morphology and general chemical characteristics.

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

Soil reaction—The acidity or alkalinity of soil. Acid reactions are characterized as follows:

Slightly acid	pH 6.1 to 6.5
Medium acid	pH 5.6 to 6.0
Strongly acid	pH 5.1 to 5.5
Very strongly acid	pH 4.5 to 5.0
Extremely acid	pH below 4.5

Soil series—Soils formed on the same kind of parent material under the same drainage conditions and having the same kind of profile.

Soil structure—The arrangement of primary soil particles or aggregates, the aggregates being separated by surfaces of weakness. The aggregates differ in grade (distinctness) of development as follows: structureless (no observable aggregation or no definite orderly arrangement; massive if coherent, single-grained if noncoherent), weak, moderate and strong. They

vary in class (size) as follows: very fine, fine, medium, coarse and very coarse. They vary also according to type (shape). The types mentioned in this report are:

Granular—having more or less rounded aggregates without smooth faces and edges, relatively nonporous.

Platy—having thin, plate-like aggregates with faces mostly horizontal.

Blocky—having block-like aggregates with sharp, angular corners.

Subangular blocky—having block-like aggregates with rounded and flattened faces and rounded corners.

By convention one describes an aggregate in the order of grade, class and type. Two examples of this convention are:

Strong medium blocky, moderate coarse granular.

Solum—The part of the soil profile that is above the parent material and in which the processes of soil formation are active. It comprises the A and B horizons.

Texture—The percentage of sand, silt and clay in a soil determine its texture. Particles from 2 to 0.5 mm. in diameter are called sand, those from 0.05 to 0.002 mm. are called silt and those less than 0.002 mm. are called clay (Figure 22). Sands are coarse-textured, loams are medium-textured and clays are fine-textured.

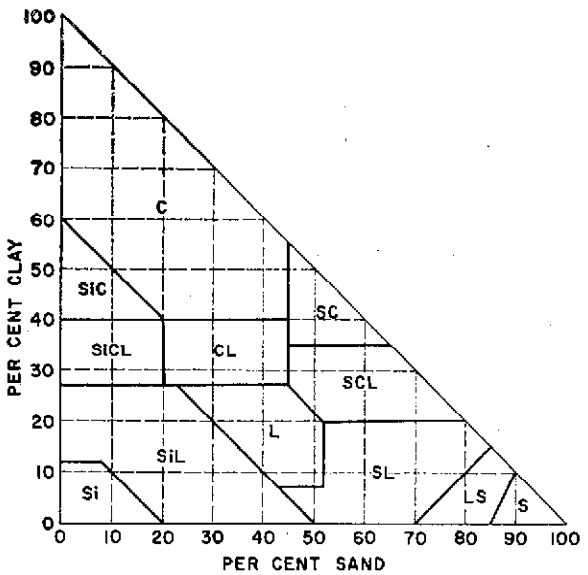

FIGURE 22.—Percentages of clay and sand in the main textural classes of soils; the remainder of each class is silt. See Toogood, J. A., Can. J. Soil Sci. 38: 54-55. 1958. The limits between classes are as in Soil Survey Manual, U.S.D.A. Handbook 18, 1951.

Topography—The soil slope. The following topographic classes are used in this report:

Depressional land—a basin surrounded by higher land.

Level land—slopes of 0 to 0.5 percent.

Level land with microrelief—a level plain with low knolls, having 0.5 percent slopes and small depressions.

Gently sloping land—smooth slopes of 0.5 to 5 percent.

Undulating land—irregular slopes of 2 to 5 percent and small depressions.

Gently rolling land—irregular slopes of 6 to 15 percent and small depressions.

Rolling land—irregular slopes of 16 to 30 percent and small depressions.

Kames—low hills of gravelly glaciofluvial material, usually having a very strongly sloping side (16 to 30 percent) and a moderately sloping side (6 to 9 percent).

Hilly to mountainous land—short irregular slopes of more than 30 percent.

Rough mountainous land—long irregular slopes of more than 30 percent.

Landslides—short, irregular slopes of 6 to 15 percent with many small depressions; areas smoothed by erosion usually have irregular slopes of 2 to 5 percent.

Vegetative season—The growing season; the period during which the mean daily temperature does not fall below 42° F.