RESEARCH COUNCIL OF ALBERTA

Preliminary Soil Survey Report 62-1

EXPLORATORY SOIL SURVEY

of

Alberta Map Sheets 84-P, 84-I, and 84-H

by

J. D. Lindsay, S. Pawluk, and W. Odynsky

(Appendix by L. A. Bayrock)

Alberta Soil Survey
Helicopter Project
1961

Research Council of Alberta
87th Avenue and 114th Street
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Price $1.00

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Foreword

Alberta has a large area of undeveloped land, primarily in the northern portion of the province. Although much of this northern area is relatively inaccessible to ordinary ground inspection, nevertheless information is very desirable for estimating its timber possibilities, for outlining the areas which may be suitable for future agricultural development, and for the planning of roads which could be utilized for mineral prospecting and other developments.

To assist in obtaining this information the Soils Division, Earth Sciences Branch of the Research Council of Alberta, started an exploratory soil survey program in 1952, and that year covered about 1,150,000 acres by means of pack horses. In 1953 the area covered was around 1,350,000 acres and in 1954 about 400,000 acres. Obviously this method of operation was much too time-consuming in relation to the enormous region to be surveyed. Consequently, a new method using a helicopter was tried in 1955 and proved to be an excellent way of making a rapid preliminary inspection of large areas in the region. Since the inception of the helicopter method about 72 million acres of land have been covered, primarily in northern Alberta.

To carry out a helicopter exploratory soil survey efficiently and successfully, it is necessary to transfer all pertinent aerial photograph information - such as observations on soils, topography, and vegetation - to base maps for field use. Alberta is in the fortunate position of having available a complete set of aerial photographs of the region, on a scale of 3,300 feet to the inch.

The information obtained during exploratory soil surveys may aid in forest management studies and will serve as a guide for planning reconnaissance soil surveys in areas which appear to be suitable for future agricultural development. Thus the exploratory soil surveys may serve to outline the areas which should be reserved as permanent forest management districts, and could be of considerable value in indicating possible sites for other future developments.

A geologist of the Research Council is included in the field staff taking part in the exploratory soil survey. The addition of this man proves invaluable, particularly in regard to the identification of the soil parent materials. At the same time, a study of the surficial geological deposits of the area is made possible.

The Research Council has published a series of reports and maps giving the location and characteristics of the exploratory soil survey areas. These reports are entitled Preliminary Soil Survey Report 58-1, 59-1, 60-1, and 61-1. These reports deal with the exploratory soil survey areas covered in the years 1957 - 1960. Reports on previous exploratory soil surveys will be published in due course. This

report with maps, Preliminary Soil Survey Report 62-1, covers the 1961 exploratory soil survey.

The helicopter exploratory soil survey represents only a portion of the work planned each year by the Alberta Soil Survey Advisory Committee, which is responsible for outlining the joint program conducted by the Soil Survey staffs of the Research Branch, Canada Department of Agriculture, and the Research Council of Alberta, through the chairmanship of the Professor of Soil Science of the University of Alberta.

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Acknowledgments

The base maps and aerial photographs for the map area were supplied by the Technical Division, Alberta Department of Lands and Forests.

The co-operation of Mr. E. Olson, Superintendent, Wood Buffalo National Park, and Mr. H. Burnstad, Park Warden at Peace Point is hereby acknowledged.

The writers' associate, Mr. C. van Waas, made the aerial photograph interpretations and transferred the pertinent data to base maps. The maps accompanying this report were prepared in the drafting office of the Research Council of Alberta.

The staff of Associated Helicopters Limited - Messrs. S. R. Kaufman, T. Vaasjo, N. R. Staniland, and J. Harper - were most co-operative throughout the survey.

Mrs. A. Bembridge assisted in the preparation and proof reading of this report.

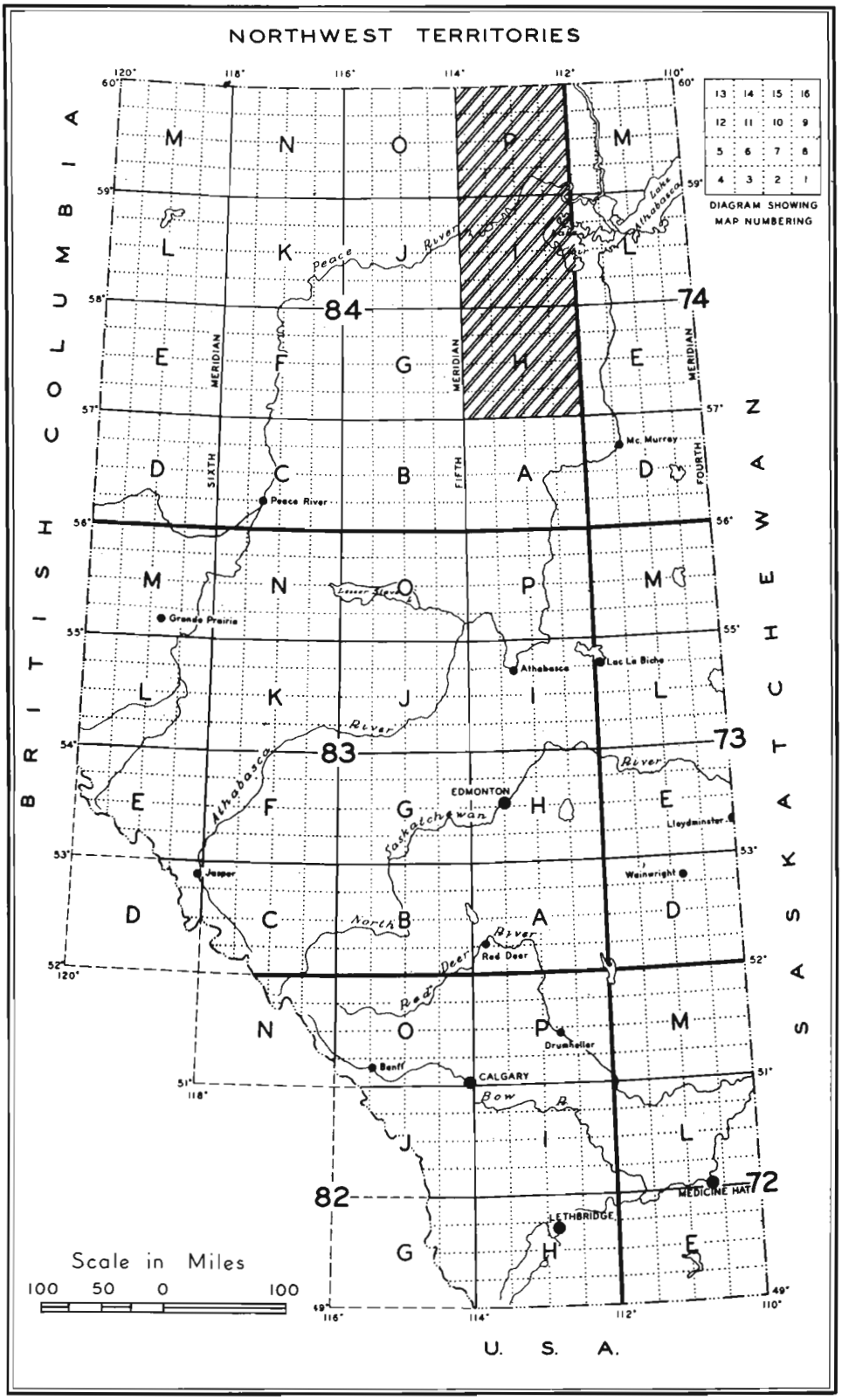


Figure 1 - Sketch map of Alberta showing the location of the 1961 exploratory soil survey area.

EXPLORATORY SOIL SURVEY OF ALBERTA MAP SHEETS

84-P, 84-I, and 84-H

Introduction

In 1961, the Soils Division of the Research Council of Alberta continued its program of exploratory soil survey by helicopter. This program has been carried on continuously since 1955 for the purpose of determining the location and extent of potentially arable land in the undeveloped northern portion of Alberta. The information that is being obtained is required by the Department of Lands and Forests to facilitate the establishment of a permanent forest management program, and also by other agencies interested in the soil resources of northern Alberta.

Location and Extent

During 1961 the exploratory soil survey covered Alberta map sheets 84-P, 84-I, and 84-H. Each complete map sheet extends approximately 70 miles north to south by 72 miles east to west, and covers about 5,000 square miles or 3,200,000 acres. As shown in figure 1, the area lies between 112 and 114 degrees west longitude and 57 and 60 degrees north latitude. These three map sheets cover approximately 15,000 square miles (9.6 million acres) in the vicinity of Peace Point, Lake Claire, and the Birch Mountains of northeastern Alberta. The two most northerly map sheets, 84-P and 84-I, lie almost entirely within the boundaries of Wood Buffalo National Park.

Alberta map sheet 84-P includes all, or parts, of townships 115 to 126 between ranges 12 and 24 west of the Fourth Meridian.

Alberta map sheet 84-I includes all, or parts, of townships 104 to 115 between ranges 12 and 25 west of the Fourth Meridian.

Alberta map sheet 84-H includes all, or parts, of townships 92 to 104 between ranges 13 and 25 west of the Fourth Meridian.

Method of Survey

The exploratory soil survey of these map sheets was carried out during the latter part of the month of August and in early September of 1961. The lack of passable roads in the area necessitated the use of a helicopter to traverse the area. Supplies and field crews were transported to the various camp locations by fixed-wing aircraft.

Prior to the field work a preliminary map on a scale of four miles to one

inch was prepared from aerial photographs. This map showed the location of major land forms and, where possible, the type of surface geological material associated with these land features.

The helicopter survey was carried on from a central base camp located as near as possible to the centre of each map sheet. The maps were divided into 12 "pie-shaped" segments which were lined from the base camp at 15-degree intervals. The radii of the segments ranged from 20 to 60 miles, thus making the total length of the traverses about 50 to 130 miles.

Approximately 80 to 90 landings were made in each map sheet for soil inspections. The distribution of the landings depended upon the nature of the terrain and tree cover, but wherever possible attempts were made to land about every ten miles along the lines of traverse.

Soil Classification and Mapping

The soils are mapped and classified very broadly, and no attempt has been made to correlate them with any of the soil series established in the province.

The type of soil occurring at specific points in each map sheet is shown on the accompanying maps. For the purpose of this exploratory soil survey the three-number system formerly employed in Alberta (11) is used for describing most of the soil profiles. Organic and Gleysolic soils have simply been indicated as such on the maps. Where the Organic soils were found to be frozen, the depth at which ice was encountered at each site is also shown on the maps.

In the number system, the first number refers to the Great Soil Group, the second number denotes the type of parent material, and the third number refers to certain special or differentiating characteristics of the soil profile.

The following table explains the system of numbers used in describing soil profiles:

First number	Great Soil Group
0	Regosol
4	Brown Forest
5	Acid Brown Wooded
6	Brown Wooded
7	Grey Wooded
8	Bisequa Grey Wooded
9	Podzol

Second number	Parent material
1	Modified residual
2	Glacial till
3	Reworked till

4	Gravelly outwash
5	Alluvial, water-sorted
6	Aeolian, wind-sorted
7	Lacustrine

Third number	Profile development
0	Little profile development
1	Hillside soils (shallow)
2	Modal soils (normal soils of a Great Soil Group)
3	Depressional, non-saline
4	Saline or alkaline
5	Saline
6	Solonetz
7	High lime to surface

An example of the number system would be 7.2.2. which would refer to a Grey Wooded soil developed on glacial till with normal profile development.

Each of the accompanying maps has been separated into two or more major areas on the basis of parent materials and designated Area I, Area II, etc. Topographic areas having a predominance of a particular type or types of soil parent material were grouped together on each map as one area, and numbered accordingly. Owing to the broad nature of the survey it was not possible to keep these areas to a single type of material, but the material first named on each map area is the one most frequently occurring.

The color descriptions used in the field and in this report are those given in the Munsell Soil Color Name Charts. All descriptions and analyses referred to are of virgin soils.

The topography of the area is shown on the maps by a system of hatching. The system used for classifying the slopes is similar to the one described in published reports of the Alberta Soil Survey (8) and is shown in the following table:

Per cent slope		Mapped phases
0.0 - 0.5 0.5 - 1.5	----------	Level and undulating
2 - 5 6 - 9	----------	Gently rolling
10 - 15	----------	Rolling
16 - 30	----------	Hilly

Irregular, often
steeply sloping
banks adjacent
to drainage courses ---------- Rough and broken

The topographical classification includes a consideration of the steepness of slope, as well as the shape and frequency of the various slopes which determine the relative roughness of the surface.

The maps are colored on a soil rating basis. The soil rating is that used and described in published reports and is based on a consideration of such factors as the characteristics of the soil profile, the degree of stoniness, and the topography. For the purpose of this survey the mapped areas have been separated into three soil rating categories, namely, pasture and woodland, doubtful, and arable.

The first category - pasture and woodland - refers to those areas considered unsuitable for agricultural development for reasons of poor soil, excessive stoniness, rough topography, or some other associated feature.

The doubtful category embraces areas in which some feature of the soil or terrain makes their value as agricultural land uncertain at present. Perhaps at some time in the future an increased demand for agricultural land may stimulate consideration of these less desirable areas for agricultural development. For example, some of the bog areas might become suitable agricultural land if satisfactory drainage were provided. The broad general nature of this helicopter survey did not allow for detailed separations in the marginal areas and hence the need arose for a doubtful category.

The third category - arable land - consists of those areas in which the soil and topography are considered suitable for agricultural development. In assessing the agricultural potential of any area, however, it is realized that factors other than the soil and topography must be considered. Such economic factors as the cost of land clearing, accessibility, and distance to markets are features which would have to be evaluated before any of the arable land indicated in this exploratory soil survey could be opened for settlement. Present economic conditions would seem to suggest that much of this remote area will remain undeveloped for the time being.

The greater proportion of the 1961 exploratory soil survey has been classed as pasture and woodland owing to a combination of factors - notably, inferior soils, steeply sloping topography, and inadequate drainage. One area, the flood plain of the Peace River, however, has been classified as doubtful arable since some of the soil areas in this section of the map area appear suitable for agricultural development. However, these areas are intimately mixed with unsuitable poorly drained boggy land and a more detailed survey is required to delineate between the arable and non-arable sections of the flood plain. Pending such a survey the area has been classified as doubtful arable.

Climate

There is only a limited amount of meteorological data (3) (5) available for most of the area covered by the exploratory soil survey in 1961. At Fort Vermilion, however, the records (4) are much more complete and have been compiled for some 50 years.

Table I shows the mean monthly and mean annual temperature and precipitation data for seven stations in or near the map area.

The range in annual precipitation in this general area of northern Alberta is from about 12.63 inches at Fort Smith, near north latitude 60 degrees, to 18.55 inches at Slave Lake, near north latitude 55 degrees 15 minutes. It is interesting to note that at Fort Vermilion where the mean annual precipitation is 12.86 inches, the extremes in annual precipitation range from a low of 6.7 inches to a high of 19.9 inches for the period 1909 - 1958. For the same period the depth of snowfall ranged from a low of 13.8 inches to a high of 88.1 inches, with the mean being 39.8 inches. There appears to be a general lowering of annual precipitation in this region with increase in latitude.

With regard to mean annual temperature, the range is from about 33.6 degrees Fahrenheit at Slave Lake to 25.5 degrees at Fort Smith. Again referring to the 50-year average at Fort Vermilion, the mean annual temperature is 28.8 degrees Fahrenheit, while the extreme high and low mean temperatures are 33.5 and 23.2 degrees Fahrenheit, respectively.

The length of frost-free period is an important consideration in assessing the agricultural potential of any area, and it is interesting to note the frost-free period for stations in or near the survey area. The frost-free period is taken as that period between the last time the temperature drops below 32 degrees Fahrenheit in the spring and the first time it reaches 32 degrees Fahrenheit in the fall of the year. The frost-free period for nine stations is shown in table II. Data for Beaverlodge, Edmonton, and Lethbridge are included for comparison.

Table II shows that there is a marked decrease in the length of frost-free period in a northerly direction. At Peace River, near the 56th parallel, the average period without frost is 91 days, while at Fort Vermilion, near the 58th parallel, it is only 72 days.

Table 1. Mean monthly and annual temperature and precipitation data for selected stations in or near the 1961 exploratory soil survey area

Station	Map sheet	Approx. elev., feet		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean annual temp., °F	Mean annual precip. inches
Fort Smith	74-M	666	T. . .	-13	-9	5	26	45	55	61	57	44	32	10	-7	25.5	--
			P. . .	0.53	0.66	0.67	0.52	0.97	1.41	1.99	1.65	1.54	0.96	0.86	0.87		12.63
Fort Vermilion	84-J	950	T. . .	- 8.7	-3.9	11.0	32.1	49.1	57.2	62.1	58.2	47.5	34.4	11.4	-4.6	28.8	--
			P. . .	0.75	0.59	0.67	0.58	1.26	1.79	2.04	1.72	1.21	0.78	0.70	0.77	--	12.86
Keg River	84-F	1402	T. . .	- 0.2	-0.7	18.6	36.0	48.4	55.6	--	--	--	--	--	--	--	--
			P. . .	0.77	0.62	0.79	0.59	1.87	2.01	2.61	1.59	1.35	1.07	--	0.99	--	--
Buffalo Head Prairie	84-K	1100	T. . .	- 6.9	-0.6	15.0	34.4	50.3	56.4	61.0	58.0	47.5	34.0	13.2	-3.6	29.8	--
			P. . .	0.55	0.44	0.88	0.55	2.09	1.80	2.37	1.79	1.58	0.82	0.96	0.66	--	14.49
McMurray	74-D	800	T. . .	- 9.4	1.2	12.9	34.8	49.0	56.8	61.4	57.8	48.0	35.6	12.9	-3.8	29.8	--
			P. . .	1.08	0.63	0.88	0.80	1.47	2.10	3.30	2.19	2.01	1.12	1.00	0.99	--	17.57
Fairview	84-C	2143	T. . .	5.2	6.1	20.1	36.5	50.2	56.3	60.3	58.1	49.7	38.5	19.6	6.6	33.9	--
			P. . .	1.23	1.30	0.98	1.01	1.40	1.99	2.52	1.96	1.48	1.14	1.40	1.42	--	17.57
Slave Lake	83-O	1921	T. . .	1.5	8.5	20.6	35.1	49.1	55.6	61.3	58.4	47.4	37.4	21.6	6.6	33.6	--
			P. . .	1.06	1.07	0.89	0.83	1.85	2.49	3.12	2.17	1.84	1.19	1.05	0.99	--	18.55

T. . . Temperature (degrees Fahrenheit)

P. . . Precipitation (in inches)

Table II. Frost-free periods -- shortest, longest, and average -- at selected stations since records were started

Station	Map sheet	Average period, days	Shortest period, days	Longest period, days	Number of years records kept
Fort Smith	74-M	59	15	94	26
Fort Vermilion	84-J	72	5*	119	50
Keg River	84-F	57	29	79	15
Buffalo Head Prairie	84-K	73	35	97	17
Peace River	84-C	91	39	164	26
McMurray	74-D	67	29	101	27
Beaverlodge	83-M	94	27	140	38
Edmonton	83-H	100	44	144	60
Lethbridge	82-H	111	80	147	26

*One isolated occurrence

Generally, however, a temperature of 32 degrees Fahrenheit is not considered to be a killing frost and crop damage does not occur until a temperature of 28 degrees Fahrenheit or lower is reached. On this basis, for a 50-year period, the average length of cropping season at Fort Vermilion is 104 days while the shortest and longest seasons for the same period are 22 and 148 days respectively.

Factors such as these are extremely important and must be given careful consideration when selecting the kind and variety of crop to be grown in these northern areas.

Vegetation

Vegetative cover is a factor of soil formation and provides some information for differentiating soil drainage and texture within an area.

The major portion of mineral soils has a mixed cover of trembling aspen (Populus tremuloides), white spruce (Picea glauca), and jack pine (Pinus banksiana).

On the porous sandy soils found in map sheets 84-P and 84-I jack pine is the most prominent tree species while aspen and white spruce predominate on the more heavily textured soils of these map sheets as well as in the Birch Mountains of map sheet 84-H. The flood plain of the Peace River supports excellent stands of merchantable white spruce timber, particularly along that portion of the river found in the southeastern section of map sheet 84-P.

An occurrence of paper birch (Betula papyrifera) was noted along the Birch River in map sheet 84-I. The soils in this area are generally somewhat poorly drained and apparently provide an ideal site for the growth of this tree species.

Meadow, Peaty Meadow, and Organic soils are of widespread occurrence throughout the entire map area. The Meadow soil areas are characterized for the most part by the growth of sedges, marsh reedgrass (Calamagrostis canadensis), horsetail (Equisetum arvense), and in some cases dwarf birch (Betula glandulosa). These Meadow soils usually have a variable depth of peat at the surface and are therefore classified as Peaty Meadow soils where the peat layer ranges from 3 to 12 inches in thickness.

Organic soils, those having more than 12 inches of peat at the surface, occupy a significant proportion of the map area. Two types of Organic soils - sedge and moss (muskeg) - were recognized in the area. The sedge type, formed from sedge and grasses, is a relatively fine textured fibrous peat whereas the moss type, derived primarily from sphagnum moss, is more coarse textured. Black spruce (Picea mariana) and labrador tea (Ledum groenlandicum) are characteristic tree and ground cover plants of the moss bogs in this area.

The moss bog soils in some portions of this area are frozen at depths ranging from 18 to 30 inches from the surface. The areas thus affected include map sheet 84-H and the highland area in the western half of map sheet 84-P. The Organic soils in the sandy lowland areas of map sheets 84-P and 84-I, however, do not appear to remain frozen throughout the summer months. The occurrence of ice or a frozen condition in some of the bogs of northern Alberta has been noted previously by several workers (6), (7), (10).

In the lowland area south of the Peace River in map sheet 84-I some of the Organic soils show clearly defined patterns in which relatively large level areas are separated by slightly elevated ridges. Two such areas are shown in figures 2 and 3. In figure 2 level areas of sedge bog are separated by ridges of black spruce, whereas in figure 3 the elevated ridges support a cover of dwarf birch.

Sjörs (9) in discussing similar patterns found in the sub-arctic parts of the boreal zone suggests that the reason for the elevated ridges seems to be the pressure of the ice being exerted horizontally during the freezing period in early winter. A similar explanation may well apply to the patterned ground of northern Alberta.

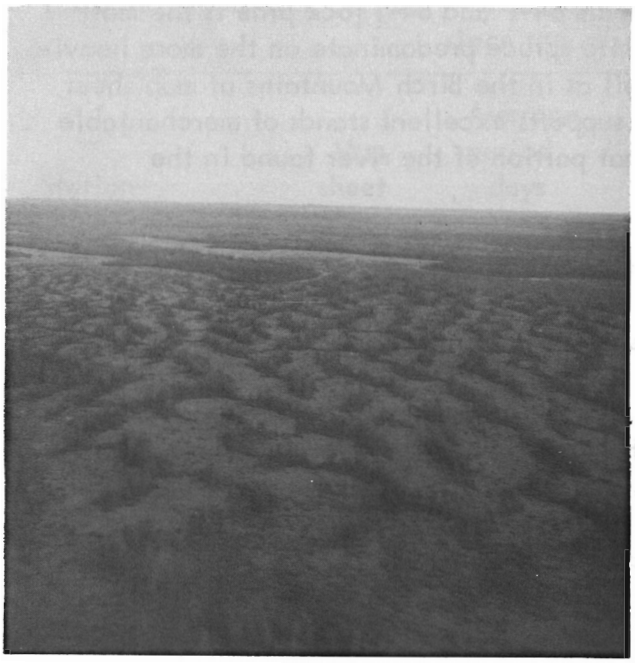


Figure 2. Patterned ground in sedge bog with black spruce ridges.

Figure 3. Patterned ground in sedge bog with dwarf birch ridges.

Alberta Map Sheet 84-P

There is no settlement in this map sheet which lies almost wholly within the boundaries of Wood Buffalo National Park. A focal point of interest within sheet 84-P is the gypsum cliffs located along the Peace River in the southeastern section of the map sheet.

Area IA

Area IA is the largest separated area in map sheet 84-P and comprises about 53 per cent of the total area. This area is characterized by a widespread occurrence of sand which originally was of alluvial or lacustrine origin. Subsequently, however, wind action has reworked much of the sand into U-shaped and longitudinal dunes. The topography, therefore, is extremely variable and consists of fairly extensive areas of level to depressional topography as well as areas of gently rolling to hilly sand dunes.

Area IA is drained by numerous rivers and streams. The southern portion is drained by the Peace River and some of its tributaries, notably the Jackfish and Beaver Indian Rivers and Jodoin and Knights Creek. The northern section is drained principally by the Little Buffalo River and its tributaries which flow north to Great Slave Lake.

It is estimated that Organic soils occupy about 60 per cent of Area IA. These soils are of both the sedge and moss bog types. For the most part the Organic soils are extremely wet and of those examined none appeared to be frozen at this time of year.

An interesting feature of Area IA is the occurrence of sinkhole plains in the central and southeastern sections of the area. The presence of sinks in this area is presumably due to solution in the joints and bedding planes of the Paleozoic dolomites and gypsum that underlie this area. A more detailed description of the sinkholes together with a discussion of their possible origin is included in the appendix of this report under the title Surficial Geology.

The mineral soils of Area IA are principally Acid Brown Wooded soils developed on sandy material. These soils are typified by a thin Ah horizon, and a reddish brown Bf horizon. A more detailed description of one such profile is given below:

Horizon	Thickness, in inches	Description
L-H	1	Very dark brown (10YR 2/2 dry), pine needle litter, pH 5.6.
Bf1	2 - 3	Reddish brown (5YR 4/4 dry), loamy sand, single grain, loose, pH 5.6.
Bf2	8	Reddish brown (5YR 4/4 dry) yellowish red (5YR 5/6 moist), sandy loam, single grain, loose, pH 6.1.
Bm	8	Greyish brown (10YR 5/2 dry), loamy sand, single grain, loose, pH 6.7.
BC	40	Brown (10YR 4/3 dry), loamy sand to sand, single grain, loose, pH 6.9.
C	at 60 inches below surface	Dark greyish brown (2.5Y 4/2 dry), sand, single grain, loose, pH 7.8.

The above described soil profile has the reddish brown Bf horizon (s) and the medium to slightly acidic sola typical of Acid Brown Wooded soils. However, as will be pointed out in the section of this report dealing with chemical characteristics of the soils, the Acid Brown Wooded soils do not have a particularly low base saturation. A low base status is one of the criteria outlined for the definition of this Great Group of soils.

In a few of the Acid Brown Wooded soils examined a very thin bleached Ae horizon was discernible. This horizon, which is typical of Podzol soils, was seldom more than 1 inch in thickness and usually averaged about one-half inch in depth. The presence of this weakly expressed Ae horizon suggests that the next stage of development of the Acid Brown Wooded soils in this area is the Podzol.

Brown Wooded soils are also found in Area IA, although to a lesser extent than Acid Brown Wooded soils. The Brown Wooded soils are characterized by a thin

Ah horizon and a yellowish brown to brown Bm horizon overlying a calcareous parent material. Soil profile development in the case of Brown Wooded soils is weakly expressed and appears to be restricted to the movement of free-lime from the upper 24 inches with a concurrent color development in the B horizon. These soils lack distinct eluvial and illuvial horizons.

In cases where weak eluvial and illuvial horizons have developed the soils are classified as Degraded Brown Wooded soils. One such soil was examined and described in Area IA; this soil profile was characterized by a thin eluvial Ae horizon overlying a yellowish brown Bm horizon. There was no evidence of clay enrichment in the B horizon. The following is a description of this type soil profile:

Horizon	Thickness, in inches	Description
L-H	1	Deciduous leaf litter slightly decomposed in the lower portion.
Ae	1	Light brownish grey (10YR 6/2 dry), sand, single grain, loose, pH 5.4.
Bm	24	Yellowish brown (10YR 5/8 dry), sand, single grain, loose, pH 7.5.
Ck	at 26 inches below surface	Olive brown (2.5Y 4/4 dry), sand, high lime carbonate content, pH 7.8.

Gleysolic soils are of common occurrence throughout Area IA. These soils are extremely varied and include Meadow, Peaty Meadow, Calcareous Meadow, and Eluviated Gleysol profiles. These soils in this area are generally underlain by sand.

The following description is that of a Peaty Meadow soil profile found in Area IA:

Horizon	Thickness, in inches	Description
L-H	4	Sedge peat, slightly decomposed in lower portion.
Ah	3	Black (10YR 2/1 moist), loam, granular, loose.
Bg	12	Grey (2.5Y 5/9 moist), mottled, fine sand, loose.
Ck	at 19 inches below surface	Grey (2.5Y 5/9 moist), mottled fine sand.

In some cases lime carbonate was found to occur to the surface in the Meadow soils; such soils were classified as Calcareous Meadow soils.

The predominance of sedges over grasses in the open meadowy areas of map sheets 84-P and 84-I made it particularly difficult to estimate the actual amount of meadow in the area. The depth of the sedge peat was extremely variable and in many cases, due to the depth of the peat being greater than 12 inches, areas that appeared to be meadows from the air were in fact Organic soils. To estimate accurately the amount of meadow a fairly detailed survey of the area would be required so that the Organic soils could be separated from the Meadow soils on the basis of the depth of peat at the surface. Indeed some of the areas indicated as meadow may consist of mixtures of Meadow and Organic soils on closer inspection.

Area IA is about 1,640,000 acres in size of which 1,600,000 acres are classed as pasture and woodland, the remainder, 40,000 acres, is water. A combination of sandy soils coupled with a widespread occurrence of Organic soils make this area unsuitable for agricultural development. Some of the meadow areas should provide fairly good rough pasture in their native state; however, it would appear unwise to disturb, through cultivation, any of these areas since they are underlain by sand and would become extremely droughty if the water-table was lowered for any reason. Many of the meadow areas are presently providing browse for the several thousand buffalo that inhabit this area.

Area IB

Area IB comprises about 10 per cent of the total area of map sheet 84-P. In so far as soils are concerned Area IB is very similar to Area IA. However, the occurrence of Organic soils, moss and sedge bogs, is almost negligible in Area IB and it is for this reason that the two areas have been separated on the accompanying map.

The topography in Area IB is generally undulating to gently rolling with occasional rolling to hilly U-shaped and longitudinal sand dunes. A sharp steeply sloping escarpment acts as the northern boundary of Area IB. Several springs which are of a saline nature issue from the base of this escarpment and are thus affecting the soils on the level land to the north of Area IB. As was the case in Area IA sinkholes are of common occurrence in Area IB; in this latter area the sinks are concentrated in a two to six mile wide plain paralleling the top of the afore-mentioned escarpment.

As mentioned above the soils are similar to those of Area IA being both Acid Brown Wooded and Brown Wooded in nature. The following description is that of a Brown Wooded soil found in Area IB:

Horizon	Thickness, in inches	Description
L	1	Pine needle litter and mosses.
Ah	1/2	Black (10YR 2/1 dry), fine sand, single grain, loose.

Ae	1/2 - 1	Light grey (10YR 7/1 dry), fine sand, single grain, loose.
Bm	17	Light yellowish brown (10YR 6/4 dry), fine sand, single grain, loose.
Ck	at 20 inches below surface	Greyish brown (2.5Y 5/2 dry), fine sand, single grain, loose, moderate lime carbonate content.

Area IB consists of about 313,000 acres of which 311,500 acres are classed as pasture and woodland. The remainder, 1,500 acres, is water. The widespread occurrence of sand makes this area unsuitable for agricultural development.

Area II

Area II comprises about 29 per cent of map sheet 84-P. This area includes that portion of northern Alberta known as the Ninishith Hills.

The topography in this area is quite variable; considerable level and depressional land occurs in the southern and central portions while gently rolling and occasional rolling topography predominates in the northern section of the area.

The area is drained principally by the Little Buffalo and Jackfish Rivers. There are numerous lakes in the area which vary in size from a few acres to the largest-Thultue, Conibear, Sass, and Bowhay Lakes which cover 5,700, 6,500, 2,400, and 2,000 acres respectively.

Many of the lakes in Area II have a white or pinkish white appearance. At the time of survey this coloration was attributed to salinity; however, a subsequent chemical analysis of a water sample from this area has shown that the lake waters are not saline. The reason for the coloration of the lakes therefore is not clear, although it may possibly be due to the growth of algae.

Organic soils are prevalent throughout Area II and it is estimated that about 70 per cent of the area is occupied by moss and sedge bogs. These bogs are generally frozen at relatively shallow depths of from 12 to 20 inches from the surface.

The mineral soils in Area II are principally Grey Wooded and Brown Wooded in character. The soil pattern or distribution, however, is extremely complex owing to the presence of at least three distinctly different parent materials. These materials are: (1) yellowish brown silt loam to silty clay loam lacustrine deposition, (2) a pinkish to reddish brown clay loam to clay lacustrine material, and (3) a pinkish to reddish brown clay loam till. On the scale of mapping employed it was not possible to separate these materials with any degree of accuracy, and it was therefore necessary to group them together to be reported as one area.

For the most part the Grey Wooded and Brown Wooded soils developed on the yellow brown silty lacustrine sediments are found in the eastern portion of Area II,

bordering Area IA. The following description is that of a Grey Wooded soil profile which is underlain by the pinkish colored till:

Horizon	Thickness, in inches	Description
L-H	1 1/2	Deciduous leaf litter, slightly decomposed, dark brown (10YR 4/3 dry), in lower portion.
Ae	3 - 4	Light grey (10YR 6/1 dry) to light brownish grey (10YR 6/2 dry), silt loam, weakly platy, friable.
AB	7	Brownish yellow (10YR 6/8 dry), silt loam, small subangular blocky, friable.
Btj	8	Brownish yellow (10YR 6/8 dry), silty clay loam, small subangular blocky, friable.
IIC	at 20 inches below surface	Reddish brown (5YR 5/3 dry), silty clay, moderate lime carbonate content, many stones.

The depth of the yellow brown silty material is quite variable and it is found overlying both reddish brown till and reddish brown lacustrine sediments.

A second soil profile of fairly widespread occurrence in Area II is a Brown Wooded or Degraded Brown Wooded soil developed directly on the reddish brown lacustrine sediments. The following is a typical profile description:

Horizon	Thickness, in inches	Description
L-H	1/2	Deciduous leaf litter.
Ae	1/2	Brownish grey, loam, small blocky, friable.
Bmtj1	2	Reddish brown, clay loam, large blocky, firm.
Bmtj2	4	Reddish brown, clay loam, medium blocky, firm.
BC	12	Reddish brown, clay loam, small blocky, firm.
Ck	at 19 inches below surface	Reddish brown, clay loam, high lime carbonate content.

The occurrence of the reddish brown colored till and lacustrine materials is not unique to this area of northern Alberta alone, but has also been reported in the Fort Vermilion area (6). The source of the distinct coloration or the reason for it is not known at the present time.

A Grey Wooded soil developed on the reddish brown till had the following soil profile description:

Horizon	Thickness, in inches	Description
L-H	1 1/2	Deciduous leaf litter.
Ae	1 1/2	Pinkish white, loam, platy, friable.
Bt	12	Reddish brown, clay loam to clay, medium blocky, firm.
BC	5	Reddish brown, clay loam, large blocky, firm.
Ck	at 20 inches below surface	Reddish brown (5YR 4/3 dry), clay loam, high lime carbonate content.

Gleysolic soils also make up a significant proportion of the soils in Area II. These soils are primarily Eluviated Gleysol and Meadow soils on medium to fine textured materials. A Calcareous Meadow soil had the following description:

Horizon	Thickness, in inches	Description
L	3	Sedge peat and grasses.
Ah	4	Black (10YR 2/1 moist), loam, granular, calcareous, pH 7.4, conductivity 2.3 mmhos/cm.
Ck	at 7 inches below surface	Dark grey (10YR 4/1 moist), sandy clay loam, mottled, calcareous, pH 6.7, conductivity 2.9 mmhos/cm.

Area II is about 855,500 acres in size. The major lakes in this area occupy about 57,000 acres while the remainder of the area, 798,500 acres, is classed as suitable only for pasture and woodland. The widespread occurrence of moss bog makes this area unsuitable for agricultural development.

Area IIIA

Two per cent of the total area of map sheet 84-P is included in Area IIIA. This area is situated adjacent to the Salt River in the extreme northeastern section of the map sheet. The topography is level to depressional.

The most noteworthy feature of Area IIIA is the presence of brine springs, at the base of a prominent escarpment, which give rise to a large saline flat devoid of vegetation. The escarpment marks the western limit of the plain.

The classification of the soils on the barren flat in Area IIIA is difficult since the soil horizons are very weakly expressed. The soil profile examined and sampled for this survey appears to be either a Saline Meadow or a Saline Regosol soil with the following profile description:

Horizon	Thickness, in inches	Description
I	12	Dark brown (10YR 3/3 dry) and very dark grey (10YR 3/1 moist), loam, fairly high in organic matter, calcareous, pH 7.4, conductivity 16.0+ mmhos/cm.
II	8	Very pale brown (10YR 3/3 dry) and light yellowish brown (10YR 6/4 moist), loam, gritty, calcareous, pH 7.7, conductivity 12.0 mmhos/cm.
III	16	Light brownish grey (10YR 6/2 dry) and greyish brown (10YR 5/2 moist), clay loam, mottled, calcareous, pH 7.4, conductivity 2.4 mmhos/cm.

The extremely saline nature of the above soil profile is evident from the electrical conductivity measurements of a water extract taken from each of the sampled horizons. A critical electrical conductivity limit of 4 mmhos/cm. has been suggested by the Salinity Staff of the United States Department of Agriculture as being the point above which crop growth is affected by soluble salts. It can be seen from the soil profile description that this critical limit is far exceeded in the upper horizons of the soil sampled from this area, and this feature no doubt accounts for the absence of vegetation in this area.

It is interesting to note that the lower horizon, below a depth of 20 inches from the surface, does not show evidence of extreme salinity. Apparently, the salts from the brine springs have been spread over the surface of the area and leached down only to a depth of approximately 20 inches. Under the relatively dry climatic conditions in this area a minimum amount of downward leaching in these soils could be expected.

A second soil, a Degraded Brown Wooded profile, examined in this area occurred under a dense stand of aspen trees and had the following soil profile description:

Horizon	Thickness, in inches	Description
L-H	1	Deciduous leaf litter.
Ah	1	Black, loam, granular, friable.
Ae	1/2 - 1	Grey, loam, platy, friable, this horizon is discontinuous.

AB	3	Dark grey, clay loam, small subangular blocky, firm.
Btj	11	Dark grey, clay loam, medium subangular blocky, firm.
Ck	at 17 inches below surface	Olive brown, silty clay, calcareous.

The soil profile showed no morphological evidence of salts and was described accordingly. However, in 1950 Atkinson, Bishop, and Leahey (1) (profile G) reported the chemical analyses for a similar profile from this area which showed definite evidence of saline conditions in the subsoil at depths greater than 12 inches from the surface.

Further discussion relative to the chemical analyses of the soils from this area is included in a later section of this report dealing with the chemical characteristics of the soils of the survey area.

Area IIIA is about 64,000 acres in size. Owing to the saline nature of the soils, the area is considered to be suitable only for pasture and woodland.

Area IIIB

Area IIIB lies immediately to the northeast of Area IIIA. It comprises less than one per cent of the total map area.

The topography in this area is level to depressional but there was no evidence of salinity as was the case in Area IIIA.

The major portion of this area is drained by tributaries of the Salt River. It is estimated that Gleysolic and Organic soils occupy about 50 per cent of this area.

The mineral soils are primarily Brown Wooded soils developed on sandy alluvial material. The following description is that of one such soil found in Area IIIB about six miles south of the Alberta-Northwest Territories boundary:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter.
Ah	1/2	Black, loamy sand, single grain, loose.
Ae	3	Pale brown, fine sand to loamy fine sand, single grain, loose.
Bm	12	Yellowish brown, fine sand to loamy fine sand, single grain, loose.
Ck	at 17 inches below surface	Greyish brown, fine sand, calcareous.

Day and Leahey (2) have described a similar soil, the Fort Smith series, at a point about two miles north of the present survey area. The similarity of the two soil profiles is evident from a comparison of the descriptions; the Fort Smith series of Day and Leahey is perhaps somewhat finer textured and the depth to free lime carbonate is somewhat greater. However, as pointed out by these workers a range in profile characteristics does occur in this soil with respect to the presence or absence of certain horizons and with respect to the depth to lime.

A second soil profile examined in Area IIIB appears to be similar to the Norberta series, a Peaty Meadow soil, described by Day and Leahey (2) for this general area. The following description is that of the Peaty Meadow soil described in connection with the 1961 exploratory soil survey:

Horizon	Thickness, in inches	Description
L	5	Dark brown sedge peat, relatively undecomposed.
Ah	4	Black, fine sandy loam, granular to single grain, loose.
Bg	13	Grey with yellowish brown mottles, fine sand, single grain, loose.
Ck	at 22 inches below surface	Greyish brown, mottled, fine sand, highly calcareous.

Area IIIB is about 22,700 acres in size. The area is classed as suitable only for pasture and woodland owing to the occurrence of coarse textured soil. Such mineral soil is characterized by low moisture-holding capacity and low fertility. The low moisture-holding capacity is offset to some extent by the surface peat layer in some of the Gleysolic soils; however, these soils are also underlain by sand and any disturbance of the soil profile that would result in a lowering of the water-table would likely create a droughty moisture regime.

Area IV

Area IV represents the eastern extremity of the Caribou Mountains. This area has been described in some detail by Lindsay, et al. (6) in 1959, and only a small portion, about 4 per cent of map sheet 84-P, was included in the 1961 survey.

Area IV of map sheet 84-P is unlike the remainder of the Caribou Mountains in that the extent of moss bog is much less. The comparative absence of moss bog in Area IV can be attributed to a gently to steeply sloping escarpment providing the means for carrying excess drainage from the area. Berry Creek, a tributary of the Peace River, is the major drainage-way in the area.

Previous investigations in this general area indicate that the mineral soils in the Caribou Mountain region are principally Grey Wooded and Brown Wooded soils

developed on glacial till. On the lower slopes of the escarpment, however, considerable outwash and alluvial materials are found which form the parent material for some of the soils. A Brown Wooded soil developed on alluvial material near Berry Creek had the following description:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter, pH 6.9.
Bm1	3	Yellowish brown (10YR 5/6 moist), very fine sandy loam, granular to weakly platy, friable, pH 7.2.
Bm2	4	Light olive brown (2.5Y 5/6 moist), very fine sandy loam, small granular, friable, pH 7.2.
BC	2	Light olive brown (2.5Y 5/4 moist), very fine sandy loam, granular, friable, pH 7.7.
Ck	at 10 inches below surface	Light brownish grey (2.5Y 6/2 moist), very fine sandy loam, granular, friable, pH 7.5.
IIC	at 24 inches below surface	Reddish brown (5YR 5/4 moist), clay loam to clay, lacustrine, pH 7.5.
IIIC	at 60 inches below surface	Reddish brown (5YR 4/3 moist), clay loam, till, pH 8.0.

Area IV is about 122,000 acres in size. The relative steepness of the slopes associated with the escarpment makes this area unsuitable for agricultural development, and it has therefore been placed in the pasture and woodland rating category.

Area V

Area V represents that portion of the alluvial flood plain of the Peace River that is found in map sheet 84-P. It is a relatively small area and comprises less than one per cent of the map sheet.

The topography in Area V is level to depressional. Meander scars and oxbow lakes are widely distributed throughout Area V. These sites are depressional and are now marked by the occurrence of moss and sedge bog and swamps or sloughs. The more level portions of the flood plain, where drainage is better, are covered by excellent stands of white spruce and aspen.

The soils of Area V are developed on material of variable texture ranging from sand to silty clay loam and silty clay. The two main profile types represented in the area are the Regosol and Brown Forest. The following description is that of a

Brown Forest soil examined in Area V:

Horizon	Thickness, in inches	Description
L-H	2	Organic litter of deciduous leaves and grasses. Partially decomposed in lower portion. pH 6.1.
Ah	3	Brown (10YR 5/3 dry) and very dark greyish brown (10YR 3/2 moist), silty clay loam, granular, friable, pH 5.9.
Bm	2	Light yellowish brown (10YR 6/4 dry) to brown (10YR 5/3 moist), loam, granular to small blocky, friable, pH 5.9.
BC	4	Light yellowish brown (2.5Y 6/4 dry) to dark yellowish brown (10YR 4/4 moist), sandy loam, single grain, loose, pH 6.2.
Ck	at 11 inches below surface	Greyish brown (2.5Y 5/2 dry) to dark greyish brown (2.5Y 4/2 moist), silt loam, lime carbonate concentrated in thin bands, pH 7.6.

Brown Forest soils represent one of the major Great Groups of soils in Eastern Canada but are of limited distribution in Western Canada. Those described in Area V are the first Brown Forest soils encountered during the course of the exploratory soil survey of northern Alberta. The distinguishing features of a Brown Forest soil profile are an Ah horizon, no eluvial or illuvial horizons, and a calcareous parent material. The thickness of the solum is rarely over 24 inches.

In the above described soil certain variations in soil texture between horizons are evident. However, these variations do not result from eluvial processes but are attributed to the alluvial type of deposition from which the soils are developed. Alluvial soils generally show distinct textural layers or lenses as a result of the mode of deposition.

Another type soil profile encountered in Area V is a Regosol. The Regosolic soils in this area are of more frequent occurrence than the Brown Forest soils and are the predominant soil of the Peace River flood plain. The following is a generalized description of a Regosolic soil from this area:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf mat.
Ah	1	Black, loam, granular, friable.

C	5	Dark grey, silty clay, weak small subangular blocky, friable.
IIC	8	Olive grey, loamy sand, single grain, loose.
IIIC	at 15 inches below surface	Grey with some yellowish brown mottles, silt loam, highly calcareous.

There are numerous variants to the above described Regosolic soil, particularly with regard to soil texture.

Area V is about 27,600 acres in size. Some of the better drained Brown Forest and Regosolic soils on medium to fine textured materials are suitable for agricultural development. However, these soils are intimately mixed with poorly drained soils and bogs found in old meander scars and oxbow lakes. The area, therefore, has been classified as doubtful arable pending a more detailed survey. A considerable proportion of the Peace River flood plain supports excellent stands of merchantable spruce timber and the area should perhaps be reserved for forest production. At the present time land clearing would be extremely costly due to the heavy tree cover.

Summary

A summary of the acreage in each of the land rating categories for map sheet 84-P is given in table III.

Table III. Land rating classification for map sheet 84-P

Area	Arable, acres	Doubtful, acres	Pasture and Woodland, acres	Water, acres
Area IA			1,600,000	40,000
Area IB			311,500	1,500
Area II			798,500	57,000
Area IIIA			64,000	
Area IIIB			22,700	
Area IV			122,000	
Area V		22,000		5,600
Total		22,000	2,918,700	104,100

Alberta Map Sheet 84-I

There are no permanently settled areas in map sheet 84-I. Lake Claire, one of the major lakes in northern Alberta, is found in the eastern section of the map sheet while a portion of the Birch Mountains occupies the southern section. All but the southern six miles of this map sheet lies within the boundaries of Wood Buffalo National Park.

Area I

Area I is the largest area separated in map sheet 84-I and comprises about 40 per cent of the total area. This area is very similar to Area IA of map sheet 84-P in regard to soils, topography, and drainage.

The topography is essentially level to depressional with some gently rolling U-shaped and longitudinal sand dunes. The area is generally very poorly drained and it is estimated that about 70 per cent of Area I is covered with moss and sedge bog. It was not possible to make an accurate estimate of the relative amounts of moss and sedge bog but the latter type appears to be far more extensive than the former in this area. A number of the bogs were inspected and found to be free of permafrost.

Drainage is carried from Area I principally by the Peace and Birch Rivers and their associated tributaries. Also, a portion of the eastern section of Area I drains directly to Lake Claire.

The soils are primarily Acid Brown Wooded in character.

These soils have been discussed under Area IA of map sheet 84-P. The following is a generalized description of an Acid Brown Wooded soil from this area:

Horizon	Thickness, in inches	Description
L	1	Pine needle litter.
Bf	7	Light brown (7.5YR 6/4 dry) and reddish brown (5YR 4/3 moist), fine sand, single grain, loose, pH 5.7.
BC	18	Light olive brown (2.5Y 5/6 dry) and olive brown (2.5Y 4/4 moist), fine sand, single grain, loose, pH 6.0.
C	at 26 inches below surface	Light olive brown (2.5Y 5/4 dry) and olive brown (2.5Y 4/4 moist), fine sand, single grain, loose, pH 6.4.

Gleysolic soils are an important group of soils in this area. They are extremely varied, however, and include the Meadow, Gleysol, and Eluviated Gleysol Great Groups as well as several Sub-groups of this Order.

The following description is that of a Peaty Gleysol soil developed on sand in this area:

Horizon	Thickness, in inches	Description
L	2	Brown to dark brown moss peat.
H	5	Black, semi-decomposed moss peat.
Bg	15	Yellowish brown, mottled, fine sand, single grain, loose.
Cgk	at 22 inches below surface	Grey, mottled, fine sand.

The water-table at the above location was at 24 inches from the surface.

An Eluviated Gleysol (Low Humic) in this general area had the following soil profile description:

Horizon	Thickness, in inches	Description
L	3	Organic litter of sedge and mosses.
Ah	1	Black, loamy sand, granular to single grain, loose.
Aeg	2	Grey, loamy sand, mottled, single grain, loose.
Bg	20	Yellowish brown, loamy sand to fine sand, single grain, loose.
Cg	at 26 inches below surface	Yellowish brown, fine sand, mottled, no lime carbonate.

Area I is about 1,200,000 acres in size. The widespread occurrence of sand and bog make this area unsuitable for agricultural development. It has therefore been placed in the pasture and woodland rating category.

Area I, particularly that portion situated near Lake Claire, is one of the principal grazing areas for the National Park buffalo. Buffalo wallows are a common sight on the Organic and Gleysolic soil areas of this region. Apparently sedge, which is the principal ground cover plant, provides native pasture for these animals.

Area II

Area II is found in two locations in map sheet 84-I. Area IIA is found at the base of the Birch Mountains in the southern portion while Area IIB, a comparatively small area, is located in the extreme northwestern section of the map sheet.

In all, Area II comprises about 26 per cent of map sheet 84-I. The topography in these sections varies from depressional to gently sloping. Area IIA has a long gentle slope from the base of the Birch Mountains to the Birch River, whereas Area IIB slopes gently down from the Caribou Mountains towards the Peace River.

Organic soils are prevalent throughout Area IIA and appear to cover about 60 per cent of the area. Moss bog predominates over sedge bog in this section of the map sheet. Area IIB, however, is generally better drained and bog is not a serious problem in this area.

The mineral soils of Area II are developed principally on lacustrine material and to some extent on glacial till. These soils are usually Grey Wooded and Brown Wooded in nature and are found in the better drained locations. Gleysolic soils are also of widespread occurrence in Area II, particularly in Area IIA where the water-table appears to be within 24 inches of the surface in many locations.

The following description is that of a Peaty Gleysol examined in Area IIA:

Horizon	Thickness, in inches	Description
L	5	Organic litter of deciduous leaves and some moss.
Ah	2	Black, loam, granular, loose.
Bg	12	Dark grey with yellowish brown mottles, silty clay, small subangular blocky, friable.
Cg	at 19 inches below surface	Greyish brown with yellowish brown mottles, lacustrine silty clay.

In this same area a Low Humic Eluviated Gleysol had the following characteristics:

Horizon	Thickness, in inches	Description
L	2	Deciduous leaf (Birch and Aspen) litter.
Aeg	3	Light grey with yellow brown mottles, loam, coarse platy to weak small subangular blocky, friable.

Bg	5	Yellowish brown, mottled, silty clay loam, small subangular blocky, friable.
Cgk	at 10 inches below surface	Yellowish brown, mottled, silty clay loam, lacustrine sediments.

As mentioned previously the better drained soils in Area II are Brown Wooded and Grey Wooded developed on lacustrine and till deposits. The following description is that of a Brown Wooded soil developed on lacustrine silty clay sediments:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter.
Bm1	3	Yellowish brown, silty clay, granular, friable.
Bm2	8	Brown, silty clay, granular to small blocky, friable.
Ck	at 12 inches below surface	Grey, silty clay, stratified lacustrine sediments.

A Grey Wooded soil developed on till from Area II had the following description:

Horizon	Thickness, in inches	Description
L	2	Deciduous leaf litter.
Ae	2	Light greyish brown, loam, medium platy, friable.
AB	3	Light greyish brown, loam to clay loam, small blocky, friable.
Bt1	5	Brown, clay, medium blocky, firm.
Bt2	6	Brown, clay, large blocky, firm.
Ck	at 18 inches below surface	Brownish grey, clay loam, massive, high lime carbonate concentration.

Area II is about 763,500 acres in size of which 724,000 acres is found in Area IIA and 39,500 acres in Area IIB. The predominance of Organic and Gleysolic soils in Area IIA makes this area unsuitable for agricultural development and it has been classed as pasture and woodland. Area IIB is classed as doubtful arable since the area is somewhat better drained and some land suitable for development is found mixed with poorer land.

Area III

Area III represents the highland areas of map sheet 84-I. Area IIIA and Area IIIB include the northern extremity of the Birch Mountains while Area IIIC denotes the southeastern corner of the Caribou Mountains. In all, about 16 per cent of map sheet 84-I is included in Area III.

The Birch Mountains have been delineated into Area IIIA and Area IIIB mainly on the basis of topography and drainage. Area IIIA represents the fairly steeply sloping escarpment of the Birch Mountains. This escarpment, owing to its sloping nature, is well drained by numerous creeks which have deeply incised erosion channels. The principal drainage-ways in this area are the Bolton, Alice, Current, Carolyn, and Steepbank Creeks.

Area IIIB includes that portion of map sheet 84-I lying immediately above the Birch Mountain escarpment. The topography in this section of the area ranges from gently rolling to depressional. The most significant single feature in this area, however, is the occurrence of moss bog which covers over 90 per cent of the surface and is found on all classes of topography.

Area IIIC, the Caribou Mountain section of map sheet 84-I, was not inspected on the ground. However, an aerial photograph interpretation indicates that it is similar to Area IV of map sheet 84-P. Thus it represents the lower slopes of the Caribou Mountain highland. Moss bog is not too significant a feature in this area and the soils are probably Grey Wooded and Brown Wooded developed on till.

Similarly, the terrain in Areas IIIA and IIIB was unsuitable for helicopter landing sites and no ground inspection was possible in any of the areas. However, the area immediately to the south was examined in some detail and the soils should be similar with regards development and parent material. On this basis, therefore, the mineral soils are primarily Grey Wooded soils developed on glacial till. The Organic soils are predominantly the moss bog type and are frozen at depths of 20 to 24 inches from the surface. Apparently the increased elevation of about 1,700 feet between this area and the Peace River lowland is sufficient to bring about the climatic changes necessary for the occurrence of permafrost in the Organic soils of the Birch Mountains. This feature was not evident in the Organic soils of the lowland area.

Area III is about 508,600 acres in size of which Area IIIA comprises 188,000 acres, Area IIIB 308,000 acres, and Area IIIC 12,600 acres. This area is classed as pasture and woodland owing to the occurrence of rather steeply sloping topography and poorly drained Organic soils.

Area IV

Area IV comprises about 5 per cent of map sheet 84-I. This area has been delineated on the accompanying map for the purpose of showing the location and extent of a series of old beach lines that at one time marked the western shore line of Lake Claire.

These beach lines are easily discernible on aerial photographs, due to the tonal patterns resulting from the growth of aspen and pine trees on the ridges as opposed to the sedge and grasses that occupy the inter-ridge depressional areas. Upon closer ground inspection the beach lines are seen to have very low relief and seldom rise more than five feet above the surrounding level to depressional areas. Taking the area as a whole it is estimated that the beach lines occupy about 30 per cent of the area with the remainder being sedge bog and meadow.

The soils of the beach lines are primarily Brown Wooded soils developed on alluvial or lacustrine sand. The following description is that of one such soil:

Horizon	Thickness, in inches	Description
L-H	1 1/2	Pine needle litter mixed with deciduous leaf mat.
Bm1	5	Brown, fine sand, single grain, loose.
Bm2	13	Yellowish brown, fine sand, single grain, loose.
Bk	2	Light grey, loamy sand, single grain, loose, lime carbonate concentrated in this horizon giving a white coloration.
Ck	at 21 inches below surface	Olive grey, fine sand, lime carbonate present.

The Organic and Gleysolic soils of Area IV are similar to those of Area I in that they consist essentially of differing thicknesses of sedge peat overlying sand. The actual differentiation of Organic from Gleysolic soils depends to a large degree on the thickness of peat and it was therefore difficult, if indeed almost impossible, to accurately estimate their relative distribution in this area since sedge occurs on the surface of all the depressional areas. However, it would appear that the Organic soils are far more frequently occurring than Gleysolic soils in this area. It should be noted also that in a large proportion of this area the water-table is at or very near the surface.

Area IV is about 140,000 acres in size. The presence of sandy mineral soils coupled with extremely wet Organic and Gleysolic soils underlain by sand suggests that this area is unsuitable for agricultural development. The area is rated as suitable only for pasture and woodland.

Area V

The flood plain of the Peace River has been delineated as Area V. It makes up about seven per cent of the total area of this map sheet.

Area V is actually a continuation of Area V of map sheet 84-P, an area that has been described in an earlier section of this report.

The topography in Area V is level to depressional. Many of the depressional areas mark the sites of oxbow lakes and meander scars presently occupied by water, moss and sedge bogs, or Gleysolic soils. The better drained soils of the flood plain are primarily Regosolic but some occurrence of Brown Forest soils was also noted.

Area V is about 228,000 acres in size of which 196,000 acres are classed as doubtful arable. The remainder, about 32,000 acres, is water. On the scale of mapping employed for this survey it was not possible to separate the land suitable for agricultural development from the land that is too coarse textured and poorly drained to be considered fit for agricultural development. Pending a more detailed survey the area therefore has been classed as doubtful arable land.

Area VI

Area VI is found in two low lying areas adjacent to Lake Claire; in all about three per cent of map sheet 84-I is included in this area.

This area is typified by the occurrence of very wet mud flats and sedge bog. The southernmost area represents the delta of the Birch River and owing to the extremely wet nature of the land in this section of the map sheet only a limited inspection of the area was possible.

In the more northerly section of Area VI a soil profile was examined and sampled near the Department of Northern Affairs' abattoir on "Sweetgrass Prairie" (5-114-12-W4). This soil appears to be of very recent origin and is classified as either a Saline Rego-Gleysol or Saline Organo-Regosol profile. The following is the soil profile description:

Horizon	Thickness, in inches	Description
Ish	3	Grey (10YR 5/1 dry) with thin strata of light grey (10YR 6/1 dry) recent deposition, color when moist is black (10YR 2/1), silty clay loam, granular, friable, pH 7.2, conductivity 4.2 mmhos/cm.
IIsh	8	Greyish brown (10YR 5/2 dry) and very dark grey (10YR 3/1 moist), silty clay loam, granular, friable, pH 7.4, conductivity 4.9 mmhos/cm.
IIIs	at 11 inches below surface	Brown (10YR 5/3 dry) and dark brown (10YR 3/3 moist), silty clay loam to silty clay, massive, pH 7.8, conductivity 5.9 mmhos/cm.

IVs	at 22 inches below surface	Light brownish grey (10YR 6/2 dry) and dark greyish brown (10YR 4/2 moist), silty clay, massive, pH 7.7, conductivity 5.2 mmhos/cm.

The Ah horizon of this soil profile consists of alternating layers or strata of mineral and organic materials which is suggestive of fairly recent periodic flooding. The soils in this area are generally very wet and free water is at the surface in many places.

The conductivity measurements of the horizons of the above soil profile indicate a fairly high soluble salt level in all horizons. Assuming that plant growth is affected where the conductivity is above 4 mmhos/cm. (United States Department of Agriculture Handbook 60), only the most salt tolerant crops could be grown on the soils of this area. The nature of the salts in this area will be discussed in a later section of this report dealing with the chemical characteristics of the soils of the area.

Area VI is about 85,300 acres in size. The area is classified as suitable only for pasture and woodland. The relatively poor drainage conditions coupled with salinity in the soils make this area unsuitable for agricultural development. Some portions of the area are presently being utilized for native pasture for buffalo. Any improvement of this pasture will require the use of salt tolerant species of grass since the more common hay and pasture crops would be unable to withstand the relatively high salinity level of these soils.

Summary

A summary of the acreage in each of the land rating categories for map sheet 84-I is given in table IV.

Table IV. Land rating classification for map sheet 84-I

Area	Arable, acres	Doubtful, acres	Pasture and Woodland, acres	Water, acres
Area I			1,191,700	
Area IIA			724,000	
Area IIB		39,500		
Area IIIA			308,000	
Area IIIB			188,000	
Area IIIC			12,600	
Area IV			140,000	
Area V		196,000		32,000
Area VI			85,300	
Lake Claire				195,700
Total		235,500	2,649,600	227,700

Alberta Map Sheet 84-H

There is no settlement in map sheet 84-H. The Birch Mountains of northeastern Alberta occupy the greater proportion of this map sheet.

Area I

Areas IA and IB represent the better drained section of the Birch Mountains; taken together these two areas comprise about 55 per cent of the total map sheet.

The topography in this section of the map sheet generally varies from gently rolling to hilly. The steepest slopes occur in the eastern portion of Area IA in the vicinity of Namur and Gardiner Lakes.

Area IA is drained by numerous rivers and streams which flow in all directions. The most important of these drainage-ways are the Mikkwa and Liège Rivers and Seaforth Creek which are a part of the Peace River drainage system, and the Tar, Ells, and Dunkirk Rivers which flow south and southeasterly to the Athabasca River. In addition a portion of the area is drained north by the McIvor River which flows to Lake Claire.

Area IB is drained principally by the Birch River which flows northwesterly and then east to Lake Claire.

Area I represents that portion of the Birch Mountains least affected by Organic soils. It is estimated that Organic soils cover about 30 per cent of this area. These soils are for the most part frozen at depths ranging from 24 to 30 inches from the surface.

The soils of Area I are principally Grey Wooded soils developed on glacial till. The following is a description of this type soil profile:

Horizon	Thickness, in inches	Description
L-H	1	Black semi-decomposed deciduous leaf litter, pH 5.6.
Ae1	1 - 2	Light grey (10YR 7/2 dry) and light brownish grey (10YR 6/2 moist), silt loam, platy, friable, pH 4.9.
Ae2	3	Very pale brown (10YR 7/3 dry) and light yellowish brown (10YR 6/4 moist), silt loam, platy, friable, pH 5.0.
AB	4	Yellowish brown (10YR 5/4 dry and 10YR 5/6 moist), sandy clay loam, small subangular blocky, friable, pH 4.6.

Bt	15	Brown (10YR 5/3 dry) and dark brown (10YR 4/3 moist), clay loam, medium blocky, firm, pH 4.8.
C1	at 25 inches below surface	Greyish brown (10YR 5/2 dry), clay loam, till.
C2	at 72 inches below surface	Greyish brown (2.5Y 5/2 dry) and dark greyish brown (2.5Y 4/2 moist), clay loam, till, pH 5.2.

The above described soil profile is typical of the majority of soils developed on till in this area. These soils show a distinct color difference between the upper and lower portions of the Ae horizons. This feature has been noted in a number of similar soils throughout northern Alberta. The exact significance of the color difference is not clearly understood, but it has been suggested that this might represent the initial stage in the development of a Podzol from a Grey Wooded soil.

It will be noted from the above soil profile description that the till in this area is non-calcareous even at a depth of six feet below the surface. Apparently this is a characteristic of the till in this Birch Mountain area, lime carbonate was not found at any of the sites where soils developed on till were examined.

It is typical of morainic areas to have some alluvial and outwash deposits associated with the till and Areas IA and IB are no exceptions. The depth of the alluvial or outwash materials is quite variable and ranges from a few inches to several feet or more, depending upon location. The following is a description of a Podzol soil developed on alluvial material overlying outwash gravel in Area IA:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter.
Ae	1	Light grey, coarse sand, single grain, loose.
Bf	3	Strong brown, coarse loamy sand, granular, friable.
C	5	Yellowish brown, coarse loamy sand, granular, friable.
IIC	at 10 inches below surface	Outwash gravel.

A Bisequa Grey Wooded soil developed on outwash from Area IA had the following description:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter.

(Ae)	3	Light grey, sand, stony, weakly platy, loose.
(Bf)	6	Reddish brown, loamy sand, stony, single grain, loose.
(C)	6	Yellowish brown, loamy sand to sandy loam, single grain, loose.
Bt	5	Brown, sandy clay loam, small subangular blocky, firm.
C	at 21 inches below surface	Yellowish brown, sand, single grain, loose.

Area I is about 1,827,000 acres in size; of this amount 1,770,000 acres occur in Area IA and 57,000 acres in Area IB. This area has been classified as pasture and woodland owing to the rough morainic topography and relatively high elevations in this section of the map sheet.

Area II

Area II is the second largest separated area in map sheet 84-H and comprises about 26 per cent of the total map sheet. This area represents the more poorly drained section of the Birch Mountains.

The topography is generally somewhat depressional in Area II with only occasional gently rolling ridges. Organic soils characterize this area and it is estimated that about 90 per cent of the land surface is covered by moss bog. These bogs are generally frozen, ice being encountered at about 24 inches from the surface.

The better drained soils are similar to those of Area I and consist essentially of Grey Wooded soils developed on till. There is also a minor occurrence of Bisequa Grey Wooded and Podzol soils developed on alluvial and outwash materials in this area.

Gleysolic soils are also of common occurrence in this section of the map sheet. For the most part these soils are Low Humic Eluviated Gleysols; the following is a description of one such profile:

Horizon	Thickness, in inches	Description
L	1	Deciduous leaf litter.
Ah	1	Black, loam, granular, friable.
Aeg	2	Yellowish brown, mottled, loam, platy, friable.
ABg	10	Yellowish brown, mottled, clay loam, medium subangular blocky, firm.

Btg	10	Greyish brown, mottled, clay loam, medium subangular blocky, firm.
Cg	at 24 inches below surface	Greyish brown, mottled, clay loam, till.

Area II is classed as pasture and woodland owing to the widespread occurrence of moss bog in this section of the map sheet. The area is about 820,000 acres in size.

Area III

Area III is located in the southeastern portion of the map sheet and comprises about 16 per cent of the total map area.

This area has a long gentle slope to the south and southeast away from the Birch Mountains. The topography is generally level to depressional. A major portion of the drainage is carried from this area by the Ells, Dunkirk, and Dover Rivers which are a part of the Athabasca River drainage system. Organic soils, primarily moss bogs, make up about 60 per cent of the over-all soil pattern in this area.

Grey Wooded soils developed on lacustrine sediments and glacial till are the most frequently occurring better drained soils in Area III. The following description is that of a Grey Wooded soil developed on lacustrine material:

Horizon	Thickness, in inches	Description
L-H	1	Mixed coniferous - deciduous forest litter.
Ae	5	Pale brown, silty loam, platy, friable.
Bt	10	Dark brown, silty clay, medium blocky, firm to slightly hard.
Ck	at 16 inches below surface	Greyish brown, silty clay loam to silty clay, occasional stone, some lime carbonate nodules, lacustrine sediments.

There are a number of variants to the above soil profile in Area III. These variations are due primarily to drainage conditions and to the depth of deposition. At a number of the test holes different degrees of mottling were noted which gave rise to Gleyed Grey Wooded and Eluviated Gleysol profiles. With regard to depth of deposition, till was found underlying some of the lacustrine sediments at 15 inches from the surface whereas at other sites it was not encountered at a depth of 36 inches.

Area III is about 481,000 acres in size. The widespread occurrence of Organic soils and poorly drained soils makes this area unsuitable for agricultural development. The area is classified as pasture and woodland.

Area IV

Area IV is one of the smaller separated areas in map sheet 84-H and comprises only three per cent of the total area.

This area represents an extension of Area IIA of map sheet 84-I. The topography of Area IV consists of a long gentle slope from the base of the Birch Mountains towards the Peace River lowland. A considerable proportion of this area is poorly drained and Gleysolic soils are perhaps the most frequently occurring soil type in this area. Organic soils are also of significant importance in this section of the map sheet.

The better drained soils in Area IV are both Grey Wooded and Brown Wooded soils developed on lacustrine sediments and glacial till.

Area IV is about 93,000 acres in size. The predominance of poorly drained soils makes this area unsuitable for agricultural development. It has therefore been classified as pasture and woodland.

Summary

A summary of the acreage in each of the land rating categories for map sheet 84-H is given in table V.

Table V. Land rating classification for map sheet 84-H

Area	Arable, acres	Doubtful, acres	Pasture and Woodland, acres	Water, acres
Area IA			1,727,300	42,700
Area IB			57,000	
Area II			813,600	6,400
Area III			477,200	3,800
Area IV			93,000	
Total			3,168,100	52,900

Some Chemical and Physical Characteristics of Representative Soil Profiles

A number of soils were sampled in the survey area and taken to the laboratory for analysis. The analyses serve a twofold purpose. They assist in the classification of the soils and at the same time give some indication of the productive capacity of the soils.

Table VI shows some chemical and physical data for three soil profiles from the survey area. In general, the nitrogen content of all the soils is highest at the surface and decreases with depth. There is a pronounced decrease in the amount of this constituent from the L and Ah horizons to the Ae and B horizons. Considering the surface horizons alone, the nitrogen content is highest in the L and Ah horizons of the Brown Forest soil and lowest in the Grey Wooded soil.

The organic carbon content of the soils follows a somewhat similar pattern to that of nitrogen in that it is highest at the surface and decreases with depth. The Grey Wooded soil examined shows a slight accumulation of organic carbon in the Bt horizon which is typical of most Grey Wooded soils.

The carbon-nitrogen ratios are highest in the surface horizon. It is generally considered that where the carbon-nitrogen ratio is above 15:1 the nitrogen becomes unavailable for plant growth. On this basis, it would appear that with the exception of the L horizon the nitrogen is available for plant growth in most horizons of the soils sampled and reported in table VI.

With regard to mechanical composition, the soils show a wide range in texture. The Acid Brown Wooded soil, which has undergone some sorting through wind action, is the most coarse textured, ranging from loamy sand to sand; the Grey Wooded soil is the finest textured, ranging from silt loam at the surface to clay loam in the subsoil. Profile 2, a Brown Forest soil, was sampled along the Peace River flood plain. Successive horizons of this profile vary considerably in texture, ranging from silty clay loam to sandy loam, which no doubt is a result of mode of deposition rather than any pedogenic processes since the soil appears to be fairly immature with regard to chemical characteristics.

The soil reaction of the Acid Brown Wooded and Brown Forest soil profiles ranges from medium acid at the surface to mildly alkaline in the parent material. The Grey Wooded soil has a very strongly acid solum and a strongly acid parent material. The latter feature is somewhat unusual for Grey Wooded soils developed on till in northern Alberta since they normally possess free lime carbonates in the parent material and exhibit an alkaline reaction in this portion of the soil profile.

The calcium carbonate equivalent determinations show no outstanding characteristics in any of the three profiles. The amount of free lime carbonate present in the parent material of the Acid Brown Wooded and Brown Forest soils was not exceptionally high while none of this constituent was found in the C horizon of the Grey Wooded soil.

Table VII shows the total cation exchange capacity, exchangeable cations, and base saturation percentage for three soil profiles.

The total cation exchange capacity closely parallels that of the clay and organic matter content in all profiles. Considering the Acid Brown Wooded and Brown

Forest soils, the presence of an Ah horizon in the latter soil profile is clearly indicated by the relatively high total exchange capacity of 34.9 milliequivalents in this horizon. The Acid Brown Wooded soil does not possess such a characteristic in the surface horizons. The exchange analysis for the Grey Wooded soil is similar to that reported for a number of Grey Wooded soils of similar texture in northern Alberta.

The base saturation data indicate a relatively high base status in all three soil profiles analyzed. This feature is characteristic of Brown Forest and to some extent grey Wooded soils but is not usually associated with Acid Brown Wooded soils. The explanation for the high base saturation in the Acid Brown Wooded soils of this area is not clear. However, with regard to other criteria, lack of eluvial and illuvial horizons, presence of a reddish brown colored Bf horizon, and a somewhat acidic solum, these soils appear to best fit the Acid Brown Wooded Great Group in the Canadian soil classification system.

The dominant cation on the exchange complex of all these soils is calcium, followed by magnesium, hydrogen, potassium and sodium, in that order. There were no solonetzic characteristics evident in any of the soil profiles examined during the course of the 1961 exploratory soil survey.

Table VIII shows soluble salt, calcium carbonate equivalent, and soil reaction (pH) analyses for three soil profiles from the map area. These soils were selected for analysis because of their saline appearance at time of examination.

Electrical conductivity measurements on a water extract from the soil present a fairly accurate indication of the total water soluble salt content. It can be seen from table VIII that profile 1 and the upper 20 inches of profile 2 contain a relatively high content of soluble salts, while profile 3 and the lower horizon of profile 2 are not severely influenced by salinity.

A critical electrical conductivity limit of 4 mmhos/cm. has been suggested by the Salinity Staff of the United States Department of Agriculture as being the point above which crop growth is affected by soluble salts. On this basis, therefore, the salt content of profiles 1 and 2 would adversely affect plant growth but in the case of profile 3 salinity should not seriously hinder crop growth.

Profile 2, which was sampled near the Salt River in map sheet 84-P, is the most saline of the soils analyzed. The analysis indicates that the principl salt present is sodium chloride. This data is confirmed by the work of Atkinson et al. (1) who in 1950 reported similar results for a soil from this area. Normally, high concentrations of the chloride ion are uncommon in Alberta soils, the principl soluble salts being sulphates of calcium, magnesium, and sodium. Brine springs, which issue from an escarpment above the affected plain, are the source of the sodium chloride in this area. These salts apparently are deposited on the surface and subsequently leached downward. The depth of penetration does not appear to exceed approximately 20 inches since the soil sample from below this depth does not show an appreciable soluble salt content.

Profile 1 was examined and sampled near the Department of Northern Affairs' abattoir at the north end of Lake Claire. The horizons of this profile show an appreciable salt content; the salts are principally sulphates of magnesium and calcium, together with some sodium chloride. It would appear that any attempt to improve the buffalo pasture in this area will require the use of salt tolerant grasses.

The analyses of profile 3 indicate that the salt content is not excessively high and consists principally of calcium sulphate and calcium carbonate. For this reason the soil has been classified as a Calcareous Meadow soil.

The soil reaction of the various horizons of profiles 1, 2, and 3 of table VIII are generally in the neutral to mildly alkaline range. The presence of neutral soluble salts and lime carbonate would tend to account for the soil horizons being in this general pH range.

References Cited

1. Atkinson, H. J., Bishop, R. F., and Leahey, A., (1950): Studies on strongly alkaline soils of the Salt River Plains in Northwestern Canada; Sci. Agr., Vol. 30, No. 1, p. 30-38.

2. Day, J. H., and Leahey, A., (1957): Reconnaissance soil survey of the Slave River Lowland in the Northwest Territories of Canada; Experimental Farm Service, Canada Dept. of Agriculture, 44 pages.

3. Government of Canada (1956): Climatic summaries; Meteor. Division, Dept. Transport, Toronto, Vol. III, 94 pages.

4. _____(1959): Climatic summaries; Experimental Farm, Res. Br., Fort Vermilion, Alberta (pers. comm.).

5. _____(1954): Meteorological observations in Canada; Meteor. Division, Dept. Transport, Toronto.

6. Lindsay, J. D., Pawluk, S., and Odynsky, W., (1959): Exploratory soil survey of Alberta map sheets 84-J, 84-K, and 84-L; Res. Coun. Alberta Prelim. Soil Survey Rept. 60-1, 49 pages.

7. Moss, E. H., (1953): Marsh and bog vegetation in northwestern Alberta; Can. J. Bot., Vol. 31, p. 448-470.

8. Odynsky, W., Wynnyk, A., and Newton, J. D., (1956): Soil survey of the Grande Prairie and Sturgeon Lake sheets; Res. Coun. Alberta Rept. 74, 111 pages.

9. Sjörs, H., (1961): Surface patterns in boreal peatlands; Endeavour, Vol. XX, No. 80, p. 217-224.

10. Wyatt, F. A., Doughty, J. L., and Younge, O. R., (1930): Preliminary soil survey of the Fort Vermilion district, Res. Coun. Alberta, (unpublished).

11. Wyatt, F. A., Newton, J. D., Bowser, W. E., and Odynsky, W., (1944): Soil survey of Wainwright and Vermilion sheets; Univ. of Alberta, Coll. of Agriculture Bull. 42, 122 pages.

Table VI. Soil reaction (pH), organic carbon, nitrogen, carbon-nitrogen ratio, calcium carbonate equivalent, and particle size distribution of some representative soil profiles

Horizon	Thickness, in inches	pH	Organic carbon, %	Nitrogen, %	C/N ratio	$CaCO_3$ equiv., %	Sand 2.0-0.05 mm., %	Silt 0.05-0.002 mm., %	Clay < 0.002 mm., %
Profile #1 - (5.6.2.) Acid Brown Wooded, loamy sand (13-117-15 W.4)									
L-H	1	5.6	41.6	1.027	40	-	-	-	-
Bf1	2 - 3	5.6	0.60	0.045	13	-	83	9	8
Bf2	8	6.1	0.49	0.043	11	-	70	22	8
Bm	8	6.7	0.25	0.013	19	-	83	8	9
BC	40	6.9	-	0.012	-	-	89	4	7
C	at 60 inches below surface	7.8	-	0.016	-	5.66	94	2	4
Profile #2 - (4.5.2.) Brown Forest, loam (6-114-19 W.4)									
L-H	2	6.1	41.1	1.834	22	-	-	-	-
Ah	3	5.9	3.54	0.247	14	-	9	55	36
Bm	2	5.9	0.78	0.063	12	-	46	36	18
BC	4	6.2	0.59	0.044	13	0.05	64	31	5
Ck	at 11 inches below surface	7.6	-	0.082	-	6.74	39	58	3
Profile #3 - (7.2.2.) Grey Wooded, clay loam (33-93-22 W.4)									
L - Ah	1	5.6	12.66	0.567	22	-	-	-	-
Ae1	1 - 2	4.9	0.56	0.032	17	-	43	55	2
Ae2	3	5.0	0.39	0.044	9	-	22	65	13
AB	4	4.6	0.30	0.027	11	-	54	19	27
Bt	15	4.8	0.45	0.030	15	-	43	22	35
C1	at 25 inches below surface	-	-	-	-	-	-	-	-
C2	at 72 inches below surface	5.2	-	0.030	-	-	35	29	36

Table VII. Total cation exchange capacity by determination and by summation, exchangeable cations, and percentage base saturation for some representative soil profiles

Horizon	Thickness, in inches	Total exchange capacity Deter. m.e./100 gms.	Total exchange capacity Sum. m.e./100 gms.	m.e./100 gms. Ca	Mg	K	Na	H	Base sat., %
Profile #1 - (5.6.2.) Acid Brown Wooded, loamy sand (13-117-15 W.4)									
L-H	1	44.6	51.5	44.0	3.6	1.2	0.0	2.7	95
Bf1	2 - 3	5.0	6.7	4.8	0.2	0.5	0.0	1.2	82
Bf2	8	5.4	6.8	5.4	0.2	0.5	0.0	0.7	90
Bm	8	4.7	6.2	5.0	0.6	0.4	0.0	0.2	97
BC	40	4.4	6.6	5.7	0.7	0.2	0.0	-	100
C	at 60 inches below surface	-	-	-	-	-	-	-	-
Profile #2 - (4.5.2.) Brown Forest, loam (6-114-19 W.4)									
L-H	2	94.8	85.9	58.2	16.1	3.4	0.1	8.1	91
Ah	3	31.2	34.9	25.8	6.0	1.2	0.0	1.9	95
Bm	2	12.9	15.9	11.6	2.8	0.3	0.0	1.2	93
BC	4	8.3	11.2	8.6	1.8	0.2	0.05	0.6	95
Ck	at 11 inches below surface	-		-	-	-	-	-	-
Profile #3 - (7.2.2.) Grey Wooded, clay loam (33-93-22 W.4)									
L-H	1	39.6	43.5	34.7	2.0	1.4	0.1	5.3	88
Ae1	1 - 2	4.8	5.1	2.2	0.4	0.4	0.03	2.1	59
Ae2	3	8.9	8.0	4.3	1.1	0.5	0.0	2.1	74
AB	4	16.0	14.7	9.5	2.4	0.3	0.05	2.5	83
Bt	15	17.4	19.1	13.8	3.0	0.4	0.1	1.8	81
C1	at 25 inches below surface	-	-	-	-	-	-	-	-
C2	at 72 inches below surface	16.8	20.1	14.7	3.8	0.3	0.05	1.3	94

Table VIII. Water soluble salt content, soil reaction and calcium carbonate equivalent percentage of some representative soil profiles

Horizon	Thickness, in inches	Conductivity, mmhos/cm.	m.e./liter						pH	$CaCO_3$ equiv., %
			HCO_3	SO_4	Cl	Ca	Mg	Na		
Profile #1 - Saline Rego-Gleysol, silty clay (5-114-12 W.4)										
Ish	3	4.2	6.0	47.5	4.1	24.4	23.2	4.0	7.2	
IIsh	8	4.9	2.6	63.5	5.4	25.2	31.3	10.3	7.4	
IIIs	11	5.9	2.6	73.0	7.6	22.6	40.8	16.1	7.8	
IVs	at 22 inches below surface	5.2	2.2	70.0	4.9	20.9	37.8	12.1	7.7	5.97
Profile #2 - Saline Regosol, loam (16-126-14 W.4)										
Is	12	16+	2.8	47.0	167.0	48.0	5.3	164.5	7.4	28.47
IIs	8	12.0	2.5	25.0	94.9	20.0	3.1	100.0	7.7	46.70
III	at 20 - 36 inches below surface	2.4	1.5	31.5	0.1	27.2	4.4	0.5	7.4	0.30
Profile #3 - Calcareous Meadow, sandy loam (35-124-20 W.4)										
Ahk	3	2.3	3.3	26.5	-	26.7	2.9	0.4	7.4	39.53
Ck	at 7 inches below surface	2.9	3.8	35.0	0.9	32.6	5.3	0.4	6.7	6.93

APPENDIX

SURFICIAL GEOLOGY

by
L. A. Bayrock

Bedrock

The bedrock of the area is divisible into two broad groups: Devonian limestones, dolomites and evaporites, and Cretaceous shales and sandstones.

The Devonian strata, consisting of two gypsum beds with interbedded limestone and dolomite crop out along the Peace River, and minor outcrops are found west of Lake Claire and in the sink hole area north of the Peace River (figure 4). The more soluble gypsum has dissolved more rapidly than the overlying carbonates and the roofs of the resultant solution caves have collapsed to produce sinkholes. A zone of sink holes (figure 4) represents each of the two separate gypsum beds. Salt (sodium chloride) is also present in the Devonian strata and in some places, such as in the northeast corner of the area (Brine Creek, Salt River), oversaturated saline waters in springs have deposited sodium chloride at the surface.

Devonian strata directly underlie surface deposits in most of the area north of the Birch Mountains. Cretaceous, poorly consolidated to unconsolidated, shales and sandstones make up the Birch and Caribou Mountains and underlie the surface deposits of the plains area to the south of the Birch Mountains. All strata of the area have a gentle dip towards the southwest.

The bedrock of the Birch Mountains is presumably overlain by gravels of Tertiary age, but pertinent evidence was not found in the field because of a thick mantle of glacial drift and the consequent lack of outcrops. Similar gravels are found capping many preglacial erosion remnants elsewhere, in the Province, such as the Swan Hills and the Caribou Mountains.

Preglacial Topography

Large-scale topographic features of the area were not significantly altered by glaciation. The Birch Mountains, an erosion remnant from pre-glacial times, rise over 1,500 feet above the surrounding lowland. The top of the Birch Mountains is relatively flat, but the side slopes are steep and rugged. The easterly slopes of the Caribou Mountains, north of the Peace River in map sheet 84-P, are similar to those of the Birch Mountains. No evidence.of large preglacial river valleys was found in the area.

Glaciation

Evidence for multiple glaciation of the area was not found, but since multiple glaciation occurred to the south it may be assumed that this area was involved

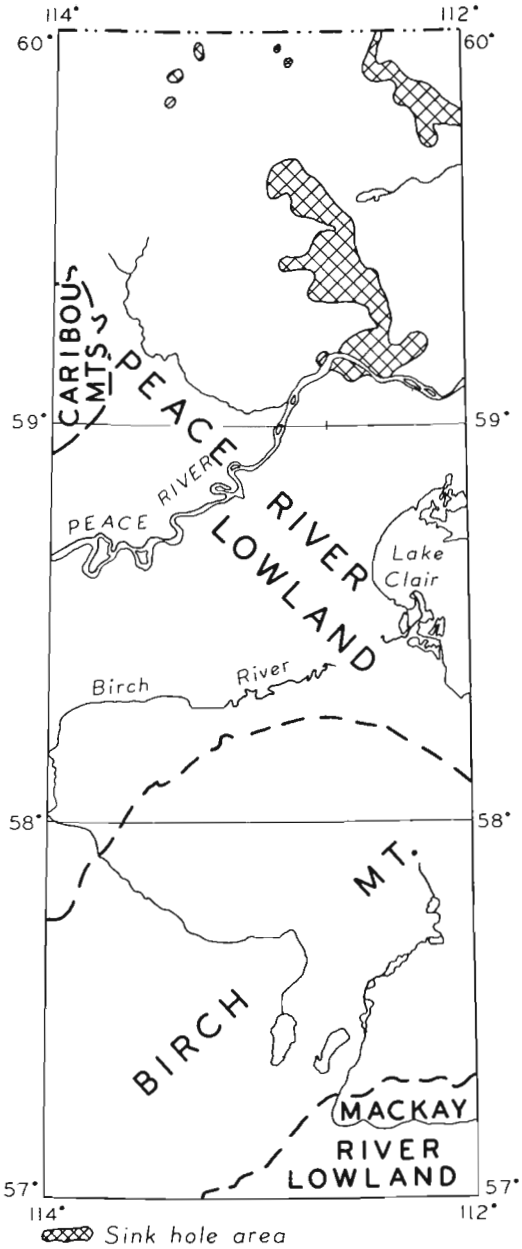


FIGURE 4

in a multiple glaciation. The last glacier to cover the country was of Wisconsin glacial stage, as ascertained by the freshness of glacial topography, the negligible amount of surface weathering, and the continuity of the surface deposits into areas of known Wisconsin glaciation.

The Wisconsin glacier advanced over the area at least 31,000 years ago, as supported by the Smoky Lake radiocarbon date (McCallum and Dyck, 1960). Ice advanced from the northeast, as shown by flutings on top of Birch Mountains and around Lake Athabasca. The maximum thickness of the Wisconsin glacier over the area is difficult to determine, but it is known that the Birch Mountains were covered and they rise 1700 feet above the surrounding lowland. Since higher terrains (e.g. Hand Hills) farther south in Alberta were covered by the same glacier, it is reasonable to assume a thickness of well over one mile for the glacier in this area.

Recession of continental glaciers is first signified by a general lowering of the surface. Where the lowering has progressed sufficiently, the higher terrain becomes exposed as nunataks, and the Birch Mountains are believed to have been exposed as a nunatak during the recession part of the Wisconsin glacier. The glacier had to flow around the large erosional remnants at this time and the southeasterly trending flutings northeast of the Caribou Mountains are believed to have been formed during this period.

During the final stages of recession large glacio-marginal lakes were present against the retreating ice front, until further ablation of the ice sheet resulted in their disappearance from the area. The lakes occupied almost the whole of the lowland area south and north of the Birch Mountains. As a rule, beaches were not associated with the lakes, because of rapidly fluctuating levels in response to the rate of retreat of the ice and the opening of newer, lower outlets. All glacio-marginal lakes were finally drained as a result of recession of the glacier.

The Peace River did not have a well defined valley immediately after the retreat of the glacier, and during floods it spread over most of the lowland north of the Birch Mountains and deposited fine alluvial sands. The clean alluvial sands were later subjected to intensive aeolian action, as signified by the presence now of U-shaped and longitudinal sand dunes, in some places up to 300 feet high. The climate

later became colder and the sand dunes were stabilized by vegetation. Muskeg was formed in blowout hollows and on lowlands between the dunes, and in some places it has completely surrounded the dunes.

The Peace River Valley was cut entirely in postglacial times. The valley is wide in the west and narrows to the east, the valley width being a function of bedrock competence. Recent alluvial deposits of sand, silt and clay mantle the bottom of the valley. A recent alluvial deposit of the same composition in the northeast corner of the area was deposited by the Slave River.

Three different types of till occur in the area. The first, pink to red-brown, underlies lacustrine and alluvial deposits of map sheets 84-I and 84-P. It is a stony calcareous till of clay loam composition. The red color of this till is believed to be the result of incorporation of red shale which apparently underlies surficial deposits of the lowlands in map sheet 84-P. The second till is a brown, clayey, and calcareous till, underlying lacustrine sediments south of Birch Mountains and also alluvial and lacustrine deposits in the lowlands close to northern limit of the Birch Mountains. The third type of till is a brown, clayey, non-calcareous till which is found on top of the Birch Mountains. This till is believed to have been derived from distant bedrock farther northeastward than the outcrops of Devonian limestones and dolomite that border the Canadian Shield. These three tills are gradational into each other.

Glacio-lacustrine deposits, overlying till in the lowlands, are mainly made up of bedded silts and clays. Rare ice-rafted pebbles are found in these deposits. On the whole, the lacustrine deposits seem to be uniform in composition over large areas. The lacustrine clays and silts vary greatly in thickness, being of the order of 2 to 3 feet close to former lake boundaries, and from 20 to 30 feet in the centers of the ice-marginal lakes. As a rule, aeolian deposits are rarely found on lacustrine sediments because of the binding action of the constituent clays.

Recent Deposits

The alluvial sands derived from the Peace River flood plain have been subjected to aeolian action and consequently most of the area underlain by these sands supports numerous dunes. The semi-arid dunes of U- and longitudinal shapes are made up of fine to medium grained sand. The effective wind direction producing the dunes was from the northwest.

Deterioration of climate in postglacial times resulted in the accumulation of organic matter in the form of muskegs and bogs. In many places surficial deposits and their topography are mantled and obscured by organic matter to such an extent that they cannot be recognized from the air or on the ground.

Reference:

McCallum, K. J., and Dyck, W. (1960): University of Saskatchewan Radiocarbon Dates II; Amer. J. Sci. Radiocarbon Suppl. 2, p. 76.

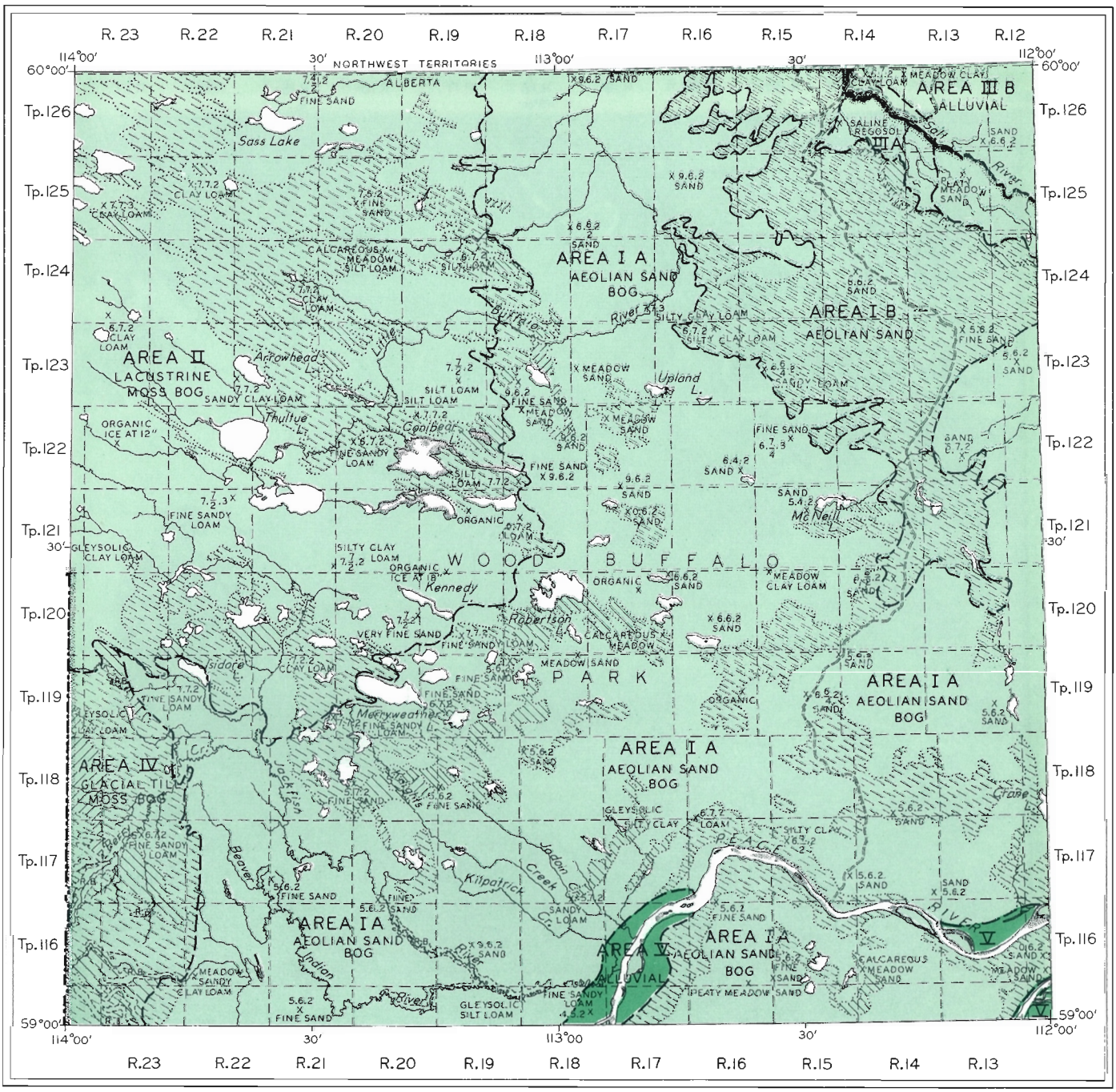
PRELIMINARY SOIL SURVEY AND RATING MAP

OF THE

ALBERTA SHEET 84-P

Scale in Miles

4 2 0 4 8 12



Soil information by Alberta Soil Survey,
Research Council of Alberta,
Helicopter Project - 1961

Prepared by Research Council of Alberta, Edmonton - 1961.
Base map supplied by Technical Division,
Department of Lands and Forests,
Province of Alberta.

LEGEND

Level and Undulating Topography.....
Gently Rolling Topography.....
Rolling Topography.....
Hilly Topography.....
Rough Broken Land..... R.B.
National Park Boundary.....

Pasture and Woodland.....
Doubtful Arable Land.....

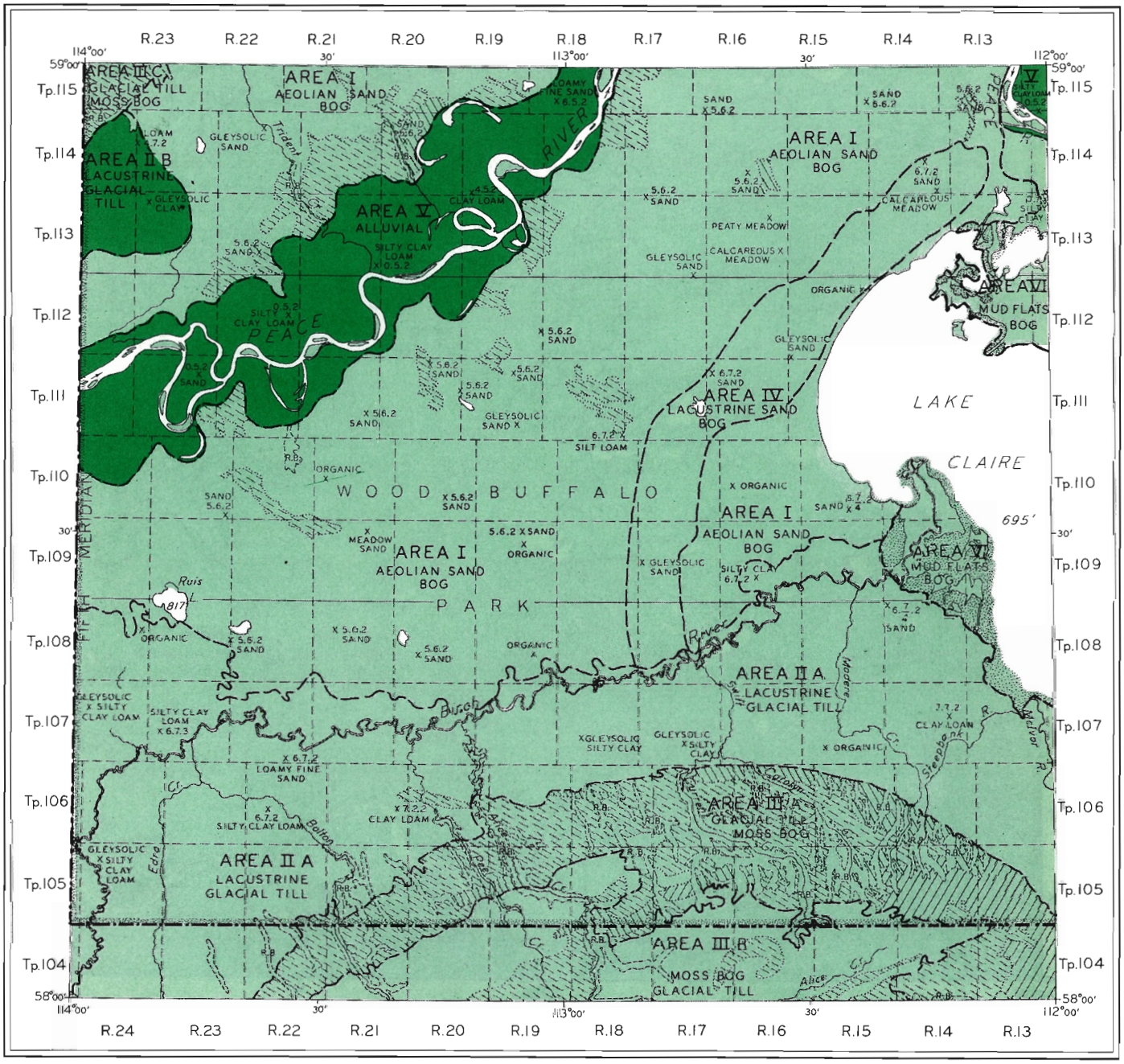
PRELIMINARY SOIL SURVEY AND RATING MAP

OF THE

ALBERTA SHEET 84-I

Scale in Miles

4 2 0 4 8 12



Soil information by Alberta Soil Survey, Research Council of Alberta, Helicopter Project - 1961.

Prepared by Research Council of Alberta, Edmonton - 1961, Base map supplied by Technical Division, Department of Lands and Forests, Province of Alberta.

LEGEND

Pasture and Woodland

Doubtful Arable Land

Level and Undulating Topography

Gently Rolling Topography

Rolling Topography

Hilly Topography

Rough Broken Land

National Park Boundary

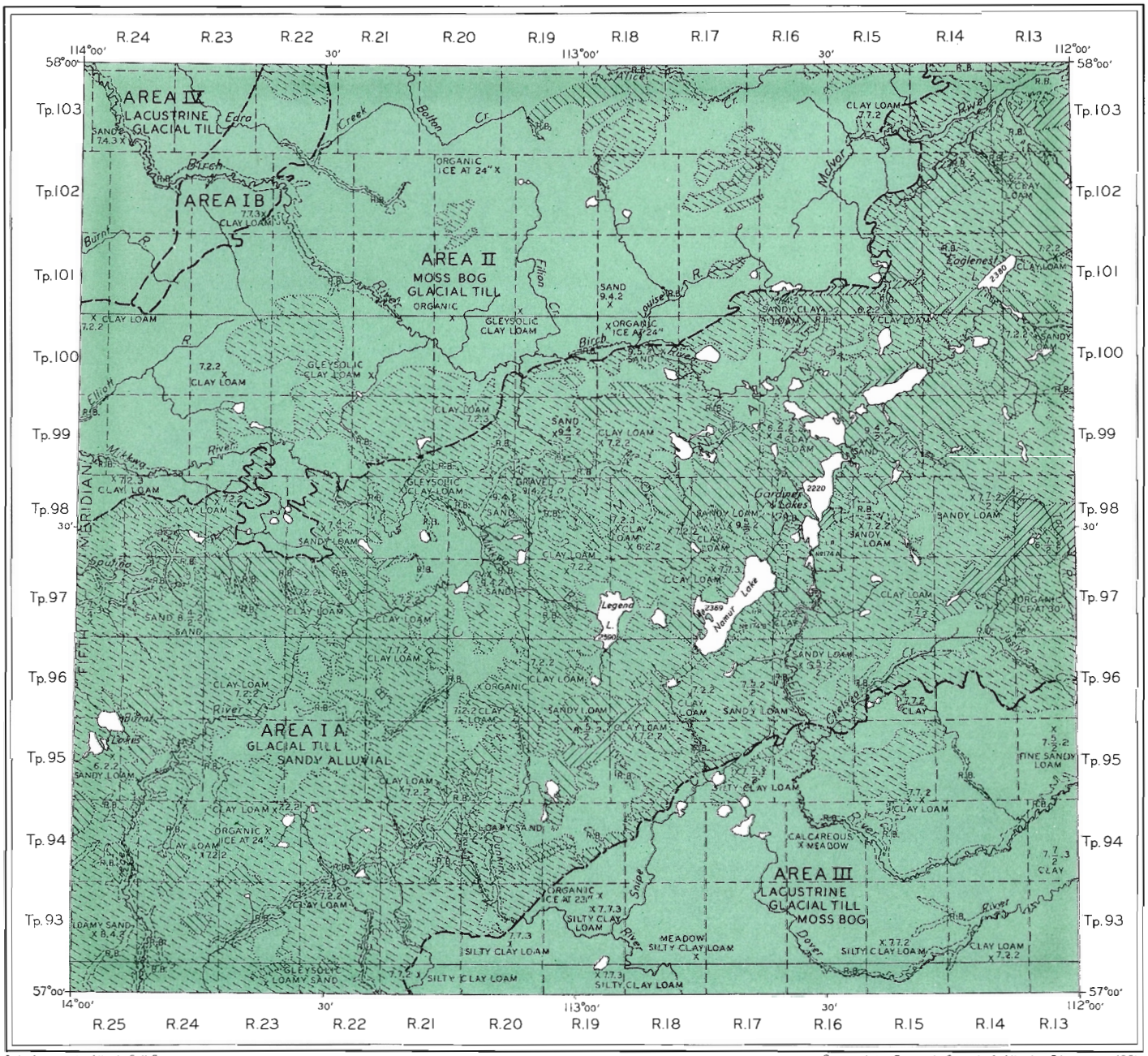
PRELIMINARY SOIL SURVEY AND RATING MAP

OF THE

ALBERTA SHEET 84-H

Scale in Miles

4 2 0 4 8 12



Soil information by Alberta Soil Survey,
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Prepared by Research Council of Alberta, Edmonton - 1961.
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LEGEND

Level and Undulating Topography.....

Gently Rolling Topography.....

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Rough Broken Land..... R.B.

Pasture and Woodland.....