Agriculture and Agri-Food Canada
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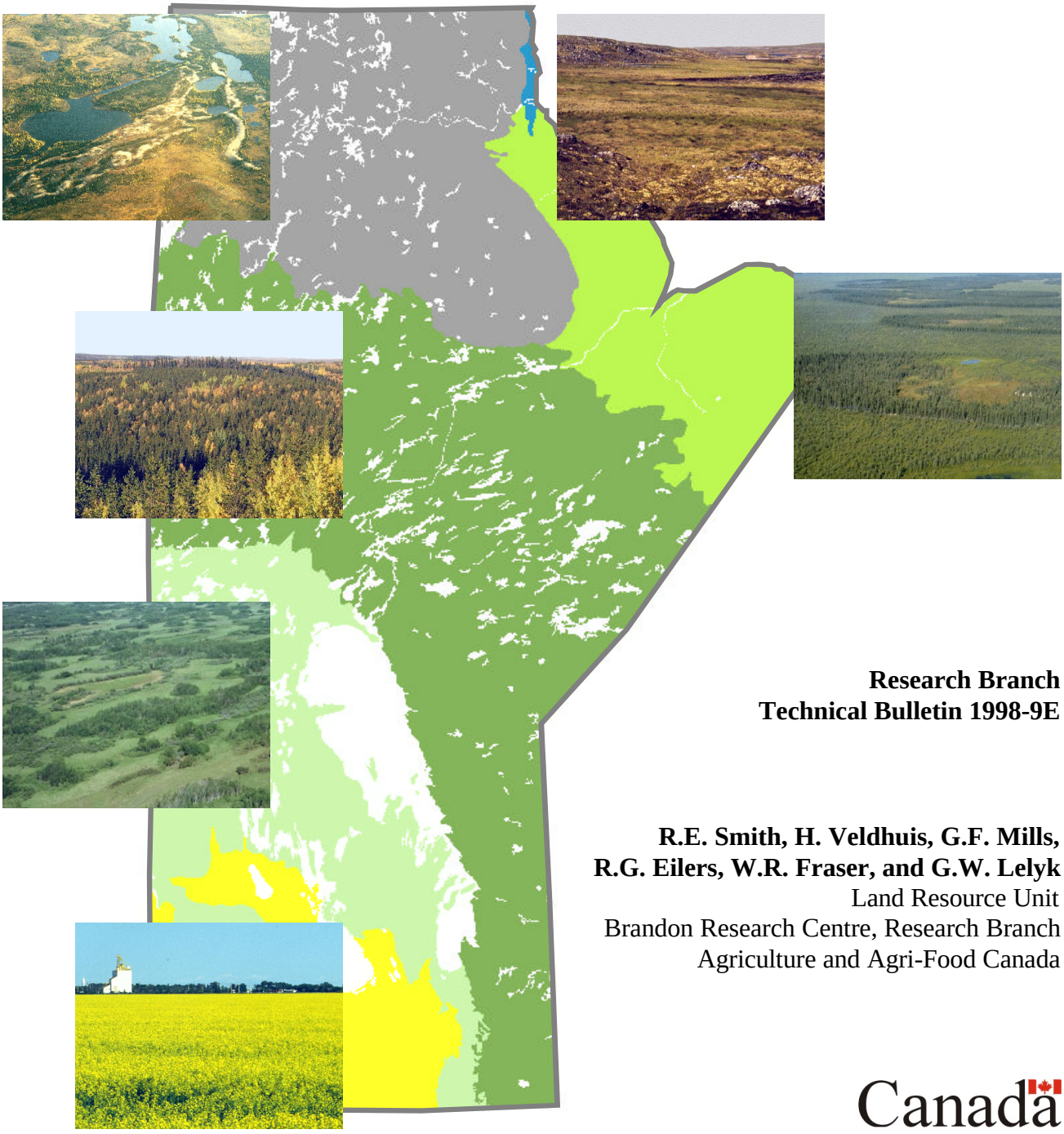
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



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Taiga Shield Ecozone

The Taiga Shield Ecozone lies on either side of Hudson Bay. The eastern segment occupies the central part of Quebec and Labrador, and the western segment occupies portions of northern Manitoba, Saskatchewan, Alberta and the south-eastern area of the continental Northwest Territories, and the southern part of Nunavut. Characteristic of the zone are the open and often stunted conifer dominated forests, and the Precambrian shield with its shallow soils and many lakes.

Climate

The ecoclimate of the ecozone is classified as Subarctic, which is characterized by relatively short summers with prolonged daylight, and long, very cold winters. Mean annual temperature in the area west of Hudson Bay is as low as -9.0°C, but it ranges from -1°C to -5°C in Quebec and Labrador, with some areas in Labrador having mean annual temperatures as high as 1°C. A few degrees of frost is a common occurrence in summer, especially in areas with the stronger continental climate conditions.

Mean annual precipitation ranges from 200 to 500 mm west of Hudson Bay, while east of Hudson Bay it ranges from 500 to 800 mm, to over 1000 mm locally along the Labrador coast.

Selected Climate Data[1] (Annual Means) for the Taiga Shield Ecozone

Station	Temperature (°C)	Precipitation			Degree Days (>5°C)	Frost Free Period (days)
		Rain(mm)	Snow(cm)	Total(mm)		
Brochet A	-4.9	261.8	167.5	427.1	952.0	97.0
Ennadai Lake	-9.3	173.7	117.1	266.7	595.0	78.0
Uranium City A	-3.5	204.9	197.9	344.8	1111.0	106.0
Yellowknife A	-5.4	150.2	135.4	266.7	1027.0	111.0

[1] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Surficial deposits and landforms

Most of this ecozone consists of broadly rolling uplands and lowlands. The main surface materials are Precambrian bedrock outcrops and till deposits in the form of discontinuous veneers and blankets, and hummocky and ridged moraine. Ridged fluvioglacial deposits are widespread, and occur frequently as groups of eskers with associated kettle lakes, forming some of the more distinctive landscape features in this ecozone. Some glaciolacustrine and marine deposits are also present. The glaciolacustrine deposits are mostly associated with larger lakes and were deposited when these lakes were much larger and deeper.

There are many lakes of varying sizes, commonly with irregular bedrock-controlled shorelines. Permafrost is discontinuous but widespread. Lowlands are commonly waterlogged or wet for prolonged periods and frequently contain shallow and moderately deep peatlands.

Soils

Brunisolic soils are dominant in the southern portion of the ecozone west of Hudson Bay, while Humo-Ferric Podzolic soils are dominant in the southern portion east of Hudson Bay. Cryosols are dominant in the northern parts, while in the central area, Cryosolic soils and Brunisolic or Podzolic soils are co-dominant. Gleysols and Organic Cryosols occur throughout the ecozone and are found mainly in the lowland areas.

Vegetation

General vegetative characteristics are notably governed by latitude. The changes are generally gradual, but become significant when compared over a large distance. Because of the extent of this ecozone, and because it forms the transition from the extensively forested Boreal Shield Ecozone to the south to the treeless Southern Arctic Ecozone to the north, the vegetation of this ecozone varies dramatically between its northern and southern sectors.

In the northern half of the ecozone, normal (or mesic) sites generally support very open stands of black spruce and tamarack, with white spruce often part of the community. Ground cover is dominated by dwarf birch, willows, northern Labrador tea, cotton grass, mosses and lichens. Drier sites have open stands of white spruce with a ground cover of various ericaceous shrubs, dwarf birch, mosses and lichens. The lichen component is dominated by the Cladina species.

Areas with tree cover are often intermixed with areas of low shrub-tundra vegetation as found in the Southern Arctic Ecozone. These areas of tundra become less frequent toward the south. Poorly drained areas are dominated by tussock sedge and cotton grass along with sphagnum moss. Along rivers, and especially in sheltered valleys, stands of white spruce, balsam poplar and paper birch are found.

In the southern half of the ecozone, the forest cover becomes increasingly more dense with taller trees, with the decrease in latitude. Paper birch becomes more common especially in recently burned areas, while stands of white spruce, paper birch and trembling aspen may be found on warmer, protected sites. Lowland areas have bog-fen complexes. Bog vegetation is composed of black spruce, Labrador tea, Vaccinium species, bog rosemary, and cloudberry, while the fen vegetation is dominated by sedges and brown mosses.

Wildlife

The ecozone provides winter range for several major herds of barren-ground caribou. Other characteristic wildlife include arctic fox in northern areas, polar bear along the coast, moose, wolf, black bear, grizzly bear in the western sector, and brown lemming and weasel.

Representative birds include arctic and red-throated loons, northern phalarope, northern shrike, osprey, tree sparrow, raven, spruce grouse and grey-cheeked thrush. In the marine environment seals are characteristic. Several fish species, including lake trout, arctic grayling, whitefish and northern pike, are found in lakes and streams.

Land use

The population of the ecozone is about 34,000, of which about 60 percent is aboriginal. Most of the population is concentrated in the few permanent settlements. Yellowknife, with a population of about 12,000 (1991), is the largest. The oldest settlements were established along the coast during the era of fur trade and whaling. Most of the more recent settlements were founded as a result of mining and hydro-electric developments.

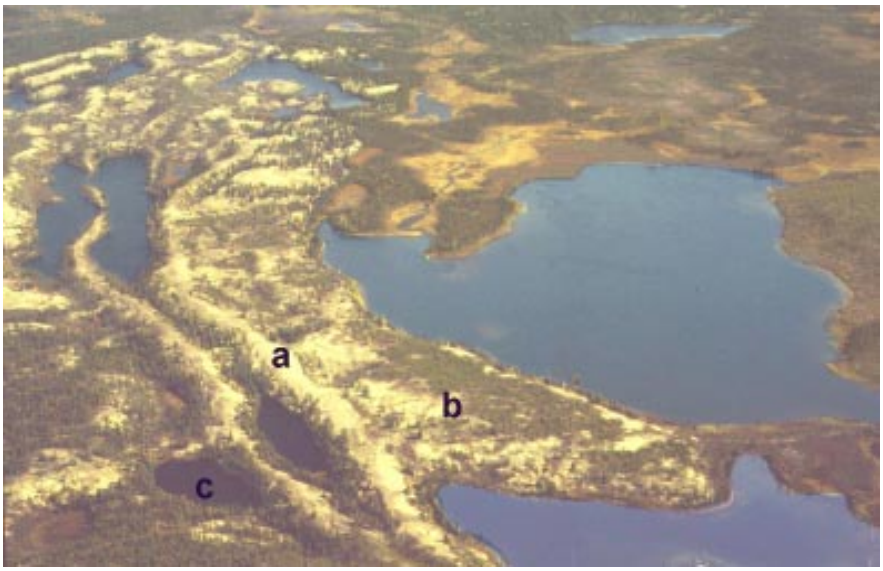
Economic activity is associated primarily with mining and hydro development, government and private service industry, and construction. In a number of southern sectors, forestry provides employment. Tourism is a growing industry and several lodges operate in the ecozone. Although most of the population is found in urban areas, subsistence hunting, fishing and trapping remain important land uses.

There are two ecoregions within the Taiga Ecozone in Manitoba.

The Kazan River Upland Ecoregion

The Kazan River Upland Ecoregion is part of the broad transitional zone between Boreal and Arctic, usually referred to as the Subarctic. The treeline marks its northern boundary, while the closed canopy forest of the northern Boreal marks its southern boundary. The Subarctic is a mixture of treeless tundra and stands of stunted trees. The barren-ground caribou migrates between the northern Boreal or southern Subarctic forest and the northern Subarctic or southern Arctic “Barren Lands”.

Figure TS1.
Esker complex. Extensive glaciofluvial sand and gravel deposits in the form of eskers, kames, esker-kame complexes, interlobate moraines, outwash plains etc. occur in northern Manitoba, in adjacent Nunavut, and in the Northwest Territories. Shown are two large eskers and their bordering aprons. The lakes closely associated with the esker complex are called kettle lakes. Lichen vegetation and exposed sand and gravel give the light yellow colour to the eskers. Permafrost may or may not be present in the crest and upper slope positions due to the coarse texture of materials, lack of a substantial organic surface layer and/or the lack of vegetation. If permafrost is present, the active layer is deep (>100 cm). On the lower slopes, mosses and/or shallow peat provide insulation, resulting in widespread permafrost with shallower active layers. Under Subarctic climatic conditions, Dystric Brunisolic soils are commonly found on the crests and Static Cryosolic soils occur on the lower slopes of these landforms.



Legend: Esker (a); esker apron (b); kettle lake (c)

Plate TS2.
Snow blasted trees. High winds in the tundra environment will drive hard snow particles with great force. As a result exposed trees often lack branches and needles along part of their stem where the snow blasting is most severe. Close to the ground the branches are dense with needles as this area is protected by the snow cover. About 1.0 m to 1.5 m above ground level the snow blasting effect is less severe allowing branches to form.

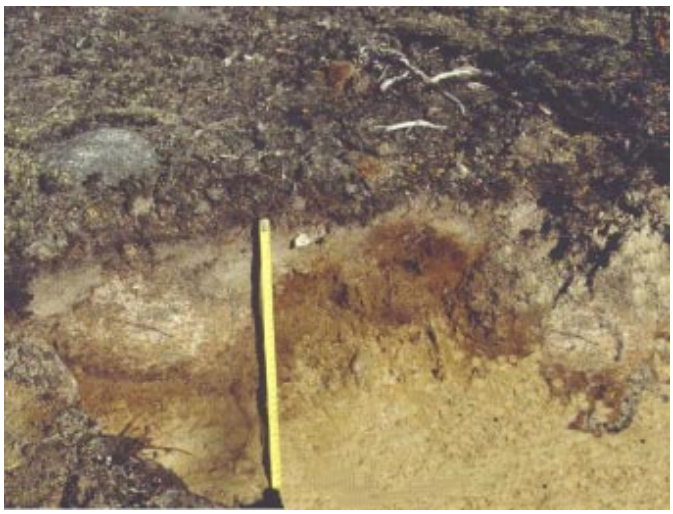
Plate TS3.
Side slope of esker. Trees and shrubs growing on lee side. The crests of eskers remain largely free of snow during the winter. Non-vegetated sections and blowouts are common. The lee side and depressions offer protection from strong winds, and the accumulation of snow provides additional protection and moisture. As a result, these sites are the areas where trees and tall shrubs find a foothold.

Plate TS4.
Drumlins. Drumlins are streamlined hills consisting of glacial drift. Their long axis, which can be several hundred metres long, is parallel to the direction of flow of the ice sheet that formed them. They may stand over 30 m above the surrounding terrain. The crests are generally dry and covered with tundra vegetation, while the slopes have more lush shrub vegetation. Permafrost is generally found throughout their extent, but active layers are deeper on the crests than on the slopes. Although they often occur in groups, the drumlins within a group can vary considerably in length and elevation. Several large drumlins are visible in the photo, but some low subdued drumlins are also present in the right foreground.

Plate TS5.

Nonsorted circle in till. Circles are a form of patterned ground. They are formed when thawing and freezing during the fall and spring causes hydrostatic and cryostatic pressures to develop, forcing soil material to the surface. Nonsorted circles lack a rim of coarse fragments around the circle centre which is a characteristic of sorted circles. Both types have strongly cryoturbated soils. Circles may not be active each year; sometimes they become active after many years of dormancy due to changing moisture conditions.

Plate TS6.



Orthic Dystric Turbic Cryosol. These soil are common throughout the Taiga Shield Ecozone. They have developed on sandy loam to loamy sand textured till materials derived from the Precambrian Shield. The materials are slightly to medium acid and contain quantities of small to very large coarse fragments. In this soil, a brown B horizon has developed, but this horizon has been disrupted through cryoturbation, resulting in the mixing of some of the B horizon material with unaltered parent material, and the movement of some organic material from the surface deeper into the soil.

Plate TS7.

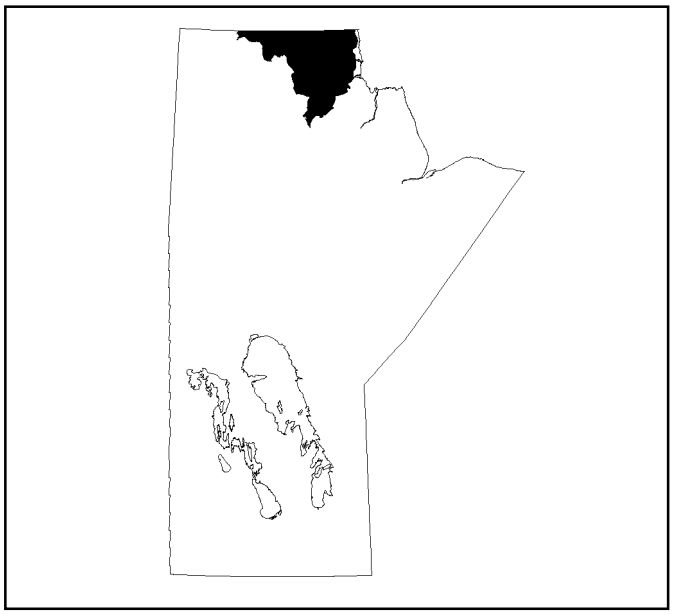
Frost-heaved boulder. Frost-heaved boulders and frost-heaved bedrock fragments are common. In some areas, the coarse bedrock fragments at the surface are so plentiful that these areas are referred to as block-fields. Coarse fragments are heaved to the surface through the formation of ice lenses below the fragments. The formation of the ice lens, which occurs before all of the soil material is frozen, pushes the boulder a short distance closer to the surface. Although the ice lens melts during the summer, the fragments are prevented from slipping back to their previous position by soil material that has slumped into the cavity or by adhesion to the surrounding soil material. Eventually, after many freeze and thaw cycles, the fragments will breech the surface as shown here. Some of the boulder surface is still covered by soil material. The boulder will continue to be heaved until it is on the surface. On inclined surfaces, these boulders may also be moved downslope.

Plate TS8.
The Tyrrell Sea "Great Beach". The Taiga Shield Ecozone in Manitoba is in part bordered by a complex of Tyrrell Sea beaches, the so-called "Great Beach". After the Wisconsin Continental Ice Sheet vacated the area, the Tyrrell Sea invaded and formed a significant beach complex along its western border. The beaches are largely composed of well drained sands. However, the lower slopes, especially on the eastern side, are masked by deep, permanently frozen peat deposits (peat plateau bogs). The vegetation on the beaches is characterized by open stands of white spruce with an extensive cover of reindeer lichens. A variety of ericaceous shrubs are present as well, as are species like wild rose and soap-berry. The soils are Eluviated Dystric Brunisols, acidic in the upper part with a brown B horizon underlying a greyish surface A horizon. The photo shows tracks worn into the lichen ground cover by migrating caribou, which travelled the beaches more frequently in the past.

Plate TS9. Taiga fall colours.
The Taiga consists of both tundra and open stands of trees. Close to the tree-line, tundra vegetation covers most of the land. Ericaceous shrubs, mosses and lichens are widespread. Alpine and arctic bearberry turn the tundra into a crimson red in the fall.

70. Kazan River Upland Ecoregion

The Kazan River Upland Ecoregion spans the boundary between Nunavut and northern Manitoba, and stretches from the Seal River in Manitoba to near the East Arm Hills in the Northwest Territories. This region is part of the broad area of tundra and boreal transition extending from Labrador to Alaska.



Climate

The ecoregion has a High Subarctic Ecoclimate marked by short, cool summers and long, very cold winters. The mean annual air temperature is approximately -8.0°C. For the Manitoba portion of the ecoregion, the average growing season ranges from 95 to 117 days, while the number of growing degree-days ranges from about 450 to slightly over 600.

Mean annual precipitation ranges from about 380 to 425 mm, with about two-fifths falling as snow. Precipitation is highest during the growing season, but shows great variation from year to year. The average yearly soil moisture deficit is less than 50 mm.

The ecoregion has a very cold, humid, Subarctic soil climate. The data most relevant is from the station at Ennadai Lake, which is now closed.

Selected Climate Data[1] for Ennadai Lake

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. °C	-30.9	-29.1	-23.8	-13.1	-2.7	7.2	13	11.5	3.9	-5.0	-17.3	-25.8	-9.3
Precip. mm	10.3	6.4	11.7	15.3	19.6	30.7	51.9	41.7	44.7	33.2	16.4	12.6	294.5
Growing degree-days	0.0	0.0	0.0	0.1	8.7	97.0	247.7	201.1	39.8	0.9	0.0	0.0	595.3

[1] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Surficial deposits and landforms

In Manitoba, this ecoregion encompasses a portion of the Kazan River Upland which is composed of crystalline Archaean massive rocks forming broad sloping uplands and lowlands. This section of the upland lies between 350 masl along its western boundary near Nueltin Lake and 30 masl along its eastern boundary near the coastal lowland of Hudson Bay. Although hummocky bedrock outcrops are common, most of the region is covered with acidic sandy and sandy loam granitic till in the form of veneers and blankets and drumlins. Slopes range from 5 to 30 percent.

Fluvioglacial deposits in the form of prominent eskers with significant local relief (occasionally as high as 50 m), and outwash aprons are common. Side slopes of eskers may be as steep as 60 percent. Fields of coarse fragments are frequently found as boulder lag material, marking former shores and drainage ways, and as frost-heaved block fields.

The Kazan Upland slopes gently eastward and drains to Hudson Bay via the Seal and Caribou rivers. A network of secondary streams and drainage ways tributary to the primary rivers , as well as numerous small to medium size lakes are also characteristic of the region.

Soils

Due to the widespread occurrence of permafrost, Cryosolic soils are dominant in this ecoregion. Most of the permanently frozen soils developed on sandy loam to loamy sand textured till have profiles exhibiting discontinuous and distorted horizons (cryoturbated horizons) and are classified as Turbic Cryosols. Patterned ground in the form of circles, stripes and nets is usually associated with these soils. Static Cryosols, which are premanently frozen soils that lack strong cryoturbation features but have premafrost within 100 cm of the surface, are associated with sand, coarse sand and gravelly glaciofluvial and till deposits. Both Static and Turbic Cryosols are also associated with poorly drained sites on a wide variety of materials.

On warm and/or very dry sites, where near surface permafrost is lacking or where the active layer is very deep, Dystric Brunisolic soils are present. These sites are usually associated with glaciofluvial deposits such as eskers.

Permafrost is continuous in the peatlands and often occurs within 20 to 30 cm of the surface. Therefore shallow and deep Organic Cryosols are the soils associated with these sites.

Vegetation

This is the ecoregion where, in Manitoba, the latitudinal limit of tree growth is reached.

The main vegetative distinction between this ecoregion and the Selwyn Lake Ecoregion to the south and west is that trees here are significantly more stunted and stands are much more open. Open, very stunted stands of black spruce and tamarack, with secondary quantities of white spruce and ground cover of dwarf birch, willow, northern Labrador tea, cotton grass, lichen and moss are dominant on well to imperfectly drained sites. Drier sites may be dominated by open stands of white spruce with a ground cover of low ericaceous shrubs, dwarf birch, mosses and lichens. Stands of white spruce, and paper birch are common along rivers. Poorly drained sites usually support tussock vegetation of sedge, cotton grass and sphagnum moss.

Although forested areas are dominant, when including those areas which only support a very sparse cover of dwarf trees, significant areas support low-shrub tundra vegetation. This vegetation may be intermixed with forested tracts or it may occur as extensive areas uninterrupted by trees.

Wildlife

Characteristic wildlife includes the barren-ground caribou, as this ecoregion forms part of its winter range. Other animals in the region include black bear, occasionally grizzly bear, arctic fox, willow ptarmigan, sandhill crane and waterfowl, including ducks and geese. The rivers and lakes contain fish species such as arctic grayling, northern pike, and lake trout.

Land use

There are no permanent settlements in this ecoregion. Most land use is associated with wildlife trapping and subsistence hunting. Some water-oriented recreation and tourism are other activities taking place in this region.

The Seal River has been declared a Canadian Heritage River.

There are three ecodistricts within the Kazan River Upland Ecoregion within Manitoba.

270. Pakulak Lake Ecodistrict (8681 km²)

The Pakulak Lake Ecodistrict spans the boundary between Manitoba and Nunavut. Less than half of the district lies within Manitoba.

Climate

This ecodistrict lies within the High Subarctic Ecoclimatic Region in Manitoba. The climate is marked by short, cool summers and long, very cold winters. Mean annual air temperature is about -8.0°C and the average growing season is 95 days, with about 450 growing degree-days.

Mean annual precipitation is slightly less than 400 mm and is highest during the growing season. Total amounts can vary greatly from year to year. The ecodistrict has an average yearly moisture deficit of less than 25 mm.

The ecodistrict has a very cold, subhumid to humid, Subarctic soil climate.

There are no climate stations in the ecodistrict. The nearest stations are at Churchill (183. Hubbart Point Ecodistrict) and at Ennadai Lake, which is now closed (271. Blevens Lake Ecodistrict).

Physiography and Drainage

The Manitoba portion of the Pakulak Lake Ecodistrict ranges in elevation from about 200 masl along its western margin near Caribou Lake to about 30 masl along its boundary with the coastal lowland near Hudson Bay. The terrain slopes gently at the rate of about 2 m per km eastward toward Hudson Bay. The ecodistrict lies almost entirely above the Tyrrell Sea marine limit, except for some small areas along its eastern boundary in Manitoba.

The ecodistrict consists largely of a till plain with weakly northwest-southeast oriented low hills overlying gently undulating granitic bedrock. The till cover occurs as nearly continuous blankets and veneers of acidic sandy to loamy till. Significant areas of polygonal peat plateau bogs and very shallow fens occupy depressional and flat terrain.

A number of prominent fluvioglacial ridged deposits (eskers) are present but are more common north of the Manitoba border. These ridges generally have slopes ranging from 15 to 30 percent to about 60 precent on the steepest side slopes, with relief of about 50 m in some cases.

Moderately long (50-150 m) undulating to hummocky slopes range from about 5 to 15 percent. Rock and boulder fields occur as lag deposits marking former shores and drainage ways as well as areas where blocks and boulders have been heaved to the surface due to frost action. Many of these fields are found in toe slope positions. Permafrost is widespread throughout the ecodistrict, but is not quite continuous.

Depth and configuration of lakes vary with depth of overburden. Where deposits are thick, the lakes tend to be shallow with fairly regular shorelines. In areas where the overburden is shallow, lakes tend to be deeper and clearer, and have convoluted bedrock-controlled shorelines. Very small to medium lakes are common, and together with the few large lakes, cover about 50 percent of the ecodistrict.

The Manitoba section of the ecodistrict is drained by the Seal, Little Seal and Caribou rivers and their tributary streams flowing east towards Hudson Bay.

Soils

The dominant soils are well to imperfectly drained Turbic Cryosols with permafrost within 0.4 m to 2.0 m of the surface.

Permafrost is widespread and in many areas the soil textures are conducive to the development of patterned ground in the form of sorted and non-sorted circles, nets, steps and stripes. Consequently, many soil profiles have a broken and uneven horizon development. In addition, Static Cryosols - soils with little or no cryoturbation, and with permafrost within 1.0 m of the surface - are also present, but are mostly associated with coarse textured materials.

Significant areas of Eluviated Dystric Brunisols are found where the permafrost is below the control section. These soils have developed largely on coarse to very coarse textured, well to rapidly drained acidic sandy till, and on fluvioglacial deposits. Areas of poorly drained organic Cryosols are more common in the southern part of the area. These are associated with polygonal peat plateau bogs and shallow basin fens, and comprised mainly of shallow to moderately deep sphagnum and sedge-brown moss peat.

The severe climate conditions prevent the use of the ecodistrict for forestry and agriculture. In addition, lack of rooting depth to bedrock, limited water holding and nutrient holding capacity and excessive stoniness provide severe constraints to the use of mineral soils. Poor natural drainage and slow heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation, especially in the eastern part, is a mixture of stunted forest and low-shrub tundra.

Trees in this ecodistrict are more stunted and stands are much more open than in areas to the south and west. Open, very stunted stands of black spruce and tamarack, with secondary quantities of white spruce and a ground cover of dwarf birch, willow, northern Labrador tea, cotton grass, lichen and moss are dominant on well to imperfectly drained sites. Drier sites may be dominated by open stands of white spruce with a ground cover of low ericaceous shrubs, dwarf birch, mosses and lichens. Poorly drained sites usually support tussock vegetation of sedge, cotton grass and sphagnum moss.

Water

The principal sources of water are the many lakes and ponds, and the Caribou, Little Seal and Seal rivers and their tributary streams that flow through the area.

Land Use

There are no settlements in this ecodistrict. Fishing, water-oriented recreation, wildlife trapping and hunting are the dominant uses of land in this area.

271. Blevens Lake Ecodistrict (2998 km²)

The Blevens Lake Ecodistrict spans the boundary between Manitoba and Nunavut. Less than one-third of the district lies within Manitoba.

Climate

This ecodistrict has a High Subarctic Ecoclimate, which in Manitoba is marked by short, cool summers and long, very cold winters. Mean annual air temperature is about -8.0°C, the average growing season is 117 days, with about 600 growing degree-days.

Mean annual precipitation is about 425 mm, of which about two-fifths fall as snow. Precipitation varies greatly from year to year, and is highest during the growing season. The average yearly moisture deficit is about 30 mm. The ecodistrict has a very cold, subhumid to humid, Subarctic, soil climate. The nearest climate station is Ennadai Lake which has been closed for many years. However, the data is still valid for this ecodistrict.

Selected Climate Data[1] for Ennadai Lake

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-9.3	10.6	6.6	13.0	-30.9
Precip. mm (equiv.)	294.5	124.3	188.6	51.9	10.3
Rain/Snow (mm/cm)	173.7/117.1	121.0/3.1	165.7/20.7	51.9/0.0	0.0/9.6
Growing degree-days >5°C	595	545	594	248	0

[1] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Physiography and Drainage

In Manitoba, the Blevens Lake Ecodistrict ranges in elevation from 350 masl at Nueltin Lake on the west to about 300 masl along its boundary with the Nejanilini Ecodistrict to the east. The ecodistrict has no distinct tilt, but slopes very gently eastward at the rate of less than 1 m per km toward Hudson Bay. Discontinuous veneers, blankets and drumlins of acidic sandy to loamy till interspersed with hummocky bedrock outcrops are characteristic.

Moderately long (50 to 150 m), gently undulating to more strongly hummocky slopes range from about 2 to 15 percent slope. Significant areas of shallow fens and polygonal peat plateau bogs occur throughout. Some prominent eskers with steep side slopes and, in some cases, relief over 50 m, also occur throughout the ecodistrict. Rock and boulder fields occur throughout and consist of former strandlines, drainage ways and frost-heaved boulder and block fields. Permafrost is very widespread but discontinuous.

Drainage in the Manitoba part of the ecodistrict is via small rivers and streams which connect the numerous lakes. In the western half , these drain north toward the Thlewiaza River (Thlewiaza River upper drainage division), and in the eastern half, into the Seal River (Seal River drainage division). Both the Thlewiaza and Seal rivers drain into Hudson Bay. The many lakes, ranging in size from small to large, comprise approximately 50 to 60 percent of the surface area of the ecodistrict.

Soils

Permafrost is widespread and generally near the surface except on warm, dry, coarse textured sites. Mineral soils with broken and uneven horizon development are the result of cryoturbation and the soils are classified as Turbic Cryosols. They are usually associated with patterned ground features such as non-sorted circles, nets, stripes and steps, and have developed on well to imperfectly drained, loamy, sandy loam and loamy sand textured till. Static Cryosols, which are premanently frozen soils but lack strong cryoturbation features, are present on sandy and gravelly till and glaciofluvial deposits. These areas may have patterned ground in the form of polygons, although ice wedges appear to be lacking in most areas.

In poorly drained areas that occur throughout the ecodistrict, Organic Cryosols are associated with shallow to moderately deep fibric and mesic peat in the form of polygonal peat plateaus and shallow basin fens. In wet areas that lack significant peat accumulations, poorly drained Gleysolic Static and Turbic Cryosols have developed.

Due to the severity of the climate, forestry and agriculture are not possible in this district. Lack of rooting depth to permafrost or bedrock, limited capacity to hold water and nutrients and excessive stoniness are additional severe constraints to plant growth and possible use of mineral soils. Poor natural drainage and slow heat conductance properties are specific limitations associated with organic soils.

Vegetation

The vegetation is generally similar to that described for the Kazan River Upland Ecoregion. Open, very stunted stands of black spruce and tamarack, which include those areas that only support a very sparse cover of dwarf trees, and an associated ground cover of dwarf birch, willow, northern Labrador tea, cotton grass, lichens and mosses are widespread on well to imperfectly drained sites. Areas of low-shrub tundra vegetation occur intermixed with forested tracts or as extensive areas uninterrupted by trees. The latter areas are especially widespread in the northern part of the ecodistrict.

Drier sites may be dominated by open stands of white spruce with a ground cover of low ericaceous shrubs, dwarf birch, mosses and lichens. Poorly drained sites usually support tussock vegetation of sedge, cotton grass and sphagnum moss. Stands of white spruce and paper birch are common along rivers.

Water

The principal sources of water are the many lakes and ponds, and the tributary stream of the Thlewiaza River that flows through the ecodistrict.

Land use

The ecodistrict has no permanent settlements. Land use is dominantly subsistence fishing, hunting and trapping by people from surrounding areas. Recreational fishing and hunting is catered to by lodges within and outside the ecodistrict. Recreational river travel is on the rise and is the most common form of tourism.

272. Nejanilini Lake Ecodistrict (16 714 km²)

The Nejanilini Lake Ecodistrict spans the border between Manitoba and Nunavut. Approximately four-fifths of the ecodistrict lies within Manitoba.

Climate

The climate of the Nejanilini Lake Ecodistrict is classified as High Subarctic Ecoclimate, which is marked by short, cool summers and long, very cold winters. Mean annual air temperature is about -7.0 °C, the average growing season is 104 days, and the number of growing degree-days is about 520.

Mean annual precipitation is about 425 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year and is highest during the growing season. The average yearly moisture deficit is less than 25 mm. The ecodistrict has a very cold, subhumid to humid, Subarctic soil climate.

No climate stations are located in the ecodistrict. However data from the station at Ennadai Lake (271. Blevens Lake Ecodistrict), which is now closed, and data from the station at Churchill Airport (183. Hubbart Point Ecodistrict) are relevant.

Physiography and Drainage

Elevations in the Manitoba portion of the Nejanilini Lake Ecodistrict range from 315 masl along its western margin near Nejanilini and Baralzon lakes to about 150 masl as it approaches adjacent Pakulak Ecodistrict to the east. The terrain slopes gently eastward toward Hudson Bay at the rate of about 2 m per km.

Ridged (drumlinized) to hummocky bedrock covered with nearly continuous veneers and blankets of acidic sandy to loamy till are characteristic. Moderately long (50-150 m), undulating to hummocky slopes range from about 5 to 15 percent. Significant areas of shallow fens and polygonal peat plateau bogs occur throughout the ecodistrict. A number of prominent fluvioglacial ridges with side slopes of 60 percent and relief of more than 50 m also occur throughout. Rock and boulder fields occur at the toe of hummocky ridges, in former drainage ways, and in areas where blocks and boulders have been frost-heaved to the surface. Permafrost is widespread but discontinuous.

The ecodistrict slopes gently and drains generally eastward to Hudson Bay via the Seal, Caribou and Thlewiaza rivers and their networks of tributary streams and drainage ways. These connect the many small and medium lakes, and fewer numbers of large and very large lakes. Surface water comprises approximately 35 to 40 percent of this ecodistrict.

Soils

Permafrost is widespread in the ecodistrict and many soil profiles exhibit broken and uneven horizon development. Therefore the dominant soils are well to imperfectly drained Turbic Cryosols. These soils are commonly associated with patterned ground in the form of non-sorted circles, nets, steps and stripes. Where cryoturbation is lacking or is only weakly expressed in the soil profile, the soils are classed as Static Cryosols. Both soil types are associated with loamy to sandy acidic till although the Static Cryosols tend to be coarser. Static Cryosols are also frequently associated with sandy fluvio-glacial deposits when the depth to permafrost is shallow.

Dystric Brunisol soils are found on sites where materials are coarse, well drained, lack permafrost or have active layers extending beyond the control section depth established for the Cryosols. Organic Cryosols are associated with polygonal peat plateaus and shallow basin fens. Wetlands lacking significant peat development have poorly drained Static and Turbic Cryosols, depending on the amount of cryoturbation present in the underlying mineral materials.

Climatic conditions are too severe for forestry or agriculture. Lack of rooting depth to permafrost or bedrock, limited capacity to hold water and nutrients and excessive stoniness are other constrains to the use of these mineral soils. Natural drainage and slow heat conductance properties are specific limitations to the usefulness of organic soils.

Vegetation

The vegetation generally follows the trends discussed in the Kazan River Upland Ecoregion section. In the Manitoba portion of the ecodistrict, vegetation consists largely of very open and stunted forest stands, low-shrub tundra vegetation, and sedge and moss covered wetlands. The trees are more stunted and stands are more open than in areas to the south and west. Open, very stunted stands of black spruce and tamarack, with secondary quantities of white spruce and ground cover of dwarf birch, willow, northern Labrador tea, cotton grass, lichen and moss are dominant on well to imperfectly drained sites.

Drier sites may be dominated by open stands of white spruce with a ground cover of low ericaceous shrubs, dwarf birch, mosses and lichens. Poorly drained sites usually support tussock vegetation of sedge, cotton grass and sphagnum moss. Low-shrub tundra becomes increasingly more common with increasing latitude.

Water

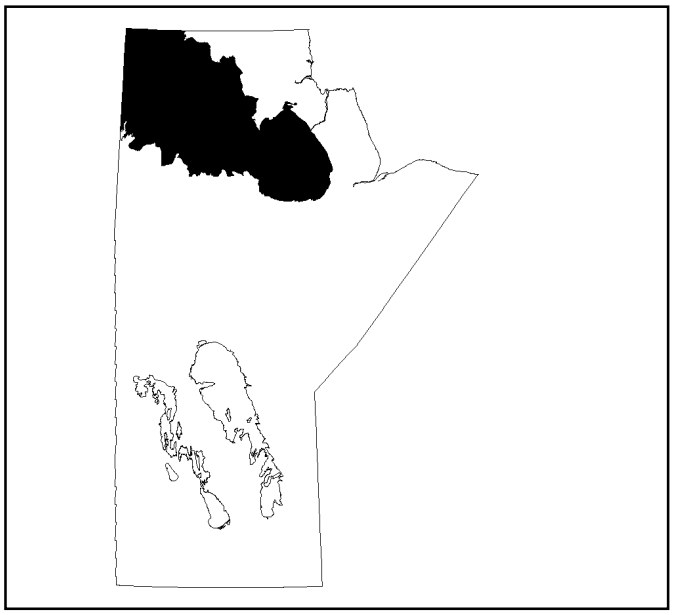
The principal sources of water are the many lakes and ponds, and the Seal and Caribou rivers and their numerous tributary streams that flow through the area.

Land use

There are no settlements in the ecodistrict. Fishing, water-oriented recreation, wildlife trapping and hunting are the dominant land uses.

71. Selwyn Lake Upland Ecoregion

The Selwyn Lake Upland Ecoregion is located in the northwest corner of Manitoba and spans the boundaries with Saskatchewan, Nunavut and the Northwest Territories. It is part of a broad area of coniferous forest transition lying between the sparsely forested region to the north and the closed Boreal forest to the south. This ecoregion extends from east of the Churchill River in Manitoba to the East Arm Hills east of Great Slave Lake.



Climate

This ecoregion has a Low Subarctic Ecoclimate, which is marked by short, cool summers and long, very cold winters. Mean annual air temperatures range from about -5.0°C to -3.4°C. The average growing season varies from about 124 to 137 days, and the number of growing degree-days ranges from about 750 to 950.

Mean annual precipitation varies from about 430 mm to more than 500 mm and fluctuates greatly from year to year. Precipitation is highest during the growing season. The ecoregion has average yearly moisture deficits ranging from less than 40 mm to slightly less than 70 mm. The ecoregion has a very cold, subhumid to humid, Cryoboreal, soil climate.

Climate stations are few in the ecoregion. The climate stations at Ennadai Lake along the northern border of the ecoregion and Brochet Airport located on its southern border, are the most relevant to the Manitoba portion of the ecoregion.

Selected Climate Data[1] for Ennadai Lake

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. °C	-30.9	-29.1	-23.8	-13.1	-2.7	7.2	13.0	11.5	3.9	-5.0	-17.3	-25.8	-9.3
Precip. mm	10.3	6.4	11.7	15.3	19.6	30.7	51.9	41.7	44.7	33.2	16.4	12.6	294.5
Growing degree-days	0.0	0.0	0.0	0.1	8.7	97.0	247.7	201.1	39.8	0.9	0.0	0.0	595.3

[1] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Selected Climate Data[1] for Brochet Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. °C	-28.5	-24.0	17.1	-5.3	3.6	11.4	15.6	14.0	6.9	-0.3	-13.0	-22.6	-4.9
Precip. mm	19.2	13.9	18.3	18.3	32.4	55.1	66.4	52.1	59.2	38.2	29.9	24.1	427.1
Growing degree-days	0.0	0.0	0.0	4.7	43.5	196.2	331.7	280.1	86.4	9.8	0.0	0.0	952.4

[1] Canadian Climate Normals, 1961-1990. Atmospheric Environment Service, Environment Canada.

[2] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Surficial Deposits and Landforms

Within Manitoba, this ecoregion is part of the Kazan Upland with its underlying bedrock of crystalline Archean massive rocks that form broad sloping uplands and lowlands. The elevation of this upland lies between 510 masl along the Saskatchewan - Manitoba border and 120 masl along its border with the Hudson Bay Lowland and the Coastal Hudson Bay Lowland ecoregions.

Surficial deposits vary across the Manitoba part of the ecoregion. In the western section, ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic, bouldery, sandy granitic till are dominant. The southeastern section has significant areas of calcareous loamy till. This till is generally thick enough to mask most of the underlying bedrock, but is itself often overlain by peat deposits and lacustrine sediments. Significant clayey lacustrine veneers and blankets occur at lower elevations around lakes as well. Prominent fluvio-glacial ridges, some with maximum relief of 50 m or more and steep side slopes, are found throughout the ecoregion.

Bog-fen sequences are the dominant wetlands, and are very prevalent in the southeastern section where they cover between 25 and 50 percent of the terrain.

The upland tilts gently and drains northeastward to Hudson Bay via the Churchill and Seal rivers and their network of secondary streams and drainage ways. Numerous small, medium and large lakes are common and drain directly, or through stream and creeks, into the major drainage ways. Small to medium lakes are very numerous in the northwest part of the Manitoba section.

Permafrost is widespread and discontinuous. Most of the permafrost is associated with peat plateau bogs, areas with impeded drainage, and fine textured soils. Ice content in mineral soils is generally low to medium. Ice wedges occur sporadically throughout the region. Permafrost becomes much less widespread towards the southern boundary of the ecoregion, especially in the mineral deposits.

Soils

Dystric Brunisols, and to lesser extent Static Cryosols, associated with upland sandy morainal deposits are dominant in the western section of the region. In the eastern section, Organic Cryosols, typical of peatlands, are more widespread. Significant soil inclusions are Gray Luvisols on calcareous silty to clayey sediments near Southern Indian Lake and elsewhere, Eutric Brunisols on calcareous till and Turbic Cryosolic soils on loamy to clay textured materials distributed throughout the ecoregion. The Turbic Cryosols have profiles exhibiting uneven and often discontinuous or distorted soil horizon development as a result of past and present cryoturbation.

Periglacial features such as active and relic sorted and non-sorted circles on coarse loamy to sandy till material, and earth hummocks (a form of non-sorted circle) on clayey sediments occur throughout the ecoregion.

Climatic conditions are too severe for forestry or agriculture. Lack of rooting depth to permafrost or bedrock, limited water and nutrient holding capacity and excessive stoniness adds additional contraints to the use of mineral soils. Natural drainage and slow heat conductance properties are specific limitations to the usefulness of organic soils.

Vegetation

In this ecoregion, the typical closed coniferous boreal forest gives way to open stands of low black spruce with understories of dwarf birch, Labrador tea, lichens, and mosses. This change in forest cover is one of the main differences between this ecoregion and the Churchill River Upland and Hayes River Upland ecoregions bordering to the south. Although black spruce is the climax species in the ecoregion, drier sites can be dominated by open stands of white spruce and paper birch, with a discontinuous understorey of ericaceous shrubs like bearberry and rock cranberry. White spruce, birch and aspen also occur on warmer protected sites.

Bog vegetation is dominated by sphagnum mosses, ericaceous shrubs and black spruce, whereas fens have a vegetation of sedges and brown mosses, with a minor shrub component.

Wildlife

Characteristic wildlife includes barren-ground caribou, for which the region provides important winter range. Other wildlife characteristic of the region are black bear, arctic fox, snowshoe hare, spruce grouse, osprey, waterfowl including ducks, geese and swans.

Land use

The ecoregion is only sparsely populated. The Northlands and Barrenland First Nations, Sayisi Dene First Nation (Tadoule Lake) and Lac Brochet are the only settlements in the Manitoba part of the ecoregion. Economic activity is very limited. Trapping, hunting, water-oriented recreation and tourism are the dominant land uses.

The Seal River has been declared a Canadian Heritage River.

There are six ecodistricts within the Selwyn Lake Upland Ecoregion in Manitoba.

Landscapes of the Selwyn Lake Upland Ecoregion

The northern part of the Selwyn Lake Upland Ecoregion in Manitoba is a patchwork of open tundra and small stands of stunted black and white spruce. Large complexes of sandy and gravelly eskers are common in this area.

276. Nueltin Lake Ecodistrict (14 565 km^2)

The Nueltin Lake Ecodistrict spans the borders with Saskatchewan, Nunavut and the Northwest Territories. About two-fifths of the ecodistrict lies within Manitoba, extending from the northwestern corner of Manitoba, at the conjunction of the Saskatchewan, Nunavut and Northwest Territories borders, eastward to Nueltin Lake.

Climate

In Manitoba, the Nueltin Lake Ecodistrict has a Low Subarctic ecoclimate, which is marked by short, cool summers and long, very cold winters. Mean annual air temperature is approximately -4.2 °C, average growing season is 130 days, and the number of growing degree-days is about 880.

Mean annual precipitation is around 435 mm, with about two-fifths falling as snow. Precipitation fluctuates greatly from year to year. While precipitation is highest during the growing season, the average yearly moisture deficit is about 60 mm. The ecodistrict has a very cold, subhumid to humid Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The data from the station at Ennadai Lake (271. Blevens Lake Ecodistrict) has relevancy to the ecodistrict.

Physiography and Drainage

Elevations range from about 480 masl along the Saskatchewan boundary to about 305 masl near Nueltin Lake on the east. The area slopes gently northeastward at the rate of about 1 m per km.

Ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic sandy to loamy till are characteristic. Moderately long (50-150 m), undulating to hummocky slopes range from about 5 to 15 percent slope. Significant areas of shallow and deep organic deposits occur throughout the ecodistrict on level to depressional terrain.

Numerous prominent fluvioglacial ridges also occur throughout the ecodistrict. Slopes range mostly from 15 to 30 percent, but some prominent ridges have side slopes of up to 60 percent, and relief of 50 m in some cases. Rock and boulder fields occur at the toe of hummocky ridges, and in areas of past or present frost-heaving. Permafrost is widespread and discontinuous throughout the ecodistrict.

The upland slopes gently and most of the ecodistrict drains northeastward to Hudson Bay via the Thlewiaza River drainage system. The most southwestern part of the ecodistrict drains southward through the Cochrane River drainage system into the Churchill River drainage system. Some of the most easterly parts are drained by the North Seal River, while northern portions are part of the Kazan River drainage division or the Thlewiaza River upper drainage division. Small, medium, large and very large lakes, which include Nueltin, Snyder, Kasmere, Tice and Putahow lakes, occupy 40 to 50 percent of the surface area.

Soils

The dominant soils are well to imperfectly drained Dystric Brunisols, and Static and Turbic Cryosols on sandy to loamy till. Dystric Brunisols dominate on sandy fluvio-glacial deposits. The distribution of Cryosols is greatly influenced by the thickness of the turf or peat layer. Soil profiles that exhibit broken and uneven horizon development are associated with relic and active non-sorted circles, which are generally found on medium textured materials.

Organic Cryosols occur throughout the ecodistrict on polygonal peat plateau bogs and are comprised mainly of sphagnum and sedge peat. Local areas of granitic bedrock also occur.

Climatic conditions are too severe for forestry or agriculture. Lack of rooting depth to permafrost or bedrock, limited capacity to hold water and nutrients and excessive stoniness are additional constraints to the use of mineral soils. Poor natural drainage and slow heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation in this ecodistrict is varied because it extends more than 300 km from south to north - from about 58° N latitude in the south to 61° N at its northern border. Vegetation composition, and especially stand closure, changes significantly from south to north for this ecodistrict as a whole. Although the changes are not as great in the Manitoba portion of the ecodistrict, forest stands are more closed and taller in its southern section than along the boundary with the Northwest Territories.

The typical closed coniferous boreal forest to the south of this ecodistrict gives way to open stands of low black spruce, with understories of dwarf birch, Labrador tea, lichens, and mosses. Although black spruce is the climax species in the ecodistrict, drier sites can be dominated by open stands of white spruce and paper birch, with a discontinuous understorey of ericaceous shrubs such as bearberry and rock cranberry. White spruce, birch, and aspen also occur on warmer protected sites.

Bog vegetation is dominated by sphagnum mosses, ericaceous shrubs and black spruce, whereas fens have sedges and brown mosses, with a minor component of shrubs.

Water

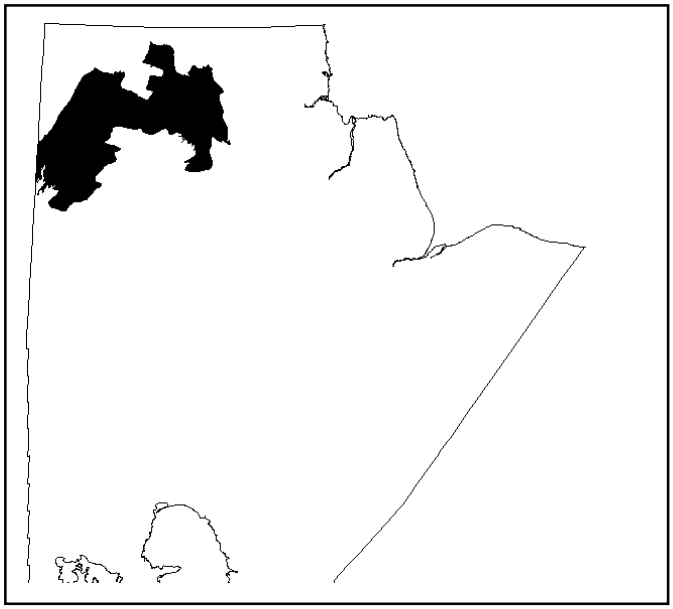
Sources of water include the many lakes, and the Cochrane and North Seal rivers and their tributary streams that flow through the ecodistrict.

Land use

There are no settlements in the ecodistrict. Fishing, water-oriented recreation, trapping and hunting are the dominant land uses and some employment is provided by the few lodges.

279. Seal River Ecodistrict (30 525 km^2)

The Seal River Ecodistrict is located east and south of the Nueltin Lake Ecodistrict and is wholly within Manitoba except for a small area in the southwest corner that lies in Saskatchewan.



Climate

This ecodistrict has a Low Subarctic Ecoclimate marked by short, cool summers and long, very cold winters. Mean annual air temperature is approximately -3.4^{o}C, average growing season is around 132 days, with about 900 growing degree-days.

Mean annual precipitation is around 460 mm and varies greatly from year to year. More than one-third of the precipitation falls as snow. Precipitation is highest during the growing season and the average yearly moisture deficit is about 70 mm. The ecodistrict has a very cold, subhumid to humid, Cryoboreal soil climate.

Brochet Airport on the shore of Reindeer Lake, which borders the ecodistrict in the southwest corner, is the only climate station in the ecodistrict.

Selected Climate Data[1] for Brochet Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	-4.9	13.7	10.3	15.6	-28.5
Precip. mm (equiv.)	427.1	173.6	265.2	66.4	19.2
Rain/Snow (mm/cm)	261.8/167.5	170.0/1.7	245.2/16.5	66.4/0.0	0.0T/20.3
Growing degree-days >5^{0}C	952.0	808.0	938.0	332.0	0.0

[1] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Physiography and Drainage

The ecodistrict ranges in elevation from 450 masl along the Saskatchewan boundary to about 250 masl at its eastern margin near Shethanei Lake. The terrain slopes gently in a generally easterly direction at the rate of about 1 to 2 m per km toward the Hudson Bay Lowland.

Ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets, and hummocks of acidic sandy to loamy till are characteristic of the area. Moderately long (50-150 m), undulating to hummocky slopes range from about 5 to 15 percent. Significant areas of shallow and deep organic deposits occur in depressions. Long, sinuous eskers are common in the district, some of which may extend for 50 km and attain elevations of 50 m or more in some sections, with side-slopes of 60 percent. These fluvioglacial ridges and their associated aprons are some of the most prominent landscape elements in the ecodistrict.

Rock and boulder fields occur at the toe of hummocky ridges, at the location of former drainage ways, and where frost heaving has moved large quantities of boulders,

blocks and rock fragments onto the surface. Permafrost is widespread and discontinuous and usually associated with areas of shallow peat (<40 cm thick), veneer bogs on gently sloping sites, and polygonal peat plateau bogs in depressional areas.

The central part of the ecodistrict drains eastward via the North Seal River into the Seal River, while the eastern portion is drained by the Seal River directly. The southeastern part of the district is part of the Cochrane River drainage division, which is part of the Churchill River drainage system. All these waters drain eventually into Hudson Bay. Numerous lakes of a variety of sizes are distributed throughout the ecodistrict.

Soils

The dominant soils are well to imperfectly drained Dystric Brunisols, and Static and Turbic Cryosols, developed on coarse loamy to sandy acidic till. Sandy fluvioglacial deposits have generally Dystric Brunisols, except where the presence of a significant organic surface layer has provided sufficient insulation to allow permafrost development. Soil profiles exhibiting broken and uneven horizon development are associated with relic and active non-sorted circles on loam to sandy loam textured deposits. Fine textured sediments such as clay and clay loam often have patterned ground in the form of earth hummocks (a particular type of non-sorted circle). However, in many localities the earth hummocks are relic features as they lack permafrost at the present.

Poorly drained areas generally have Cryosolic soils, especially if there is some peat accumulation. Where peat deposits exceed 40 cm in depth, Organic Cryosols are the common soils and are associated with peat plateau and polygonal peat plateau bogs. These peat soils have developed mainly from mixed moss and sedge peat, sphagnum moss peat and, in the southern sector, woody moss (forest) peat. Veneer bogs occur more commonly in the southern part of the district. Areas of granitic bedrock outcrop occur throughout the area, and are locally widespread.

In addition to severe climatic constraints which prevent the use of the ecodistrict for forestry or agriculture, the lack of rooting depth to permafrost or bedrock, limited water and nutrient holding capacity and excessive stoniness would also severely limit the use of mineral soils for forestry or agriculture. Stands of marginally merchantable timber are found only on some favourable sites. Poor natural drainage and slow heat conductance properties are additional severe limitations to the use of organic soils.

Vegetation

The vegetation is very much similar to that described for the Nueltin Lake Ecodistrict. Tree cover is very patchy and stunted in the northern part of the ecodistrict. Polygonal peat plateaus with primarily moss, lichen and ericaceous shrub vegetation are common in the north as well.

Water

The ecodistrict has abundant sources of water. The principal sources are the numerous small to medium lakes, and the North Seal and the Seal rivers.

Land use

The Northlands and Barren Lands First Nations, Sayisi Dene First Nation (Tadoule Lake) and Lac Brochet are the only communities in the ecodistrict. Fishing, trapping and hunting are the dominant land uses. Activities associated with water-oriented recreation, such as the operation of lodges and eco-tourism are slowly increasing.

280. Sprott Lake Ecodistrict (14 443 km^2)

The Sprott Lake Ecodistrict occupies the central part of the Manitoba section of the Selwyn Lake Ecoregion, and is completely contained within Manitoba.

Climate

This ecodistrict has a Low Subarctic Ecoclimate marked by short, cool summers and long, very cold winters. Mean annual air temperature is approximately -3.5°C, the average growing season is 136 days and the number of growing degree-days is around 940.

Mean annual precipitation, of which more than one-third falls as snow, is about 500 mm and fluctuates greatly from year to year. Precipitation is highest during the growing season and the average yearly moisture deficit is about 60 mm. The ecodistrict has a very cold, subhumid to humid, Cryoboreal, soil climate.

No climate station is located in the ecodistrict. The nearest climate station is Brochet Airport to the west (276. Nueltin Lake Ecodistrict).

Physiography and Drainage

The Sprott Lake Ecodistrict is part of the Kazan Upland. It slopes gently eastward from 400 masl in the west to 275 masl near North Knife Lake in the east. It is characterized by ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic sandy to loamy till. Moderately long (50 to 150 m), undulating to hummocky slopes range from about 5 to 15 percent slope. Prominent fluvioglacial ridges (with about 50 m relief in some cases) occur throughout.

Shallow peat in the form of veneer bogs is widespread on gentle slopes, while deeper organic deposits in the form of basin fens and peat plateau bogs are present in depressions. Permafrost is widespread, discontinuous and usually associated with imperfectly and poorly drained, fine textured sediments, and veneer and peat plateau bogs.

The upland slopes gently at the rate of about 1 to 2 m per km and drains northeastward to Hudson Bay via the North Seal, South Seal and Knife rivers and their network of tributary streams and drainage ways. Numerous very small to large lakes are distributed throughout the ecodistrict.

Soils

The dominant soils are Organic Cryosols associated with peat plateau bogs and veneer bogs. These peatlands are characterized by widespread permafrost. Peat materials consist of mixed mosses, sedge and woody forest peat. The soils of shallow and deep fens are generally Organic Mesisol soils, as these peatlands are largely without permafrost.

Significant areas of mineral soils are dominantly well to imperfectly drained Dystric Brunisols on sandy to coarse loamy, acidic till. Associated soils are imperfectly to poorly drained Static and Turbic Cryosols on till deposits and on localized areas of fine textured glaciolacustrine sediments. Evidence of the past and present effect of permafrost on soil development is found in soil profiles with uneven and broken horizon development, and in the presence of non-sorted circles on till and earth hummocks on glaciolacustrine sediments. Areas of granitic bedrock occur locally.

The ecodistrict is not suitable for agriculture or forestry due to severe climatic constraints. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Lack of rooting depth to permafrost or bedrock, excessive stoniness and limited water and nutrient holding capacity are additional severe constraints to the use of mineral soils.

Vegetation

The vegetation is typical of the southern part of the Subarctic and is dominated by open, stunted black spruce stands with a ground cover of mosses, lichens and ericaceous shrubs on well to imperfectly drained sites and by peatlands. Peatland vegetation consists of black spruce, ericaceous shrubs and mosses on peat plateau bogs, and sedge, brown mosses and tamarack on fens.

In the most southerly parts of the ecodistrict, closed stands of marginally merchantable timber may be found on favourable sites.

Water

Suitable sources of water are plentiful with the principal sources being the numerous lakes, and the South Seal, North Seal and Knife rivers and their tributary streams that flow through the area.

Land Use

The ecodistrict has no permanent settlements. Fishing, trapping and hunting are the dominant land uses.

281. Embleton Lake Ecodistrict (25 235 km²)

The Embleton Lake Ecodistrict occupies the southeastern part of the Selwyn Lake Upland Ecoregion. The ecodistrict is totally contained within Manitoba.

Climate

This ecodistrict has a Low Subarctic Ecoclimate, which is marked by short, cool summers and long very cold winters. Mean annual air temperature is approximately -4.9°C, the average growing season is 124 days, with about 770 growing degree-days.

Mean annual precipitation, of which about two-fifths falls as snow, is about 480 mm and varies greatly from year to year. Although precipitation is highest during the growing season, the average yearly moisture deficit is around 40 mm. The ecodistrict has a very cold, subhumid to humid, Cryoboreal soil climate.

There are no climate stations located in the ecodistrict. The nearest climate station is at Gillam Airport (360. Knee Lake Ecodistrict) located south of the ecodistrict.

Physiography and Drainage

The Embleton Lake Ecodistrict lies between 305 masl along its western boundary near Northern Indian Lake and 120 masl along its eastern boundary. The terrain slopes gently eastward at the rate of about 1.2 m per km toward the boundary with the Coastal Hudson Bay Lowland and the Hudson Bay Lowland ecoregions. The upland generally drains northeast and east toward Hudson Bay. For some distance, the ecodistrict boundary consists of a major relic beach marking the extent of the Tyrrell Sea.

Most of the ecodistrict is underlain by Precambrian granitic bedrock, but the most easternly section is underlain by Ordovician limestone. None of the limestone bedrock is exposed, and only limited Precambrian bedrock areas are exposed.

Morainal drift, glaciolacustrine blankets and veneers, and organic deposition mask the underlying bedrock. The till material in the eastern sector is calcareous, loamy and often drumlinized. The till is in part covered by veneers and blankets of clayey, calcareous, glacio-lacustrine sediments, which are especially prevalent in low lying areas. In turn, these sediments are often masked by extensive peatland development. Therefore, large areas of mineral deposits are covered by shallow to deep peat in the form of veneer bogs, peat plateau bogs and fens. These wetlands cover more than 50 percent of the land area in the eastern and southern sectors of the ecodistrict. Shallow organic veneer with discontinuous permafrost is common on gentle slopes, while horizontal fens, and permanently frozen peat plateau and palsa bogs occupy depressional areas.

To the northwest, peatlands are less extensive, but are still a prominent landscape element. The till materials in that part of the ecodistrict are medium to coarse textured, acidic, and usually contain large quantities of coarse fragments. Moderately long (50-150 m), undulating to hummocky slopes range from about 5 to 15 percent slope. Prominent fluvioglacial ridges and hummocks (esker-kame complexes and interlobate moraines with relief of over 60 m in some cases) mark its western and southern boundaries. Raised marine beaches mark the eastern limit adjacent to the Hudson Bay Lowland.

Permafrost is widespread but discontinuous and is associated mostly with peat plateau and veneer bogs, although fine textured soils contain locally low to medium ice-content permafrost. Although active layer depths are

strongly affected by organic surface layer depth and soil texture, depth to permafrost on mineral soils is usually between 60 to 100 cm.

The ecodistrict is part of a number of drainage systems. The most northerly part drains via the Knife River and its tributaries, while the cental part drains via the Churchill River and its tributary streams and rivers. The east-central part is drained by the Owl River system, while the most southerly part of the district drains via the Limestone River system into the Nelson River. There are some medium to large lakes and many small lakes which are most numerous in the western and central part of the district.

Soils

The dominant soils are Organic Cryosols developed on veneer and peat plateau bogs and Organic Mesisols and Fibrisols developed on fens. The bogs have widespread permafrost and consist of weakly decomposed, shallow sphagnum peat overlying moderately decomposed (mesic) forest or sedge peat.

Significant areas of mineral soils consisting of well to imperfectly drained Eutric Brunisols on loamy calcareous till occur on exposed sandy marine ridges along the eastern margin of the district. Dystric Brunisols have developed on the sandy and coarse loamy acidic till deposits in the western sector. Gray Luvisols are typical in the silty and clayey glaciolacustrine sediments. Locally these soils exhibit uneven horizon development and have relic non-sorted circles and earth hummocks on the surface, which is evidence of past, more extensive, permafrost conditions. Although recently developed permafrost areas do occur locally in mineral soils, cryoturbation is minimal and the soils are typically Static Cryosols.

Severe climate constraints, poor natural drainage and slow heat conductance properties limit the use of organic soils for agriculture and forestry. Most of the ecodistrict's mineral soils have additional limitations due to lack of rooting depth to permafrost, low soil temperatures, or compact basal till, stoniness and coarse textures. However some areas could support limited forestry, although growth rates are low, and rotations are long.

Vegetation

The vegetation of the ecodistrict generally reflects its northern location. In the northern sector, stands are generally open and dominated by black spruce, mosses, lichens and ericaceous shrubs. The peatlands, widespread in the eastern sector, have black spruce, sphagnum and other mosses, lichens and ericaceous vegetation, while fens have sedges, brown mosses and a varying component of tamarack and shrubs.

In the southern sector, stands are more closed and taller, with more trembling aspen and white spruce on favourable sites. In this sector, the presence of merchantable timber increases significantly, but it is still confined to the best sites.

Water

Good sources of water are fairly plentiful and are comprised of the lakes and rivers in the central and western sectors and the rivers in the peatland dominated eastern sector.

Land use

There are no permanent settlements in the ecodistrict. Most of the land-based activities are associated with trapping and hunting. Subsistence and recreational fishing are also important. Economic activity is also associated with the railroad from Thompson to Churchill, which traverses part of the eastern sector. The railroad and a few winter roads provide the only land access to the ecodistrict.

282. Big Sand Lake Ecodistrict (6938 km²)

The Big Sand Lake Ecodistrict is located in the southern part of the Selwyn Lake Upland Ecoregion, and lies entirely within Manitoba.

Climate

This ecodistrict has a Low Subarctic Ecoclimate, which is marked by short, cool summers and long, very cold winters. The mean annual air temperature is approximately -3.5 °C, the average growing season is 135 days, with about 950 growing degree-days.

Mean annual precipitation, of which more than one-third falls as snow, is around 500 mm and varies greatly from year to year. Although precipitation is highest during the growing season, the average yearly moisture deficit is about 50 mm. The ecodistrict has a very cold, subhumid to humid Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The nearest relevant station is at Brochet Airport (279. Seal River Ecodistrict).

Physiography and Drainage

The Big Sand Lake Ecodistrict is underlain by Precambrian granitic bedrock, and ranges in elevation from slightly over 400 masl near its western boundary to about 300 masl at its eastern margin.

The ridged to hummocky bedrock is largely covered with veneers and blankets of acidic sandy to coarse loamy till, but exposed bedrock is common, especially along lake shores.

Moderately long (50 to 150 m) undulating to hummocky slopes range from about 5 to 15 percent slope. Prominent, sinuous fluvioglacial ridges (eskers) occur throughout. Several of these eskers are many kilometres long, with relief of about 30 m in some cases, and side-slopes as steep as 60 percent.

Significant areas of clayey glaciolacustrine veneers and blankets occur at lower elevations in the southern section of the ecodistrict. However, wetlands are extensive and peatlands cover the mineral deposits in many lowland areas. Shallow to deep peatlands in the form of permanently frozen peat plateau bogs, veneer bogs, and palsa bogs, mixed with non-frozen basin and horizontal fens are common. Permafrost is widespread, discontinuous and mostly associated with peatlands and poorly drained mineral soils overlain by thin surface peat.

The upland slopes gently at the rate of about 1 to 2 m per km and drains generally eastward to Hudson Bay. Most of the ecodistrict is drained by the South Seal River and its tributary streams, and a small section in the southeast drains toward South Indian Lake which is part of the Churchill River drainage system. Big Sand Lake is by far the largest lake, but the ecodistrict also contains many small and some medium and a few large lakes. Lakes occupy about 30 percent of the surface area.

Soils

The dominant soils in the Big Sand Lake Ecodistrict are well to imperfectly drained Dystric Brunisols on sandy acidic till. Some soil profiles exhibit uneven horizon development, while some non-sorted circles are present on the surface, and are evidence of the impact of former and present permafrost conditions on soil development. Local areas of Turbic Cryosols, associated with loamy and clayey materials, occur as inclusions. Bedrock outcrops also occur throughout the area.

Organic Cryosols are associated with significant areas of peat plateau and veneer bogs overlying loamy till and clayey glaciolacustrine sediments. The organic materials are comprised mainly of woody forest peat and sphagnum peat. Deeper peat deposits generally underlain by sedge peat are more common in the eastern sector.

The severe climate, lack of rooting depth to permafrost or bedrock, excessive stoniness and limited water-holding capacity and nutrient retention severely constrain the use of mineral soils for forestry and agriculture. Poor natural drainage and slow heat conductance properties, in addition to climatic constraints, are the most severe limitations to the use of organic soils.

Vegetation

The vegetation of the ecodistrict is typical of the southern part of the subarctic and is dominated by open, stunted black spruce stands with a ground cover of mosses, lichens and ericaceous shrubs on well to imperfectly drained sites, and by peatlands. Peatland vegetation consists of black spruce, ericaceous shrubs and mosses on peat plateau bogs, and sedge, brown mosses and tamarack on fens. In the most southerly parts of the ecodistrict, closed stands of marginally merchantable timber may be found on favourable sites.

Water

The principal sources of water are Big Sand Lake and the many smaller lakes, the South Seal River and its tributary streams that flow through the ecodistrict.

Land Use

There are no permanent settlements in the ecodistrict. Fishing, water-oriented recreation, trapping and hunting are the dominant land uses.

283. Northern Indian Lake Ecodistrict (10 332 km²)

The Northern Indian Lake Ecodistrict is located in the southern part of the Selwyn Lake Ecoregion, and lies entirely within Manitoba.

Climate

This ecodistrict has a Low Subarctic Ecoclimate marked by short, cool summers and long, very cold winters. Mean annual air temperature is approximately -3.4°C, the average growing season is 137 days, and the number of growing degree-days is about 950.

Mean annual precipitation is about 525 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year. Although precipitation is highest during the growing season, the average yearly moisture deficit is about 50 mm. The ecodistrict has a very cold, subhumid to humid, Cryoboreal soil climate.

There are no climate stations in the ecodistrict and the nearest are at Brochet (279. Seal River Ecodistrict) to the west and Gillam Airport (360. Knee Lake Ecodistrict) to the southeast.

Physiography and Drainage

The Northern Indian Lake Ecodistrict lies between 365 masl along its western boundary near Big Sand Lake and 240 masl southeast of Northern Indian Lake. It is characterized by hummocky Precambrian bedrock covered with almost continuous veneers and blankets of clayey glaciolacustrine deposits and, to a lesser degree, with acidic sandy to loamy till.

Moderately long (50 to 150 m) undulating to hummocky slopes range from about 2 to 15 percent slope. Prominent fluvioglacial ridges in the form of interlobate moraines border the area to the east. Some prominent eskers are found throughout the ecodistrict.

Organic deposits are widespread and cover between 25 and 50 percent of the land surface. They overlie extensive areas of clayey, glaciolacustrine sediments. Peatlands occur in the form of veneer bogs on gentle slopes and as peat plateau bogs and horizontal fens in level to depressional areas. Permafrost is widespread, discontinuous and is mostly associated with veneer bogs on gentle sloping sites and peat plateau bogs on level and depressional terrain.

The upland slopes gently at the rate of about 0.5 to 1 m per km and is drained eastward by the Churchill River and its network of tributary streams and drainage ways. While the northern portion of Southern Indian Lake and Northern Indian Lake dominate the area, many smaller lakes are distributed throughout the ecodistrict.

The flow of the Churchill River is markedly reduced from historic flows by the Missi Falls control dam, situated where the Churchill River flows out of Southern Indian Lake. The reduced outflow has resulted in higher water levels in Southern Indian Lake, resulting in severe shoreline erosion. Most of the new shoreline is being established in clayey sediments and organic materials, which extensively contain ice-rich permafrost. On the other hand, water levels in Northern Indian Lake and in other smaller lakes have been lowered through drawdown, resulting in the creation of new shorelines at lower elevations.

Soils

The dominant soils in the Northern Indian Lake Ecodistrict are Gray Luvisols that have developed on clayey sediments, Organic Cryosols associated with widespread peat plateau bogs and veneer bogs, and Organic Mesisols developed on fens. Dystric Brunisols on acidic till and eskers, and Eutric Brunisols associated with sandy fluvioglacial (interlobate moraine) deposits also occur in the ecodistrict. Local areas of granitic bedrock also occur.

Clayey mineral soils frequently exhibit uneven and broken horizon development and incorporation of organic materials below the surface. These soils are associated with relic and active earth hummocks. These surface features are evidence of the effect of former and current permafrost conditions on soil development. Although permafrost is not as widespread in fine textured sediments as it is in organic deposits, areas of Turbic Cryosols occur in terrain with earth hummocks, while Static Cryosols occur where closed stands of black spruce and/or feather moss groundcover create conditions favourable for permafrost development.

Severe climatic constraints, poor natural drainage and slow heat conductance properties limit the use of organic soils for forestry or agriculture. Lack of rooting depth to permafrost or bedrock, and in some cases excessive stoniness, limited water and nutrient holding capacity are additional severe constraints to the use of mineral soils.

Vegetation

The vegetation of the ecodistrict is typical of the southern part of the Subarctic and is dominated by open, stunted black spruce stands with a ground cover of mosses, lichens and ericaceous shrubs on well to imperfectly drained sites, and by peatlands. Peatland vegetation consists of black spruce, ericaceous shrubs and mosses on peat plateau bogs, and sedge, brown mosses and tamarack on fens. Along the Churchill River and in the most southern parts of the district, closed stands of marginally merchantable timber may be found on favourable sites.

Water

The principal sources of water are the numerous lakes along the Churchill River and the Churchill River itself and its tributaries.

Land Use

Trapping and hunting are the dominant land use activities. Commercial fishing is an important activity on the two large lakes. Although this enterprise has suffered as a result of the change in water levels and the continuing erosion of shorelines, it remains an important economic activity for a number of people from the First Nation's community of South Indian Lake. Fishing, canoeing and other water-oriented recreation are typical uses of the ecodistrict's natural resources.