LAND CLASSIFICATION FOR LAND EVALUATION: CORMORANT LAKE PILOT PROJECT

by

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WINNIPEG, MANITOBA

INFORMATION REPORT MS-X-20

FORESTRY BRANCH

APRIL, 1969

Climate

The temperature regime of the area is characterized by cool summers and cold winters, with the mean annual temperature between 29° and 31°F. The number of frost free days[1] and the average length of the frost free period[2] (as determined from the meteorological records of five stations within or in the immediate vicinity of the area) show that the growing season is about 100 days long, but this may be considerably longer for frost hardy native plants. The approximate length of the vegetative season is taken as the time period while the average temperature is about 42°F. According to this approximation, the vegetative period is about 140 days in the area, extending from the end of April to the middle of September.

The average annual precipitation is about 17.5 inches, with little variation between the various stations. About half of the precipitation falls as rain during the four month growing season (May, June, July and August).

Physiography

The physiography of the area is determined by bedrock, modified to various degrees by glacial activity. The most striking feature is the contact between the Canadian Shield and the Manitoba Lowlands which divides the area into two nearly equal halves.

1. The Manitoba Lowlands portion.

This area is underlain by Ordovician dolomite or dolomitic limestone occurring in flat beds that dip gently to the south. The resulting topography is low, with a low frequency of slopes. Low plateaus of bedrock are frequent in some areas. These are generally well defined to the north by a low escarpment, but in some cases the escarpment completely surrounds these plateaus. The Pas escarpment is the most prominent topographic feature of the area, rising some 100 feet above the surrounding country with a steep slope to the west, but a gentle fall to the east. Low, east-west oriented drumlins occur in the southeastern part of the area and on The Pas escarpment.

Bedrock plateaus are covered by a thin rubbly till near escarpments, but the till becomes deeper on the gently sloping southern flanks of the plateaus. Deep till occurs on slopes and in flats. Clay till is found in the southwest on slopes and in depressions at higher elevations. Lacustrine clay is common in most low-lying areas below the 1,000 foot contour in the west and below the 900 foot contour in the east.

2. The Canadian Shield portion.

This area is characterized by the configuration of the bedrock. Volcanic and gneissic bedrock usually from a more broken topography with steep, often nearly perpendicular slopes, rising some 100 feet or more above the valleys. Granitic bedrock generally forms lower, more rounded hills, but the slope frequency is high.

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[1] Number of days when the minimum temperature was above 32°F.

[2] Number of days from last frost in spring to first frost in fall.

Shallow till occurs on ridges and on slopes, but bare bedrock is abundant on most ridges. Deeper till is found in some valleys or on the south side of rock ridges. Lacustrine clay pockets of small size are common in valleys below the 1,000 foot contour in the west and below the 900 foot contour in the east.

Surficial geological materials

The entire area was glaciated during the Pleistocene age. Striations and the lithology of till indicate that the last ice movement took place from the north in the northern part of the area, and from the east in the southern part. Glacial Lake Agassiz inundated all but a very small part of the area after the melting of the ice. The lake level was lowered in stages as the lake found lower outlets. Finally organic materials began accumulating in depressions and the Saskatchewan River built its delta just south of the area.

The main deposit of the ice sheets was ground moraine, consisting of till. The composition of till depends on the material incorporated into the glacier. Five types of till were distinguished on the basis of their lithology or texture, each associated with an ice advance in specific areas.

1. Highly calcareous loamy till. This till is found in the southwestern part of the area. It consists of a mixture of Paleozoic carbonate rocks and Precambrian granitic or volcanic rocks. It was formed as the dominantly Precambrian till was reworked by the westerly moving ice carrying mainly carbonate rocks.

2. Very highly calcareous loamy till. This till occurs in the southeastern part of the area. It consists almost completely of Paleozoic carbonate material, with very little Precambrian material. It was deposited by westerly moving ice that advanced exclusively over carbonate bedrock.

3. Moderately calcareous sandy to loamy till. This till occurs in a narrow band across the central part of the area. It consists of a mixture of Precambrian materials and Paleozoic carbonate materials. It was formed as the re-expansion of the northern ice lobe overrode earlier carbonate rich till south of Reed and Simonhouse lakes.

4. Non-calcareous sandy till. This shallow, discontinuous till is found in the northern part of the area. It consists entirely of Precambrian material or volcanic or granitic rocks. It was formed by the northern ice lobe that advanced across Precambrian bedrock areas.

5. Highly calcareous clay till. Small areas of this till occur in the southwestern part and in a narrow band across the central part of the area. It consists of overridden lacustrine clay with few stones. It was formed by a readvance of ice across Lake Agassiz sediments.

Local glaciofluvial sand and gravel occurs in north-south trending valleys on the Canadian Shield. These probably represent valley trains or imperfectly formed eskers.

Unmodified Lake Agassiz sediments generally occur as small pockets, mainly in depressions. One relatively large area is in the Wanless area, the other is the extreme east-central part of the area, being an extension of a large clay plain to the east.

The lacustrine sediments are clay in texture and are highly calcareous. The surface sediments are homogeneous and sparingly stony. These often rest on varved clays which may also contain a few rafted stones.

Other locally significant Lake Agassiz sediments are the beaches. These are especially well developed along the flanks of The Pas escarpment and along local highlands in the southern part of the area. They consist of very highly calcareous sandy gravel or moderately calcareous sand.

Recent alluvium was laid down mainly by the Saskatchewan River during periods of flooding. The material varies from fine sand to clay, but generally it has a loamy texture and is highly calcareous. Alluvium is found in large flats in the southern part of the area.

Organic deposits are formed by the remains of vegetation accumulating in poorly drained situations. These deposits occur in all parts of the mapsheet, but are most common in the southeast. Permafrost may be encountered in some fibrous deposits usually within two feet of the surface.

Soils

The soils of the study area have developed beneath boreal forest cover and under subarctic climatic conditions with or without permafrost. Under these environmental conditions a low order of chemical weathering and partially mobilized and partially translocated clay, iron and aluminum indicate weak podzolic processes in the mineral soils. Organic soils, generally formed from herbaceous forest and Sphagnum peat materials accumulate extensively under the prevailing climatic conditions.

A brief discussion of the development of the major profile types in the Cormorant Lake area follows:

Podzolic Grey Wooded[1] soils have developed under forest vegetation. The soil forming processes involved in the formation of these soils are the removal of bases from the solum and the translocation of clay. This results in the formation of a light-colored, eluviated Ae horizon and a darker-colored, fine textured, illuviated Bt horizon. Under virgin conditions an organic surface horizon, L-H, is found. The C horizon consists of lighter-colored, mildly alkaline, and relatively unaltered material. The Orthic Grey Wooded soils are the Westray, Egg Lake, Sipiwesk, and Cedar Lake series and the Woodridge complex. The solodic Grey Wooded soils are the Wabowden and Wanless series. The Gleysol Grey Wooded soils are the Roe Lake and Dyce series and the Tremaudan complex.

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[1] Soil classification terminology according to the Report on the Sixth Meeting of the National Soil Survey Committee of Canada, Laval University, Que., October 18-27, 1965.

Brunisolic Brown Wooded and Acid Brown Wooded soils have developed under forest vegetation and they are characterized by an organic surface L-H horizon with a brownish Bm or Bf horizon. The solum of Brown Wooded soils is weakly to mildly alkaline and the Acid Brown Wooded soils have a moderately to strongly acid solum. The parent material of Brown Wooded soils is usually calcareous and these soils appear to represent a stage of soil development. between Regosolic and Podzolic soils. Their lack of distinct eluvial and illuvial horizons appears to be due to climate, youthfulness, high lime parent materials or a combination of all these factors. The parent material of Acid Brown Wooded soils is, however, acidic and these soils appear to represent a stage of development between Regosol and Podzol soils. The Acid Brown Wooded soils are characteristic of the Precambrian Shield. The Degraded Brown Wooded soils are the Atikameg and Cranberry series and the Woodridge complex. The Gleyed Degraded Brown Wooded soils are the Chitek and Leak Lake series and the Tremaudan complex. The only Orthic Acid Brown Wooded soil is the Angus series. The Degraded Acid Brown Wooded soils are the Fay Lake and Clarke series. The Gleyed Degraded Acid Brown Wooded soils are the Hat Lake and Pakwa series.

Regosolic soils have very weak development because of their youthfulness. These soils are the Carrot series (Gleyed Deorcic Regosol) and the Nels series (Gleyed Orthic Regosol).

Gleysolic soils are saturated with water during one or more seasons and this results in saturated conditions and poor aeration. These soils have developed under hydrophytic vegetation. They may have developed organic horizons which could be unconsolidated peat and/or mineral Ah horizons. These soils are gleyed with development of mottles being due to the partial oxidation and reduction of iron caused by intermittent wet and dry periods. The peaty Rego Gleysol soils are the Dering, Goose River, Lost Lake, Medard, Norris and Baldy series. The Carbonated Rego Gleysol soils are the Le Pas, Big Lake, and Pasquia series. The only Peaty Low Humic Eluviated Gleysol is the La Perouse series.

Organic soils are accumulations of plant residues developed on poorly and very poorly drained depressional to level areas. They consist mainly of three kinds of organic materials: forest peat, Sphagnum moss peat, and herbaceous peat. Basically, the type of organic soil formed is a function of plant origin, affected by climatic, edaphic, and biotic factors. These organic soils are:

1. The Atik, Iskwasum, and File Lake complexes (Terric Fibric Mesisol, Terric Mesic Fibrisol, Terric Mesisol, and Terric Fibrisol) and the Flux Lake complex (Lithic Fibric Mesisol, Lithic Mesic Fibrisol, Lithic Mesisol and Lithic Fibrisol) have developed on less than 52 inches of dominantly, moderately decomposed (mesic) forest peat.

2. The Chocolate, Farewell and Optic Lake complexes (Terric Mesic Fibrisol, Terric Fibric Mesisol, and Terric Fibrisol) have developed on less than 64 inches of dominantly fibric Sphagnum moss peat.

3. The Reed Lake, Loonhead and Mawdesley complexes (Terric Mesisol and Terric Fibric Mesisol) have developed on less than 52 inches of dominantly, moderately decomposed (mesic) sedge peat.

4. The Hargrave, Claw Lake and Wekusko complexes (Typic Mesisol and Mesic Fibrisol) have developed on greater than 52 inches of dominantly, moderately decomposed (mesic) forest peat.

5. The Kiskitto, Crowduck, and White Forest complexes (Typic Mesisol and Mesic Fibrisol) have developed on greater than 64 inches of dominantly fibric Sphagnum peat.

6. The Rock Island complex (Typic Mesisol) soils have developed on greater than 52 inches of dominantly, moderately decomposed (mesic) sedge peat.

Cryic organic soils have developed on poorly drained fibrous Sphagnum moss or moderately decomposed forest peat. The thickness of the permafrost ranges from one foot at the southern limit of the study area to more than 20 feet in the northern areas (Brown, 1965). They generally form domes or palsas which could reach six or ten feet in height.

A palsa is formed when accumulating peat and developed plant cover insulate the frozen layer and allow it to increase in volume. As the thickness of the frozen layer, and thus the height of the palsa, increases, an unstable situation arises. The surface moss layer cracks and the sides slump, breaking the insulating layer, thus changing the energy balance and causing the frozen lens to melt and eventually collapse completely leaving a small pool of water or organic materials highly saturated with water. The cryic organic soils are the Nekik Lake complex (Cryic Mesisol and Cryic Mesic Fibrisol) and the Cormorant Lake complex (Cryic Sphagno Fibrisol and Cryic Mesic Fibrisol).

Vegetation

The regional climate of the area imposes severe restrictions on the growth and species composition of the forests. However, classification of sites within the regional climatic regime is made possible by other environmental parameters that influence the vegetation and vary from one locality to the next. Perhaps the most significant of these variables is the water regime although the hydrogen ion concentration and the available nutrients cannot be entirely discounted. Since these latter two environmental parameters are influenced by the water regime it is convenient to consider the different sites in terms of the water regime.

Such catastrophic events as fire and lumbering also have a significant affect on the vegetation of the area. The most prominent effect involves the successional stages but the nutrient regime is affected to a greater or lesser extent depending on the intervals and durations of the disruptive forces.

If stands of trees are grouped according to site-type based on water regime, trends in species composition and, to a lesser extent, growth rate are noticeable. On saturated sites black spruce is the only tree present of consequence although larch may occur successionally. Aspen and balsam poplar enter on wet sites but are successional to black spruce. Jack pine occurs in early successional stages following fire on moist sites but is soon replaced by hardwoods and/or black spruce. White spruce may also occur following the hardwoods or associated with black spruce. On fresh sites the early successional stages are dominated by jack pine and aspen but eventually these are replaced in most instances by black spruce and various admixtures of white spruce. Jack pine dominates dry sites initially but is replaced by black spruce.

In general fire promotes jack pine and lumbering promotes hardwood species in the early successional stages. The regional climate favours frost hardy evergreen species. White spruce is favourably influenced by the presence of relatively large bodies of water although the wind factor and topography must be considered to determine the influence.

The greatest proportion of the Manitoba Lowlands is composed of sites on the wet end of the moisture scale. The high lime content occurring in some parts of this area undoubted affects the growth of trees but a detailed study would be necessary to disclose the magnitude of the effect. The nutrient regime and the possibility of physiological drought would be important factors to consider.

On the Canadian Shield very complex situations exist where several moisture regimes may occur within small localities, especially on rock outcrops. Often the fissure characteristics of the bedrock regulates the moisture and nutrient regimes. Organic material formed in situ, as well as allochthonous material from the bedrock outcrops, accumulates in the valleys and tends to increase the moisture regime.

Black spruce would dominate the vegetation on all sites within the region if all the disruptive forces were omitted. Jack pine would disappear from most sites after the first generation but may persist in open stands for longer periods. The hardwood species, namely aspen and balsam poplar, would persist until the spruce formed a closed canopy because they can reproduce under their own canopy, but not under dense spruce stand. White spruce is a secondary invader and can reproduce under a closed canopy. However since it will have to compete with black spruce it would not form a dominant component except perhaps in small localities.

THE LAND CLASSIFICATION SYSTEM, as applied to the Cormorant Lake area.

The hierarchy of a proposed land classification system was outlined by Lacate (1969). This system was used in the Cormorant Lake area, with some adaptations to local conditions.

Land Regions

Land Regions are defined as areas of land characterized by a distinctive regional climate as expressed by vegetation (Lacate, 1969).

Two Land Regions were distinguished in the area (Fig. 1) and a third barely reaches the southern part of the area. These regions may be named from south to north for convenience (Zoltai, et al. 1967), and characterized as follows:

1. Moderate Boreal, moist subhumid Land Region.

Regional vegetation on gently sloping loam is a mixture of trembling aspen and white spruce. Black spruce is restricted to wet depressions; jack pine grows on sand. No permafrost features were encountered.

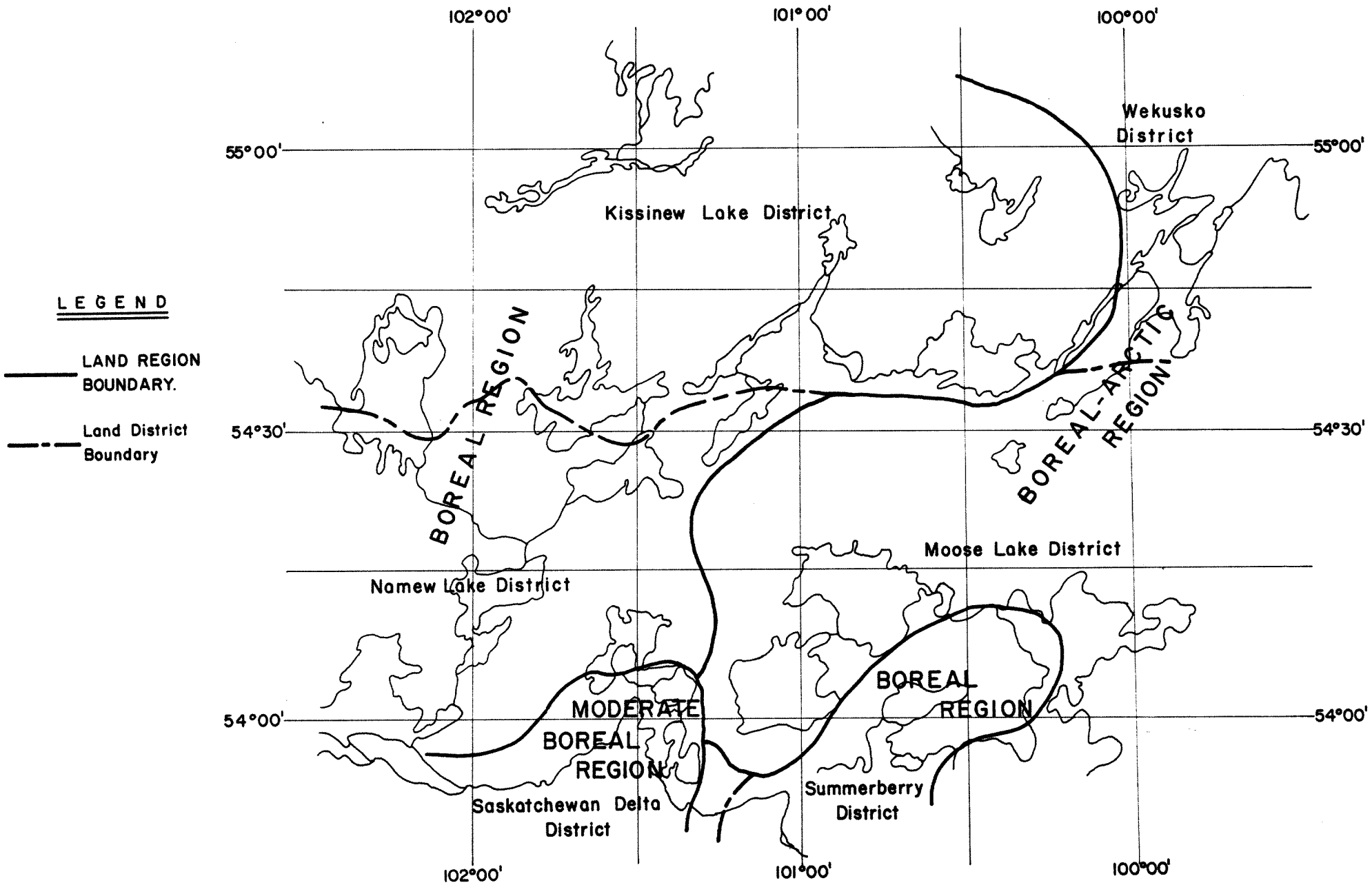

Figure 1. Land Regions and Land Districts of the Cormorant Lake area

2. Boreal, moist subhumid Land Region.

Regional vegetation on gently sloping loam is trembling aspen, white spruce and black spruce. Black spruce occupies wet depressions and moist lower slopes. Jack pine is common on sand and on bare bedrock. A few palsas, peat plateaus with permafrost and collapsed palsas occur on fibric organic materials.

3. Boreal-arctic Land Region.

Regional vegetation on gently sloping loam is black spruce. White spruce and trembling aspen are restricted to lakeshores or river courses. Jack pine occupies sand plains or bedrock outcrops. Palsas, peat plateaus with permafrost and collapsed palsas are very frequent in fibric organic matter.

Land Districts

Land Districts are defined as areas of land characterized by a distinctive pattern of relief, geology, geomorphology, and associated vegetation (Lacate, 1969).

The following Land Districts were recognized in the map area:

In the Moderate Boreal, Medium Subhumid Region:

1. Saskatchewan Delta Land District: characterized by extremely flat topography in recent alluvial sediments. Active and relict natural levees and river courses provide the only relief.

In the Boreal, Moist Subhumid Region.

1. Nemew Lake Land District: characterized by low relief till plain, with flat, low dolomite plateaus. Small lacustrine clay plains and peat plains occur in flats.

2. Kissinew Lake Land District: characterized by rolling topography, controlled by Precambrian gneissic or volcanic rocks. A discontinuous thin till sheet covers the area, with extensive bare bedrock outcrops. Small clay pockets and peat occur in some depressions.

3. Summerberry Land District: characterized by extremely flat topography in recent alluvial sediments. Active and relict natural levees and river courses provide the only relief.

In the Boreal-Arctic Land Region:

1. Moose Lake Land District: characterized by low relief till plain, with flat, low dolomitic plateaus, some low drumlins. Large peat plains are found, but only restricted lacustrine clay occurs in some depressions.

2. Wekusko Land District: characterized by rolling topography, controlled by Precambrian gneissic or volcanic bedrock. The area is covered by discontinuous thin till, with numerous bedrock outcrops. Lacustrine clay occurs in some valleys, and peat accumulated in some plains.

Landscape Unit

An integration of the land and water portion of the landscape was attempted in the landscape units. These are patterns of land types and water types grouped together to provide a convenient unit for resource management and multiple land use planning (Hills, 1966). Thus, landscape units are broad patterns of land and water, grouped into areas on physiographic criteria to provide a convenient base for evaluating the productive capacity of any area for forestry, agriculture, wildlife, recreation and water production for the purpose of resource management and regional development.

Landscape units are defined by their land or water characteristics, or by a combination of these. The distribution pattern of the land and water should be uniform within an area, but the individual land and water systems composing the landscape still retain their identity.

Land System

Land system is defined as an area of land throughout which there is a recurring pattern of landform, soils, and vegetation (Lacate, 1969).

Land Type

Land type is defined as an area of land on a particular landform segment, having a fairly homogeneous combination of soil and chronosequence of vegetation (Lacate, 1969).

The land types are identified in the field and grouped into areas where they recur in a recognizable pattern. These patterns are the Land Systems which were mapped in the Cormorant Lake area. The Land Systems were then grouped into Landscape Units of the basis of drainage basins, occurrence and kind of lakes and rivers.

On the following pages this hierarchical mapping system is illustrated by describing two Landscape Units, together with the land systems that compose them. The land types are shown in diagrams and in tables for each land system. A map showing the landscape units and land systems is located in the pocket of this report. A more complete description of physiographic features (slopes, parent material, etc.) is presented by Zoltai (1968).

The landscape units are identified on the map by a name, usually that of a dominant lake. The land systems are identified by a code, the first part identifying the broad physiographic province (ML - Manitoba Lowlands; CS - Canadian Shield). The numerals in the second part refer to particular combinations of geologic materials and relief classes (Zoltai, 1968). The letter 'P' indicates the presence of organic material modifying the mineral soil land. Placed before the numeral, it shows dominance of the peat, but following the numeral, it indicates that although the peat occupies large areas, it is not dominant. A lower case letter following the numeral indicates the petrography of the dominant mineral soil.

Land systems are identified by code rather than name as advised by Lacate (1969). In the Cormorant Lake area, 41 land systems were identified on the basis of mineral soil. As each pattern can and does occur in association with various amounts of peatland, some 120 land systems could be identified in this area alone. Naming these would certainly lead to confusion.

CHOCOLATE LANDSCAPE UNIT (103 sq. mi.)

Weakly to very weakly broken area of loamy till and clay till, with shallow loamy till over bedrock on some low plateaus and deep lacustrine clay in some flats. Peat plains occur in some depressions.

Land systems composing the land portion of this landscape unit are:

ML-P; ML-P45; ML-65; ML-76.

Lakes cover four per cent of the area. Lakes of various size classes* occupy the following proportion of the landscape unit:

Relatively small lakes: 2%
Small lakes: 2%

The lakes have regular to somewhat irregular shorelines. All lakes are shallow. The shore material is mainly organic matter, or, less frequently, bouldery till. The lakes are without open outlets, draining through bogs.

ROCKY LANDSCAPE UNIT (122 sq. mi.)

Weakly to very weakly broken area of deep to shallow loamy till over dolomitic bedrock, with lacustrine clay or clay till in flats or on slopes. Peat occupies depressions or large flats.

Land systems composing the land portion of the landscape unit are:

ML-P; ML-26; ML-P26; ML-P35; ML-P45; ML-49P; ML-66; ML-76

Lakes occupy 42% of the area. Lakes of various size classes cover the following proportion of the landscape unit:

Moderately large lakes: 35%
Relatively small lakes: 5%
Small lakes: 2%

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* The following size classes were used:

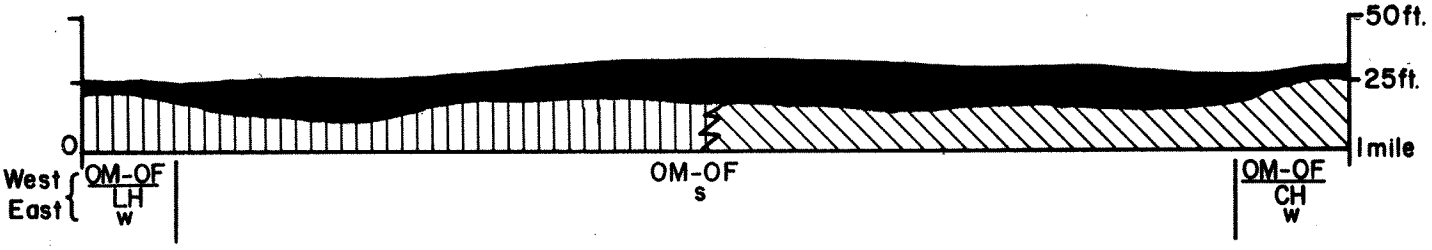
less than one square mile	- small lake
1-16 square miles	- relatively small lakes
16-50 square miles	- moderately large lakes
50-500 square miles	- large lakes
over 500 square miles	- very large lakes

The larger lakes are moderately deep, often with extensive shallow bays. These lakes drain through small rivers or creeks. Some small lakes are without open outlets and drain through bogs. The shorelines are irregular to somewhat irregular. The shore material is bouldery where till forms the shores. Flat to steep bedrock may form the shores on sections of some lakes. Organic matter is the shore material on large sections of some lakes.

Land System ML-P

Very weakly broken areas of deep to shallow mesic to fibric peat.

Example:



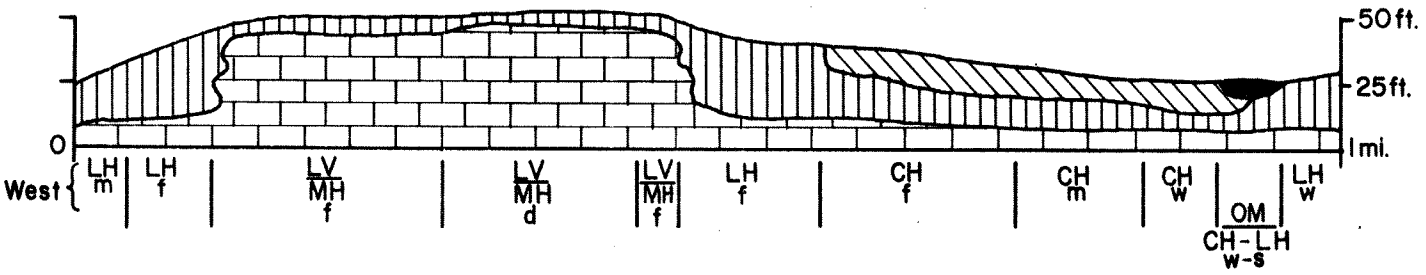
Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W*	E*				
OM-OF CH-LH w	Shallow mesic to fibric organic matter over clay or loam	wet	15	15	Chocolate Farewell Atik Iskwasum Reed Lake	Carex, bS	Carex,bS,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	85	85	Hargrave Claw Lake Rock Is.	Carex, bS	Carex,bS,eL	7W

*W and E refer to different Land Regions: West: Boreal, moist subhumid region.
East: Boreal-Arctic land region.

Land System ML-26

Very weakly broken plains of highly calcareous loamy till (ML-26h) and shallow very highly calcareous till over dolomitic bedrock; with flats of highly calcareous clay. Minor areas of shallow mesic peat over clay or loam.

Example:



Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W	E				
LV/MH d	Very highly calcareous loamy till over dolomitic bedrock	dry	15	-	Atikameg rock substrate phase	bS	jP	6RM
LV/MH f	As above	fresh	20	-	Atikameg rock substrate phase	tA,bS,wS	tA,bS; jP	5R
LH f	Highly calcareous loamy till	fresh	20	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	5	-	Chitek	tA,wS,bPo	tA,bS; bS	4
LH w	As above	wet	5	-	Dering	bPo,bS,wS	bS	5W
CH f	Highly calcareous lacustrine clay or clay till	fresh	15	-	Wabowden Sipiwesk Cedar Lake Wanless	tA,wS	tA,bS,jP	4
CH m	As above	moist	10	-	Roe Lake Dyce	tA,wS,bPo	tA,bS; bS	4
CH w	Highly calcareous lacustrine clay	wet	5	-	La Perouse Medard	bPo,bS,wS	bS	5W
OM/CH-LH w-s	Shallow mesic organic matter over clay or loam	wet to satur.	5	-	Chocolate Farewell	Carex, bS	Carex,bS,eL	7W

Land System ML-26P

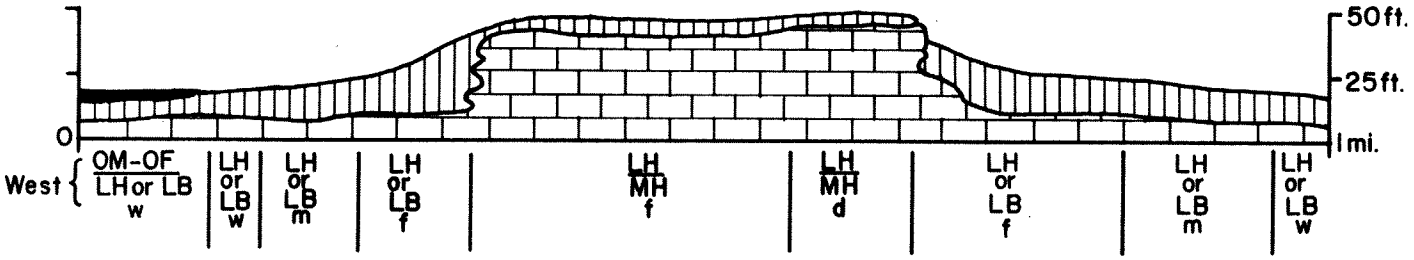
Very weakly broken plains of highly calcareous loamy till (ML-26Ph) and shallow very highly calcareous loamy till over dolomitic bedrock, with flats of highly calcareous clay. Deep to shallow mesic to fibric peat occurs in many flats.

Land Type			% area		Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	W	E				
Symbol	Geologic material							
LV/MH d	Very highly calcareous loamy till over dolomitic bedrock	dry	10	-	Atikameg rock substrate phase	bS	jP	6RM
LV/MH f	As above	fresh	20	-	Atikameg rock substrate phase	tA,bS,wS	tA,bS;jP	5M
LH f	Highly calcareous loamy till	fresh	10	-	Atikameg Westray	tA,bS,wS	tA,bS;jP	5M
LH m	As above	moist	10	-	Chitek	tA,wS,bPo	tA,bS;jP	4
LH w	As above	wet	5	-	Dering	bPo,bS,wS	bS	5W
CH f	Highly calcareous lacustrine clay or clay till	fresh	5	-	Wabowden Sipiwesk Cedar Lake Wanless	tA, wS	tA,bS,jP	4
CH m	As above	moist	5	-	Roe Lake Dyce	tA,wS,bPo	tA,bS;bS	4
CH w	Highly calcareous lacustrine clay	wet	10	-	La Perouse Medard	bPo,bS,wS	bS	6w
OM/CH-LH s-w	Shallow mesic organic matter over clay or loam	satur. to wet	5	-	Chocolate Farewell	Carex,bS	Carex,bS,eL	7W
OM s	Deep mesic organic matter	satur.	20	-	Rock Island	Carex,bS	Carex,bS	7W

Land System ML-35

Very weakly broken plains of highly calcareous loamy till (ML-35H) or low base loamy till (ML-35b), with plateaus of shallow highly calcareous loamy till over dolomitic bedrock. Minor areas of shallow fibric to mesic peat in some depressions.

Example:



Land Type								
Material		Moisture	% area		Soil	Stable vegetation	Common present vegetation	Forest capab'y
Symbol	Geologic material		W	E				
LH / MH d	Highly calcareous loamy till over dolomitic bedrock	dry	10	-	Atikameg rock substrate phase	bS	jP	6RM
LH / MH f	As above	fresh	25	-	Atikameg rock substrate phase	tA,bS,wS	tA,bS; jP	5R
LH f	Highly calcareous loamy till	fresh	25	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	20	-	Chitek	tA,wS,bPo	tA,bS; bS	4
LH w	As above	wet	10	-	Dering	bPo,bS,wS	bS	5W
OF-OM / LH,LB w	Shallow fibric to mesic organic matter over loam	wet	10	-	Iskwasum File Lake	bS,Carex,	bS,Carex, eL	7W

In Land system ML-35b

LB f	Low base loamy till	fresh	25	-	Fay Lake Angus	tA,bS,wS	tA,bS; jP	5M
LB m	As above	moist	20	-	Hat Lake	tA,wS,bF	tA,bS	4
LB w	As above	wet	10	-	Lost Lake	tA,bPo,bS	bS,tA	5W

Land System ML-35P

Very weakly broken plains of very highly calcareous loamy till (ML-35Pv), with plateaus of shallow very highly calcareous loam over dolomitic bedrock. Deep fibric to mesic peat occurs in many depressions. Minor areas of highly calcareous clay in some flats.

Land Type			% area		Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	W	E				
Symbol	Geologic material							
LV MH f	Very highly calcareous loamy till over dolomitic bedrock	fresh	-	15	Atikameg rock substrate phase	tA,bS,wS	tA,bS;jP	5R
LV f	Very highly calcareous loamy till	fresh	-	10	Atikameg	tA,bS,wS	tA,bS;jP	5ML
LV m	As above	moist	-	25	Chitek	tA,wS,bPo	tA,bS;bS	5L
LV w	As above	wet	-	25	Dering	bPo,bS,wS	bS	6W
CH w	Highly calcareous lacustrine clay	wet	-	5	La Perouse Medard	bPo,bS,wS	bS	6W
OF-OM	Deep fibric to mesic organic matter	satur.	-	20	Hargrave Claw Lake Rock Island	Carex,bS	Carex,bS	7W

Land System ML-P35

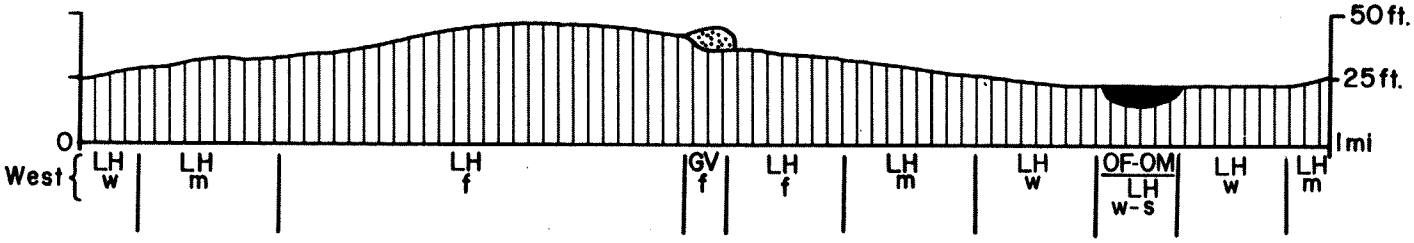
Very weakly broken plains of deep to shallow mesic to fibric peat over loam or clay. Low knolls of deep, highly calcareous loamy till and shallow loam over dolomitic bedrock. Minor areas of lacustrine clay in some flats.

Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W	E				
LV/MH f	Very highly calcareous loamy till over dolomitic bedrock	fresh	10	-	Atikameg rock substrate phase	tA,bS,wS	tA,bS;jP	5M
LH f	Highly calcareous loamy till	fresh	5	-	Atikameg Westray	tA,bS,wS	tA,bS;jP	4
LH m	As above	moist	5	-	Chitek	tA,wS,bPo	tA,bS;bS	4
LH w	As above	wet	5	-	Dering	bPo,bS,wS	bS	5W
CH w	Highly calcareous lacustrine clay	wet	5	-	La Perouse Medard	bPo,bS,wS	bS	5W
OM-OF/LH-CH w	Shallow mesic to fibric organic matter over loam or clay	wet	25	-	Atik Iskwasum Reed Lake Loonhead	bS,Carex	bS,Carex,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	45	-	Hargrave Claw Lake Rock Island	Carex,bS	Carex,bS	7W

Land System ML-45

Very weakly broken plains of highly calcareous loamy till (ML-45h). Minor areas of shallow fibric to mesic peat in some depressions; very highly calcareous beach sand and gravel in some low ridges.

Example:



Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W	E				
GV f	Very highly calcareous beach sand and gravel	fresh	3	-	Woodridge	bS,tA,wB	jP; bS,jP	5M
LH f	Highly calcareous loamy till	fresh	42	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	25	-	Chitek	tA,wS,bPo	tA,bS; bS	4
LH w	As above	wet	25	-	Dering	bPo,bS,wS	bS	5W
OF-OM LH w-s	Shallow fibric to mesic organic matter over loam	wet to satur.	5	-	Farewell Loonhead Iskwasum	Carex, bS	Carex,bS,eL	7W

Land System ML-45P

Very weakly broken plains of highly calcareous till (ML-45Ph) or very highly calcareous loamy till (ML-45Pv), with deep to shallow mesic to fibric peat in many depressions. Minor areas of highly calcareous clay in some flats.

Land Type					Soil	Stable vege-tation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W	E				
LV f	Very highly calcareous loamy till	fresh	-	10	Atikameg	tA,bS,wS	tA,bS;jP	5ML
LV m	As above	moist	-	25	Chitek	tA,wS,bPo	tA,bS;bS	5L
LV w	As above	wet	-	20	Dering	bPo,bS,wS	bS	6W
LH f	Highly calcareous loamy till	fresh	20	-	Atikameg Westray	tA,bS,wS	tA,bS;jP	4
LH m	As above	moist	15	-	Chitek	tA,wS,bPo	tA,bS;bS	4
LH w	As above	wet	20	-	Dering	bPo,bS,wS	bS	5W
CH w	Highly calcareous lacustrine clay	wet	5	5	La Perouse Medard	bPo,bS,wS	bS	5W (W) 6W (E)
OM-OF LH w-s	Shallow mesic to fibric organic matter over loam	wet to satur.	25	25	Iskwasum Loonhead Farewell	bS,Carex	bS,Carex,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	15	15	Hargrave Rock Island	Carex,bS	Carex,bS	7W

Land System ML-P45

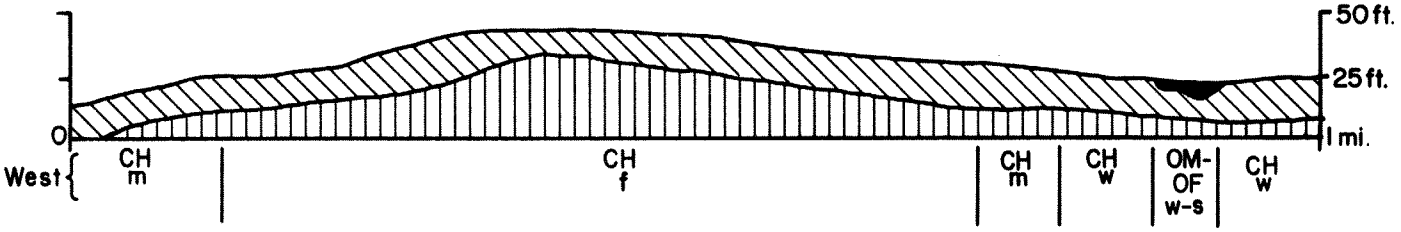
Very weakly broken plains of deep to shallow mesic to fibric peat, with low knolls of highly calcareous loamy till (ML-P45h) or very highly calcareous loamy till (ML-P45v). Minor areas of highly calcareous clay in some flats.

Land Type			% area		Soil	Stable vege-tation	Common present vegetation	Forest capab'y
Material		Moisture	W	E				
Symbol	Geologic material							
LV f	Very highly calcareous loamy till	fresh	-	3	Atikameg	tA,wS,bS	tA,bS;bS	5ML
LV m	As above	moist	-	15	Chitek	tA,wS,bPo	tA,bS;bS	5L
LV w	As above	wet	-	5	Dering	bPo,bS,wS	bS	5W
LH f	Highly calcareous loamy till	fresh	8	-	Aitkameg Westray	tA,bS,wS	tA,bS;jP	4
LH m	As above	moist	10	-	Chitek	tA,wS,bPo	tA,bS;bS	4
LH w	As above	wet	5	-	Dering	bPo,bS,wS	bS	5W
CH m	Highly calcareous lacustrine clay or clay till	moist	2	2	Roe Lake Dyce	tA,wS,bPo	tA,bS;bS	4
OM-OF / LH,LV w	Shallow mesic to fibric organic matter over loam	wet	25	25	Iskwasum Loonhead Farewell	bS,Carex	bS,Carex,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	50	50	Hargrave Rock Island	Carex,bS	Carex,bS	7W

Land System ML-49

Very weakly broken plains of highly calcareous clay (ML-49h) flats and slopes. Minor areas of deep to shallow mesic to fibric peat in some depressions.

Example:



Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material			% area					
Symbol	Geologic material	Moisture	W	E				
CH f	Highly calcareous lacustrine clay or clay till	fresh	60	-	Wabowden Sipiwesk Cedar Lake Wanless	tA, wS	tA,bS,jP	4
CH m	As above	moist	20	-	Roe Lake Dyce	tA,wS,bPo	tA,bS; bS	4
CH w	Highly calcareous lacustrine clay	wet	15	-	La Perouse Medard	bPo,bS,wS	bS	5W
OM-OF / CH w-s	Shallow mesic to fibric organic matter over clay	wet to	3	-	Reed Lake Chocolate Atik	Carex, bS	Carex,bS,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	2	-	Kiskitto Rock Island Hargrave	Carex, bS	Carex, bS	7W

Land System ML-49P

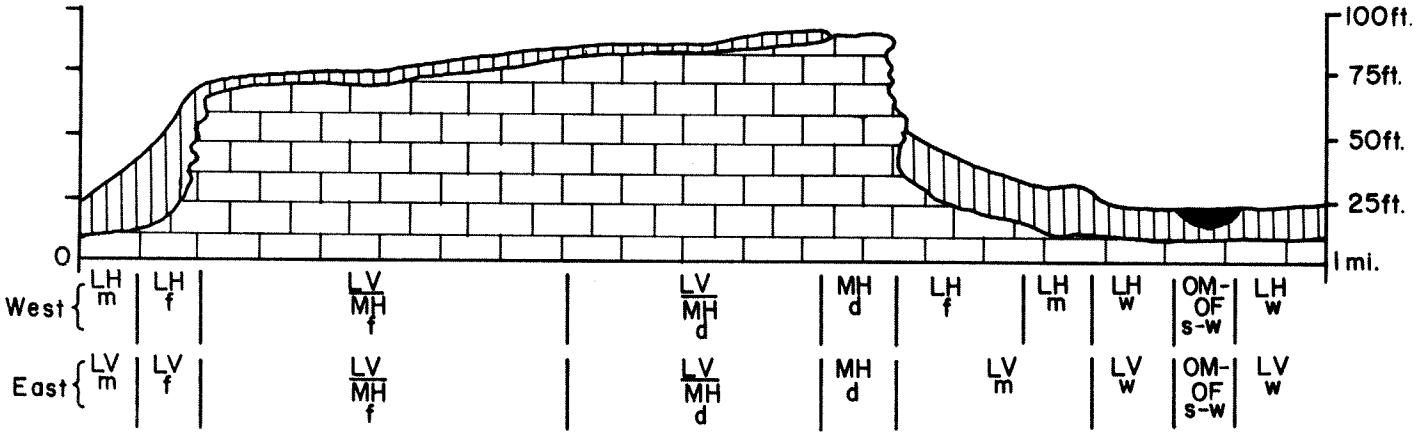
Very weakly broken plains of highly calcareous clay (ML-49Ph) with deep mesic to fibric peat in many depressions. Minor areas of shallow fibric to mesic peat over clay in some depressions.

Land Type					Soil	Stable vegetation	Common present vegetation	Forest capab'y
Material		Moisture	% area					
Symbol	Geologic material		W	E				
CH m	Highly calcareous lacustrine clay or clay till	moist	20	-	Roe Lake Dyce	tA,wS,bPo	tA,bS;bS	4
CH w	Highly calcareous lacustrine clay	wet	50	-	La Perouse Medard	bPo,bS,wS	bS	5W
OF-OM CH w-s	Shallow fibric to mesic organic matter over clay	wet to satur.	5	-	Reed Lake Chocolate Atik	Carex,bS	Carex,bS,eL	7W
OM-OF s	Deep mesic to fibric organic matter	satur.	25	-	Kiskitto Rock Island Hargrave	Carex,bS	Carex,bS	7W

Land System ML-65

Weakly broken areas of plateaus and low escarpments of shallow very highly calcareous loamy till over dolomitic bedrock, with slopes and flats of deep highly calcareous loamy till (ML-65h) or very highly calcareous loamy till (ML-65v). Minor areas of bare dolomitic bedrock; shallow to deep mesic to fibric peat in some flats.

Example:

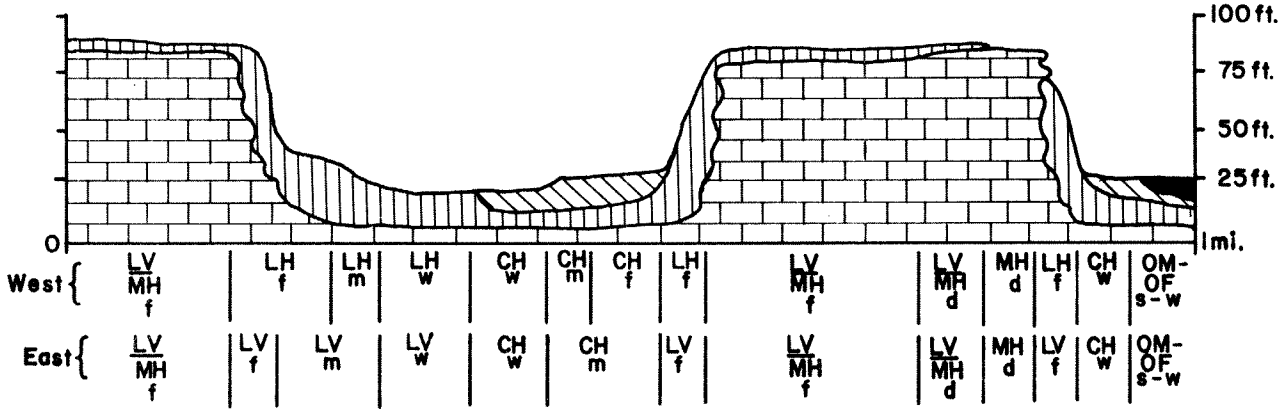


Land System								
Material			% area					
Symbol	Geologic material	Moisture	W	E	Soil	Stable vegetation	Common present vegetation	Forest capab'y
MH d	Dolomitic bedrock moderately resistant to weathering	dry	5	5	Rock outcrop	jP	jP	7RM
LV/MH d	Very highly calcareous loamy till over dolomitic bedrock	dry	20	20	Atikameg rock substrate phase	bS	jP	6RM
LV/MH f	As above	fresh	30	30	Atikameg rock substrate phase	tA,bS,wS	tA,bS; jP	5R
LV f	Very highly calcareous loamy till	fresh	-	5	Atikameg	tA,bS,wS	tA,bS; jP	5ML
LV m	As above	moist	-	20	Chitek	tA,wS,bPo	tE,bS; bS	5L
LV w	As above	wet	-	15	Dering	bPo,bS,wS	bS	6W
LH f	Highly calcareous loamy till	fresh	15	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	10	-	Chitek	tA,wS,bPo	tA,bS; bS	4
LH w	As above	wet	15	-	Dering	bPo,bS,wS	bS	5W
OF-OM/LH,LV s-w	Shallow fibric to mesic organic matter over loam	wet to satur.	5	5	Iskwasum Farewell Loonhead	bS,Carex	bS,Carex,eL	7W

Land System ML-66

Weakly broken areas of plateaus, knolls and slopes of shallow very highly calcareous loamy till over dolomitic bedrock and deep highly calcareous loamy till (ML-66h), or very highly calcareous loamy till (ML-66v). Deep highly calcareous clay occurs in some flats. Minor areas of deep to shallow mesic to fibric peat in some depressions; bare bedrock outcrops on some plateaus.

Example:

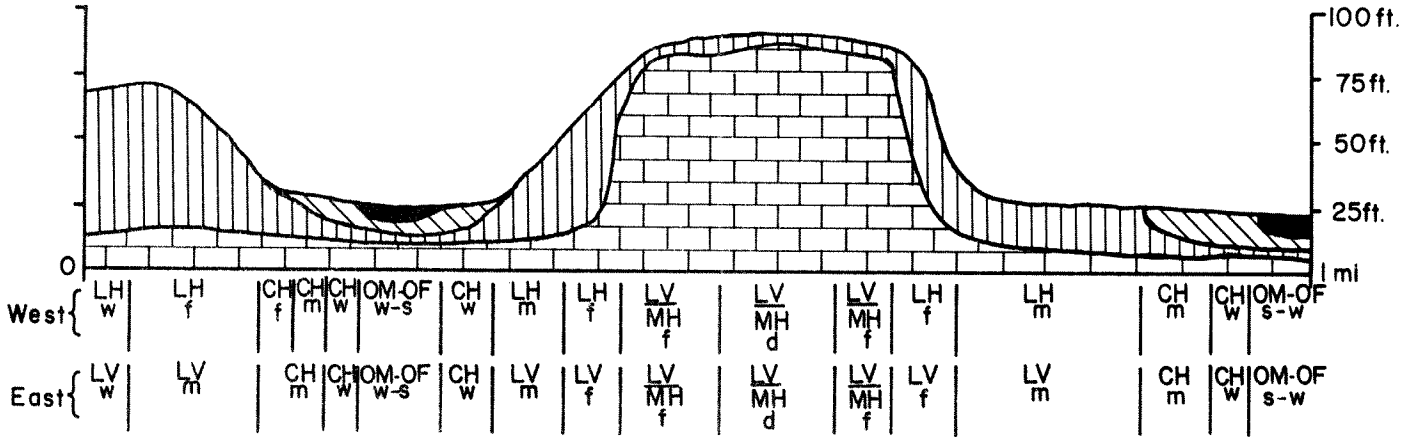


Land Type								
Material			% area					
Symbol	Geologic material	Moisture	W	E	Soil	Stable vegetation	Common present vegetation	Forest capab'y
MH d	Dolomitic bedrock, moderately resistant to weathering	dry	5	5	Rock outcrop	jP	jP	7RM
LV/MH d	Very highly calcareous loamy till over dolomitic bedrock	dry	5	5	Atikameg, rock substrate phase	bS	jP	6RM
LV/MH f	As above	fresh	35	35	Atikameg rock substrate phase	tA,bS,wS	tA,bS; jP	5R
LH f	Highly calcareous	fresh	15	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	5	-	Chitek	tA,wS,bPo	tA,bS; bS	4
LH w	As above	wet	10	-	Dering	bPo,Bs,wS	bS	5W
LV f	Very highly calcareous loamy till	fresh	-	10	Atikameg	tA,bS,wS	tA,bS; jP	5ML
LV m	As above	moist	-	10	Chitek	tA,wS,bPo	tA,bS; bS	5L
LV w	As above	wet	-	10	Dering	bPo,bS,wS	bS	6W
CH f	Highly calcareous lacustrine clay or clay till	fresh	5	-	Wabowden Sipiwesk Cedar Lake Wanless	tA,wS	tA,bS,jP	4
CH m	As above	moist	5	10	Roe Lake Dyce	tA,wS,bPo	tA,bS; bS	4
CH w	Highly calcareous lacustrine clay	wet	10	10	La Perouse Medard	bPo,bS,wS	bS	5W (W) 6W (E)
OM-OF s-w	Deep (and shallow) mesic to fibric organic matter	satur. to wet	5	5	Hargrave Rock Island	Carex, bS	Carex, bS	7W

Land System ML-76

Weakly broken areas of deep highly calcareous loamy till (ML-76h) or very highly calcareous loamy till (ML-76v), with plateaus of shallow, very highly calcareous loamy till over dolomitic bedrock. Deep highly calcareous clay occurs in flats. Minor areas of shallow to deep mesic to fibric peat in some depressions.

Example:



Land Type: Material Symbol	Land Type: Material Geologic material	Moisture	% area W	% area E	Soil	Stable vegetation	Common present vegetation	Forest capab'y
LV/MH d	Very highly calcareous loamy till over dolomitic bedrock	dry	10	10	Atikameg rock substrate phase	bS	jP	6RM
LV/MH f	As above	fresh	15	15	Atikameg rock substrate phase	tA,bS,wS	tA,bS; jP	5R
LV f	Very highly calcareous loamy till	fresh	-	10	Atikameg	tA,bS,wS	tA,bS; jP	5ML
LV m	As above	moist	-	25	Chitek	tA,wS,bPo	tA,bS; bS	5L
LV w	As above	wet	-	5	Dering	bPo, bS,wS	bS	6W
LH f	Highly calcareous loamy till	fresh	25	-	Atikameg Westray	tA,bS,wS	tA,bS; jP	4
LH m	As above	moist	10	-	Chitek	tA,wS,bPo	tA,bS; jP	4
LH w	As above	wet	5	-	Dering	bPo,bS,wS	bS	5W
CH f	Highly calcareous lacustrine clay or clay till	fresh	5	-	Wabowden Sipiwesk Cedar Lake Wanless	tA,wS	tA,bS,jP	4
CH m	As above	moist	10	15	Roe Lake Dyce	tA,wS,bPo	tA,bS; bS	4
CH w	Highly calcareous lacustrine clay	wet	10	10	La Perouse Medard	bPo,bS,wS	bS	5W(W) 6W(E)
OM-OF w-s	Mesic to fibric organic matter	wet to satur.	10	10	Chocolate Hargrave Moose Lake	Carex, bS	Carex,bS	7W

Land Evaluation

The purpose of the Bio-Physical land classification is to provide a delineation of land areas meaningful for the evaluation and management of renewable natural resources. The preliminary map and descriptions of the Cormorant Lake area were used by the members of the Canada Land Inventory teams as a basis for their field investigations. Forestry, agriculture, ungulate wildlife, sports fishing, recreation capability were studied in 1968, and waterfowl capability is to be evaluated in 1969. Personal contact with experts in various disciplines was kept to a minimum (a briefing lasting 2 hrs.) to evaluate the effectiveness of the presentation. The following are the comments from various disciplines.

Forest capability

P. Gimbarzevsky
Chief, Resource Development,
Spartan Air Services Ltd.,
Western Division,
Calgary, Alberta

The preliminary bio-physical report and maps were used quite extensively in our forest land capability classification of the Cormorant Lake area in Manitoba. Some brief comments follow:

1. Land systems provide basic information on soil characteristics (depth, texture, and mineralogical composition), drainage and topographic features - the most important factors in determination of biological productive capacity.

2. Physiography, surface geology and past glacial history of the area have been extremely useful in the initial planning of field investigations and familiarization with the working area.

3. As a result of information available from the geophysical map our field work has been considerably reduced, to about 50% of the original estimate.

4. A further reduction of field work may be obtained if field data could be given for each land system checked on the ground.

Agricultural capability

G.C. Jenkins
Chief, Agriculture Sector,
Canada Land Inventory for Manitoba,
Winnipeg, Manitoba

The information provided by the bio-physical classification report and map in the Cormorant Lake area was most helpful in pinpointing areas that may hold interest for agriculture. Vast acreages on this map sheet have little agricultural capability, but the soils suitable for agriculture are shown on the map. These areas are examined in greater detail, saving a great deal of time and effort. Such information as to

the depth of materials, kind of materials and drainage condition gives us a good picture of what we can expect to find in the area. In inaccessible areas such as the Cormorant Lake area we can conduct spot checks in the field and then extrapolate this information to areas indicated as similar by the Bio-physical survey.

Ungulate capability

R.C. Goulden
Chief, Wildlife Sector,
H.D. Goulden
Wildlife Biologist,
Canada Land Inventory for Manitoba,
Winnipeg.

1. Comprehensive descriptions of the physical characteristics of land as provided in the text of S.C. Zoltai's "Preliminary Cormorant Lake Report" are extremely useful and in fact essential for wild ungulate capability mapping in that area. Information of this type and in this detail is a minimum prerequisite if a meaningful wild ungulate capability classification is to be undertaken in northern Manitoba.

2. The delineated 'landscape units" are a good basis for initial broad separations and classification of ungulate capability types. However, these landscape units (while useful in the above context) are not always meaningful in terms of ungulate capability. For example, riparian areas are sometimes included in units containing large dissimilar inland areas. In general, ungulate capability is higher in riparian terrain than in large inland tracts, therefore, in ungulate mapping these two types of areas should be separated. Sometimes it is possible to accomplish this at the next level of detail, the 'land system' level.

3. A discussion on the area's ecological characteristics to compliment information on physical attributes would weld this report into an invaluable tool for the wild ungulate capability classification program.

Waterfowl capability

G.D. Adams
Wildlife Biologist,
Canadian Wildlife Service,
Dept. of Indian Affairs and Northern Development,
Winnipeg, Manitoba

The following features of the Bio-physical system are very useful:

1. Landscape units appear to group important features such as distribution patterns of land and water into significant primary units for waterfowl capability classes. A further breakdown of the landscape unit into smaller units for classification may often be desirable. Further subdivision will probably be on the basis of distribution of size classes,

wetland types, and relative fertility of waters, rather than according to land systems. However, preliminary samples of total dissolved solids indicate a general uniformity of values in small lakes within the landscape unit.

2. The proportions of the different geological materials are useful. There appears to be a good correlation between lacustrine clay deposits, water fertility, and duck use.

3. The macrorelief classes signify areas on the Canadian Shield where we can expect to locate relatively more waterfowl habitat units. For example, the very weakly broken areas tend to include more shallow lakes with gently sloping shorelines which are more suitable for waterfowl use.

4. The percentage of the moisture regimes, while highly variable within the landscape unit, is useful to compare different land units in respect to the occurrence of wet and saturated soils.

5. The proportion of the landscape units occupied by lakes, and especially the breakdown of the lakes into size classes is useful for comparison. However, it would be desirable to describe interspersion classes and have at least one further subdivision in the size classes to designate small lakes or potholes of a few acres in area. These smaller lakes have a higher ratio of shoreline length to area, and in general are used more frequently by breeding birds.

6. The descriptions of the lakes in regard to relative depths and the nature of the shorelines eliminates a number of field observations.

7. More attention should be paid to describing the dominant wetland types such as bog, fen, marsh, etc., and to describing the shoreline characteristics of open waters.

Sports Fish capability

A.N. Fedoruk
Biologist
Chief, Sports Fish Sector
Canada Land Inventory for Manitoba,
Winnipeg, Manitoba

A meaningful mapping unit for conveying fish capability information is a natural division of a drainage basin, or watershed. Within each basin surface water follows a system of water courses in which water behaviour is distinctly related to the physical characteristics of that basin. The landscape boundaries identified by the Bio-Physical classification system approximate the boundaries of the drainage divisions. The landscape unit frequently corresponds to lowest level of drainage division or watershed unit which is convenient for mapping fish capability. In this respect, the Bio-Physical system adequately serves fish capability studies.

Information on the land (particularly soils) within a landscape unit provide information which may infer water quality conditions. It remains a matter for limnologists to co-relate soil information with fertility levels of lakes and streams.

Fish capability interpretations could nearly be completed from bio-physical information if some measure of lake morphometry and stream flow characteristics were also provided.

Recreation capability

R. Peiluck
Chief, Recreation Sector,
Canada Land Inventory for Manitoba,
Winnipeg, Manitoba

Outdoor recreation is usually site-oriented, being centered on lands of outstanding or unique recreation values that are amenable to intensive recreational use. The Bio-Physical system does not identify these sites, although it draws attention to potential sites, as scenic, high relief areas and sandy beaches. As less intensive recreational use of land, fishing and hunting are of the greatest importance in the north. Hence it can be said that if the classification system is useful for evaluating the wildlife and sports fishing capability of the land, it is significant in evaluating the recreational capabilities of the various areas.

General comments

Two groups of land users can be recognized: those centered on the land portion of the landscape (forestry, agriculture) and those centered on the water (waterfowl, fish and recreation). Upland game occupies a position between these groups. Their comments clearly reflect these basic differences: the classification was most useful to those centered on land. Much more information is provided on the quality of the land than the water, and much of the information is relevant to capability of the land for growing plants.

Considering the scanty data given on water bodies, the landscape units proved to be useful, although for fish capability a simple watershed delineation might be equally meaningful. The importance of fishing, trapping and hunting increases in the north in relation to forestry or agriculture. This should serve as a warning to devote more attention to waterbodies, if the Bio-Physical classification is to be successful in these areas.

References

Brown, R.J.E. 1965. Permafrost investigations in Saskatchewan and Manitoba. Nat. Res. Council Div. of Bldg. Res., Tech. Paper 193, 36 p.

Hills, G.A. 1966. The classification of land for multiple use. In: Proceedings of National Committee on Forest Land, Canada Dept. of Forestry. p. 71-75.

Lacate, D.S. 1969. Guidelines for Bio-Physical land classification. (Progress Report). Canada Dept. of Forestry and Rural Development. 46 p.

Zoltai, S.C., J.P. Senyk, P. Gimbarzevsky, A. Kabzems. 1967. Land capability classification for forestry, Manitoba and Saskatchewan. In Land capability classification for forestry, R.J. McCormack, ed., Dept. of Forestry and Rural Development, Canada Land Inventory, Rept. No. 4:10-13.

Zoltai, S.C. 1968. Preliminary report on the Cormorant Lake pilot project, Manitoba. Canada Dept. of Forestry and Rural Development, Canada Land Inventory, Progress Report. p. 41-127.