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Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes

Research Branch
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Foreword

The original draft of this report was compiled by Mr. R.E. Smith, former head of the Canada-Manitoba Soil Survey, now retired. The information in this report has been drawn from the many sources listed in the reference section and from sources not listed. Many people contributed to the compilation of this report in an indirect way; Dr. D. Wotton, Manitoba Department of the Environment, Dr. J.W. Stewart, Department of Botany, University of Manitoba, and Mr. W. (Bill) Koontz, Manitoba Department of Natural Resources. Messrs. G.F. Mills and H. Veldhuis produced a draft report in the 1980's on the Ecoclimatic Regions of Manitoba. That information was partially incorporated in the Ecoclimatic Regions of Canada, First Approximation (Ecoregions Working Group 1989) and again was used extensively in the preparation of this report. It should be noted that these reports and many other sources were invaluable for compiling this report. Any errors in interpretation of published and unpublished data, omissions and other mistakes in this report are solely the responsibility of the authors.

This report is intended to provide information of a general nature on the climate, the biological and physical resources and the characteristics of each ecozone, ecoregion and ecodistrict identified in Manitoba. The information for each particular ecozone, ecoregion or ecodistrict is provided in a comprehensive package for each entry. Of course, this resulted in some repetitiveness in the text that may become bothersome if a large number of descriptions need to be consulted.

Readers should consult the section on conventions used, and the glossary for terms that may not be familiar. For terms that may have been missed in the glossary, readers should consult the original reference document.

It is our sincere hope that this document will be of use to people working in various disciplines in government and private industry, and also that it will be of use to that portion of the general public interested in natural resource issues and the environment. We realize that significant improvements can be made both to the information provided and to the presentation format. We therefore invite comments, corrections and constructive criticisms in order to improve the document if a second edition should be published.

For the authors,

Hugo Veldhuis

Acknowledgements

To Professor of Soil Science, J. H. Ellis and Professor of Botany, C. W. Lowe of the University of Manitoba for their pioneering effort in developing a hierarchical framework for the reporting of the essential facts of the natural soil landscapes of Manitoba.

To the many tireless men and women of the Canada-Manitoba Soil Survey, who undertook the mapping and sampling of the soils in the field, the analysis of soils in the laboratory, the compilation of maps and the assembling of background information contained in the numerous soils reports and biophysical studies of the province from whence much information was freely used in this report.

Acknowledgment and thanks to P. W. Haluschak, W. Michalyna, and G. P. Podolsky for their technical advice; to J. R. Griffiths for his valuable assistance in developing appropriate digital maps of Ecoregions and Ecodistricts for the province of Manitoba; to C. Aglugub for the initial assembly of early drafts of this report; to D. Swidinsky for report editing; to J. M. MacLeod for the final edits and her contribution to the formatting of plates and other illustrations; and to S. Depoe, and D. J. Brock for their assistance in selecting, scanning and formatting slides and photographs.

Acknowledgments are also made to all those who contributed photos and slides used in the report; and to L. Crooks of Beaverbrook Communications for carrying out the layout and formatting of the report.

Photo credits:

The photos and slides used to produce the plates were supplied by P. W. Haluschak, L. A. Hopkins, and G. F. Mills of the Soils Section, Soils and Crops Branch, Manitoba Department of Agriculture and P. J. Cyr, R. G. Eilers, W. R. Fraser, and H. Veldhuis of the Land Resource Unit, Brandon Research Centre, Agriculture and Agri-Food Canada. The Manitoba Department of Natural Resources provided the slides for the illustrations on pages 5-16 (Great Grey owl), 7-17 (Mallards), 7-49 (Canada geese), 8-3 (Snow geese). D. Clark of Parks Canada provided the picture on page 8-13 (Polar Bears).

Preface

In 1995, Agriculture and Agri-Food Canada and Environment Canada published “A National Ecological Framework for Canada” complied by a nationally constituted, multi-disciplined Ecological Stratification Working Group. This report, with an accompanying map (1:7 500 000 scale), described a nation-wide spatial framework for geographical reporting and monitoring of the natural and ecological resources of Canada. It has since been adopted by many jurisdictions including Environment Canada, Forestry Canada, Natural Resources Canada and Parks Canada, as well as by many provincial resource departments and agencies. It is also being used on a geo-political basis for both provincial and federal research and policy development and program delivery. Both federal, and many provincial “state of the environment” reporting documents are based on this Ecological Framework.

This report of the “Terrestrial Ecozones, Ecoregions and Ecodistricts of Manitoba” has been designed to provide a more complete description of the ecological and resource environments for more local applications of the Manitoba portion of the National Ecological Framework. This report describes in more detail each ecodistrict or portions thereof that occur in Manitoba in terms of the landscapes and resource conditions in a standard format suitable for general planning purposes.

Each ecodistrict is described as an entity, and the report can be consulted as one would a dictionary. To obtain information about a specific ecodistrict in a simple look-up fashion, use the numeric coding system as shown on the accompanying map (1:1 500 000).

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Objective

As a result of national coordination meetings (Smith, 1992), both Environment Canada and Agriculture and Agri-Food Canada staff redefined Ecoregion and Soil Landscapes of Canada (SLC) based ecodistricts boundaries in order to establish a single set of polygon boundaries at the ecoregion and ecodistrict level for Canada.

Equally as important as the development of this ecological framework is the development of a data management model that will facilitate ecoregion and ecodistrict data storage and maintenance, and acquisition of new data. It will also establish linkage to national and regional soil resource databases and other sources of resource data. Access to this type of information through such a data model will provide a useful and efficient basis for the management of large volumes of multiple factor data required for reporting on, monitoring, and managing Manitoba's land based natural resources.

The objective of this report is two-fold:
(1) to document, within the national context, the development of a landscape-based, hierarchical, ecological framework linking the Manitoba section of the Soil Landscapes of Canada map (SLC) with Environment Canada's Ecological Land Classification (ELC) system at the ecoregion hierarchical level and,

(2) to develop map and data base products suitable for Environment Canada's State of the Environment (SOE) Reporting Branch reporting on trends in environmental quality. This provides a framework for the coordination of existing sectoral environmental monitoring, development of appropriate biological stress indicators, and facilitating other land evaluation research activities.

Natural Landscape Regionalization in Manitoba

In Manitoba, the development of a natural landscape-based, hierarchal framework for the reporting of the essential facts on the soil landscapes of the province began with the pioneer work of Professor J.H. Ellis in 1927, founder of the Soils Division of the Manitoba Agricultural College. He developed a system of field classification of soils that has had a major influence on soil classification and mapping in Canada. The system was based on a concept suggested by C.C. Nikiforoff of the Russian School of Soil Science who was surveying the soils of the Red River Valley on the U.S. side of the border in 1927. The hierarchal framework established at that time recognized a soil-climate-vegetation interaction in the landscape that enables differentiation of soil properties in terms of soil associations and soil associates within a larger regional context called soil landscape areas.

The following discussion traces the evolutionary development of methodology for land resource description characterization and mapping in Manitoba.

Soil Associations

Under Ellis' Manitoba field classification, soil types that developed on similar material (or geological surface deposits) in the same soil zone were designated as "associations", and individual associated soils, recognized by their profile characteristics reflecting variations in local soil climate and vegetation, were referred to as "associates".

In Manitoba, soil mapping employed soil associations as the major kind of mapping unit until the late 1950's when mapping units in more detailed soil surveys were named in terms of soil series, which were roughly equivalent to soil associates. The usefulness of the soil association system of field classification is borne out by the fact that the same basic system is still used in the Saskatchewan soil survey program.

Soil Landscape Areas

The reconnaissance soil survey of southwestern Manitoba (Ellis 1940) introduced the use of soil landscape areas to provide a more general description of the physical features of the survey area. These natural areas recognized different aspects due to variation in geological deposits, elevation, topography, relief, drainage, and in some cases, vegetation without reference to potential or current land use implications. A summary of dominant plant species within specific landscape areas was provided by Professor C.W. Lowe of the Botany Department of the University of Manitoba, from field observations made in conjunction with the soil survey. These soil landscape areas were recognized as a suitable basis for the transfer of physical and biological information for a host of regional applications at reduced scales (usually less than 1:1M) in the province. They provide the basis for many of the ecoregions and ecodistricts in southern Manitoba presented in this report.

Other Landscape Regionalizations

Manitoba's land resource base has been described in map form on the basis of many other environmental themes that address different purposes and use dissimilar criteria in the description of their basic units. Some examples include : The Forest Regions of Canada (Rowe 1972), Physiographic Subdivisions of Canada (Bostock 1970), The Ecoclimatic Regions of Canada (Ecoregions Working Group 1989), Soil Landscapes of Canada, Manitoba (Canada Soil Inventory 1989), Terrestrial Ecozones of Canada (Wicken 1986), Soil Climates of Canada (Clayton et al. 1977), and more recently Land Resource Regions and Areas of Southern Manitoba (Eilers and Mills 1992). All of these themes have impacted, to a greater or lesser degree, on the development of ecoregions and ecodistricts as currently presented in Manitoba.

Biophysical Land Classification

In the mid-1970's, the Northern Resources Information Program (NRIP), a joint venture between the Canada-Manitoba Soil Survey and the Manitoba Department of Renewable Resources and Transportation Services, introduced an inventory system known as The Biophysical Land Classification System to provide basic land and land-related resource information in northern and eastern Manitoba. The system, based on a method proposed by Lacate (1969), used an integrated hierarchy of four classification levels to classify and map terrain in terms of landform, surface deposits, vegetation, soils, drainage, permafrost, associated aquatic systems and climate (Mills et al. 1976).

The first and most generalized level, the Land Region, consists of an area of land characterized by a distinctive regional climate as expressed by vegetation. Conceptually, it is equivalent to the ecoregion level in the Canadian Ecological Land Classification System (CELCS) employed by The State of the Environment Branch, Environment Canada (Environmental Conservation Service Task Force, 1981). It is generally used at mapping scales of 1:1M to 1:3M or smaller.

The second level, the Land District, is an area of land characterized by a distinctive pattern of relief, geology, geomorphology and associated vegetation. It is approximately equivalent to the ecodistrict in CELCS and is useful at mapping scales of 1:500 000 to 1:1M.

The third level, and the basic mapping level employed in the northern resources mapping program in Manitoba, is the Land System, an area of land throughout which there is a recurring pattern of landform, soils and vegetation. It is equivalent to the CELCS ecosection and is employed at mapping scales of 1:125 000 to 1:250 000. Many of these basic mapping units were employed by the Canada Soil Inventory to characterize and delineate soil landscapes in northern Manitoba for the 1:1M Soil Landscapes of Canada (SLC's) series (Canada Soil Inventory, 1989). Many of these soil landscape polygons have also been used for the Manitoba portion of Environment Canada's reporting framework at the ecodistrict level.

The fourth level, the Land Type, is an area of land on a particular landform segment having a fairly homogeneous combination of soils and chronosequence of vegetation. This mapping unit is employed at scales of 1:50 000 to 1:20 000, but was not used in Manitoba.

Introduction of Land Resource Regions and Areas in Manitoba

The introduction of Land Resource Regions (ecoregions) and Land Resource Areas (ecodistricts) in 1978 in Manitoba stemmed from the use of Ellis' landscape areas (Ellis 1940) and the nesting of soil associations, soil associates and soil series mapping units into areas and regions from available mapping and soil characterization site data (Faculty of Agriculture, 1978). The expressed aim in developing such a hierarchal, ecological framework was to produce a map of regions that would reflect general spatial patterns in environmental resources. It delineated and classified ecologically distinct areas employing available ecoclimate, regional landscape physiography, surface materials and form, soil development and vegetation data. Such factors possess characteristics that tend to cohere and endure over the long term. They are also patterned after concepts developed for use in the United States (Austen, 1965). Land use maps were useful as indicators of where spatial changes in resource quality occurred.

The revision of land resource regions and areas reported in "Land Resource Regions and Areas for Southern Manitoba" (Eilers and Mills, 1992) derived much from the initial land resource regions and areas map (Faculty of Agriculture, 1978), the Ecoclimatic Regions of Manitoba (Mills et al, 1985), the Ecoclimatic Regions of Canada (Ecoregions Working Group, 1989) and the Soil Landscapes of Canada, Manitoba (Canada Soil Inventory, 1989). Land Resource Area (LRA) polygons were delineated and defined in terms of relatively homogenous attributes of natural indicators of climate (physiognomy, structural dominance and vigour of native vegetation), soil development, soil texture, geological surface material composition and form. Geographically associated SLC polygons were nested within LRA's.

This regionalization of natural soil landscapes and supporting databases, is useful for both generalized biological and non-biological research and applications.

Developing Ecoregions and Ecodistricts

The development of basic ecological units depicting natural landscapes of Canada at different levels of generalization provides a means to link Soil Landscapes of Canada (SLC) maps and their supporting databases to the Ecological Land Classification hierarchy employed by Environment Canada's State of the Environment Reporting Branch.

The collection, analysis and interpretation of land resource data was a well established role of the Centre for Land and Biological Resources Research of Agriculture Canada. Data collected during the course of joint Agriculture Canada and provincial soil surveys involve field measurement and collection of point source data from modal soil profiles to represent soils in large scale map units. Much of this data and many of these maps are compiled as digital coverage within Agriculture Canada's CanSIS/National Soil Data Base (MacDonald and Valentine, 1992), using the ARC-INFO geographical information system. This data needed to be brought into a common framework to allow integration and analysis of many other types of land resource data to solve problems of resource management, use, and assessment of environmental conditions and trends.

The Canadian Ecological Land Classification System divides Canada's natural landscapes into 15 terrestrial ecozones which are in turn sub-divided into 45 ecoprovinces, 177 ecoregions and 5428 ecodistricts. Ecozones are the most generalized level in the classification system. Ecoprovinces, ecoregions and ecodistricts represent subdivisions at progressively more detailed levels of ecological generalization (Environment Canada, Data Management Division 1991).

Ecological land classification provides a more holistic, physical description of land. It integrates surface vegetation cover, underlying geology, physiography, soil and climate that is more useful than a single sector approach to quantitative land resource analysis at the national and regional level. The approach to developing this framework was very similar to the approach taken by the U.S. Environmental Protection Agency in creating ecoregions of the contiguous United States (Gallant et al, 1989).

Development of the framework at the ecoregion level was done through an analysis of a combination of maps of physical factors that cause regional variations such as climate, geological and physiographic characteristics and those that integrate associated factors such as soils and vegetation to distinguish distinct regional patterns of ecosystems. Small-scale, low resolution national maps and general environmental descriptions were, for the most part, used as references. The combination of small-scale maps most useful for delineating ecoregions consisted of Ecoclimatic Regions of Canada (Ecoregions Working Group, 1989) and the Physiographic Subdivisions of Canada (Bostock, 1970). Other useful maps consulted included the Geological Map of Canada (Geological Survey of Canada, 1970), the Soil landscapes of Canada series of maps (Shields et al, 1991), the Soil Climates of Canada (Clayton et al, 1978), Terrestrial Ecozones of Canada (Wicken, 1986), and many regional soil surveys, biophysical and ecological studies. The latter sources of information were also very useful for defining and delineating the more detailed and homogenous ecodistricts.

Land use maps, although useful in reflecting land resource potential and therefore useful for defining ecoregions and ecodistricts, were not consulted since vast areas in Canada have not been affected by human activity and technology to affect environmental influences.

The component maps were analyzed together to delineate regions that were relatively homogeneous in overlapping patterns of climate, as expressed in natural vegetation, and regional physiography and geology, land-surface form and soil development. The key to this process was to distinguish overall regional homogeneity in a combination of these characteristics from the heterogeneity in each component characteristic. Some ecoregions could be clearly and easily delineated because of the distinctiveness of all five physical components relative to adjacent ecoregions. Other regions were less distinct and were delineated on the basis of broader attribute classes or groupings of these characteristics.

The size of each ecoregion was a function of within-region homogeneity relative to among-region variation at scales useful for national and regional resource management, monitoring and the reporting of environmental conditions and trends. For these purposes ecoregions could not be so large as to contain entire watersheds that, for example, traversed major contrasting ecoclimates and regional physiographic subdivisions such as the huge Saskatchewan River watershed, but of a size that would tend to exhibit more homogeneity within regions than the total range of component variability among adjacent contrasting regions. Some regions exhibit a range of variability common throughout the region that were too small and patchy to allow delineation at scales appropriate for national and regional application. The Columbia Mountains and Highlands in southern British Columbia, for example, were characterized by such contrasts. There, mountain ranges and narrow valleys have vertically stratified ecosystems ranging from treeless alpine tundra, to subalpine and montane forested mountains, to agricultural valley bottoms.

Ecodistricts in this framework are approximately equivalent to ecodistricts in the hierarchy of Environment Canada's ecosystem classification. They are subdivisions of ecoregions differentiated primarily on the basis of such defining criteria as landform composition, land-surface shape, textural group, soil development, and distribution of permafrost. Additional characterizing attributes include AVHRR (Advanced Very High Resolution Radiometers) land cover classes and vegetation classes derived from the Soil Landscapes of Canada database.

Ecodistricts attribute classes are slight modifications of those used to define Soil Landscapes of Canada polygons (Shields et al, 1991). For the most part, a land resource area is composed of Soil Landscapes of Canada polygons that share a dominant landform in terms of composition and surface shape characteristics and no more than a few differing textural groups and soil development classes. Ecodistricts tend to be more homogenous than ecoregions and are smaller in size in southern Canada than they are in northern Canada reflecting the greater extent of more detailed soil mapping in the south.

Definitions and Criteria

Ecozones

Ecozones are areas of the earth's surface representative of very generalized ecological units that consist of a distinctive assemblage of physical and biological characteristics. They possess environmental characteristics that tend to cohere and endure over the long term (Wiken, 1986).

Ecozones are the most generalized level in Environment Canada's ecological land classification system. Ecoregions and ecodistricts represent subdivisions at progressively more detailed levels of ecological generalization.

The focus of this report is a description of ecoregions and ecodistricts and, except for summary descriptions, does not represent a significant evaluation of ecozones under which ecoregions have been organized on the seamless national Terrestrial Ecozones and Ecoregions of Canada map.

Ecoregions

Ecoregions are broad, integrated map units characterized by a unique combination of landscape physiography and ecoclimate. They are formed by conjoining major ecoclimatic regions as defined by the Ecoregions Working Group (1983) and major physiographic subdivisions as defined by Bostock (1970).

Ecoregions form part of an ecoprovince and an ecozone, the latter being the most generalized level within Environment Canada's Ecological Land Classification hierarchy, and as such are characterized by distinctive ecological responses to climate as expressed by vegetation, soil development, and presence or absence of near surface permafrost. Ecoregion boundaries have been guided by distinctive features of both climate and physiography.

The combination of 8 major ecoclimates and 5 major physiographic subdivisions has led to the recognition of 16 unique ecoregions in Manitoba.

Ecodistricts

Ecodistricts are integrated map units characterized by relatively homogeneous physical landscape and climatic conditions. They are subdivisions of an ecoregion and have a more uniform biological production potential. Soil Landscapes of Canada polygons are nested within ecodistricts. Ecodistricts in this framework are approximately equivalent to ecodistricts in the hierarchy of Environment Canada's ecosystem classification. They are differentiated primarily on the basis of such defining criteria as landform composition, surface shape, textural group, soil development, and distribution of permafrost. Additional characterizing attributes include AVHRR land cover classes and vegetation classes derived from the Soil Landscapes of Canada database.

Secondary characterizing attributes for ecodistricts in southern Manitoba have been found to be useful and include: agroclimatic rating, mean annual air temperature (°C), mean frost free period (number of consecutive days with minimum temperature >0°C; period between last spring and first fall frost), mean number of growing degree days (accumulation of days that the daily average temperature [average of maximum and minimum temperature] is greater than 5°C multiplied by the number of °C the daily average exceeds 5°C for each day), mean annual precipitation (mm), mean growing season (May-August or May-September), precipitation in mm, moisture deficit (Precipitation [P] - Potential Evapotranspiration [PE]) accumulated over the growing season by August 13 or September 30), identification of a dominant and subdominant Soil Series with their Canada Land Inventory (CLI) agriculture capability class, and a dominant and subdominant land use and cropping system.

Additional sectoral interpretations (e.g. forestry), socio-economic units, enumeration area data, vegetation descriptions or any suitable ecological equivalents that may be employed within the province may also be attached to these units as such needs arise.

In Manitoba, the nesting of Soil Landscapes of Canada units (SLC's) within Ecoregions has resulted in the recognition of 93 unique Ecodistricts. It should be noted that ecodistricts tend to be more homogenous and smaller in size in southern Manitoba than they are in the north reflecting the greater extent of more detailed mapping in the south.

Map Compilation

As stated earlier, small-scale, low resolution national maps and general environmental descriptions were, for the most part, used as references for delineation of ecoregions and ecodistricts. These small-scale maps were produced over the years by a number of provincial and national working groups, agencies and individuals.

Delineating actual ecoregion boundaries involved an interpretive process of both map overlay and qualitative analysis of the relative accuracy and level of generality of each component map. After evaluating and compensating for the differences in accuracies and generalities of each map and identifying the obvious regional interrelationships among components, final ecoregion boundaries were drawn. In actuality, there is no discreet, correct location for placement of lines on a map and therefore boundaries should be interpreted to represent transitional tracts of varying widths. Sites located near boundaries often have characteristics typical of more than one region.

Ecoregion names were usually taken from a centrally located, prominent physiographic element such as a mountain range, plateau, plain, basin or lake, or in the case in the prairie provinces, major ecoclimatic belts.

Ecoregion polygons have been ordered and coloured by Ecozones, a regionalization that emphasizes major enduring differences in both physiography and ecoclimate within Canada.

Ecoregion map codes are numeric and were ordered within ecozones. Ecodistricts codes are also numeric and ordered within nationally recognized ecoregions.

The Manitoba ecoregion and ecodistrict maps are provincial segments of the seamless national maps of ecoregions and ecodistricts. While some ecoregion and ecodistrict polygons in Manitoba span neighbouring Saskatchewan, Ontario,Nunavut and the Northwest Territories, calculation of their extent in hectares (or in square kilometres)is based on their land area within Manitoba.

Ecoregion and ecodistrict maps are compiled as digital coverage within Agriculture Canada's National Soil Data Base (MacDonald and Valentine, 1992) using the ARC-INFO geographical information system. Windows or segments of special interest areas within the province and their supporting data can be extracted from this database to suit individual applications and other GIS systems. Requests for such information should be routed through the Land Resource Unit, Brandon Research Centre, Agriculture and Agri-food Canada, Rm 362A Ellis Building, University of Manitoba, Winnipeg, MB, R3T 2N2. Phone (204) 474-6118.

A narrative description of each ecoregion was based on the definitive criteria for the construction of the map unit. The description of physiography followed that given by Bostock and as modified for Manitoba by Mills (unpublished). Soil climate description was taken from Soils of Canada (Clayton et al, 1978). Vegetation description followed, to a degree, the conventions in The Canadian Vegetation Classification System proposed by Strong et al (1990).

Within each ecoregion individual ecodistrict descriptions were based on the criteria used for their definition. Additional secondary characterizing attributes included climatic characteristics, physiography and drainage, soil development, vegetation, sources of water and land use. Information on soil climate, including soil temperature and soil moisture, pertains to moderately well drained soils, with gentle slopes and loamy textures; these soils are called "modal or mesic soils". Soils that vary in one or more properties from the modal soil are usually either drier and warmer or wetter and colder than the modal for that area. Organic soils are generally much wetter and at least one class colder than mineral soils in the same ecodistrict.

Ecozones, Ecoregions and Ecodistricts of Manitoba

Justification

This report describes briefly the landscape and ecology of the ecozones, ecoregions and ecodistricts that occur whole or in part in Manitoba. As the information that is available in regard to landforms, surficial materials, soils, vegetation, wildlife etc. varies form area to area in detail and accuracy, so varies the information provided in the descriptions. Many sources, including scientific papers, articles, reports, personal communications, published and unpublished data, were used to bring together the information provided. Most sources are listed in the reference section, but is was deemed unworkable to list the references in the text. A number of sources were used extensively throughout the report and these have been listed below. It was also deemed useful when, at the same time, some explanation and /or qualification was to be provided on this data and information, before the reader consulted a particular description. Terms used in the descriptions are defined in Appendix A. For more extensive information on some of the terms, it is recommended to consult the appropriate reference.

Climate

In the climate sections extensive use was made of the Canadian Ecodistrict Climate Normals (1961-1990) by Bootsma. The data provided by Bootsma was generated as follows (abstracted from Bootsma, 1998):

The 1961-1990 data for temperature and precipitation included only stations with averages based on more than 19 years of data. Data from additional stations which had temperature and precipitation normals for the 1951-1980 period was used also to provide maximum station density, but these normals were first adjusted to the 1961-1990 period by comparison with nearby stations.

Monthly air temperature and precipitation variables were interpolated using the Thiessen polygon method. The Thiessen polygons were overlayed with ecodistrict polygons, and an area-weighted value was generated for each ecodistrict.

Averaged monthly and annual potential evapotranspiration (PE) values were estimated from monthly climatic normals for each ecodistrict using the Penman method. The Penman PE calculations were made on a daily basis assuming a grass cover with an albedo of 0.25 when average mean daily temperatures were above 0 degrees Celsius. When temperatures were below freezing, an albedo of 0.75 for snow cover was assumed. Negative daily PE values which could occur in winter were set to zero. Daily normal PE values were summed to obtain monthly and annual monthly values for Penman PE.

The moisture deficit presented is the one estimated for soils with a 200 mm available water-holding capacity using the Penman PE estimates.

Annual growing degree-days above 5 degrees Celsius were computed from the monthly mean air temperature data. Interpolation techniques were used to generate daily mean air temperatures from monthly values and daily growing degree -days were calculated by subtracting the base temperature from the mean daily temperature (negative values were set to zero). Daily values were summed to obtain annual total.

Date of the growing season start and end were determined by the first and last day of the year when the mean daily air temperature equals or exceeds 5 degrees Celsius. This is generally considered to coincide with the growing period for perennial forage crops.

Temperature and precipitation data average values for climate parameters for the ecodistricts have been rounded somewhat, but are close to what was calculated by Bootsma. The data was calculated from climatic data from stations throughout Canada; thus the values for ecodistricts which are only partially located in Manitoba were based on stations both within and outside the Manitoba boundaries. Figures are for mean yearly temperature and growing season length.

The figures presented in the climate sections have been rounded to a slight degree from those provided by Bootsma. For more information on the methodologies used and rationale for the Canadian Ecodistrict Climate Normals 1961-1990, it is suggested that the reader contact Andrew Bootsma, Land Resource Evaluation Program, ECORC, Ottawa, ON, K1A 0C6. The data presented for individual climate stations (tables) was derived from Climatic Normals as referenced.

The soil climate terms used refer to soil temperature classes as defined in the table below and are modified from the Soil Climate Map of Canada 1975.

Data and information for other sections in the descriptions were derived from sources as noted below.

Physiography and drainage

Information for this section came from soil and biophysical reports, topographic maps (scale 1: 250 000), surficial geology maps, papers on Glacial Lake Agassiz, the Proposed Watershed Divisions of Manitoba by A. N. Fedoruk, and other published and unpublished data.

Soils

Most of the information for this section was derived from soil reports and soils maps at various scales, biophysical reports and maps, published and unpublished data, and observations by the authors.

Vegetation

The information in this section is from vegetation reports, papers on the vegetation of northern Manitoba by J.C. Ritchie, vegetation sections in soil and biophysical reports, other published and unpublished data, personal communication, and observations by the authors.

Wildlife

Most of this information is from the unpublished report on the Ecoclimatic Regions for Manitoba.

Other sections

The information in the remaining sections was taken from a large variety of sources.

Soil Temperature Classes and Characteristics as Defined for Soil Climate Regions and Subregions

Soil Climate Regions and Subregions	Soil Temperature Classes and Characteristics (for 50 cm depth)			
	Mean Annual Soil Temperature (MAST)	Mean Summer Soil Temperature (MSST)	Number of Days > 5°C	Degree Days >5°C
Arctic	<-7.0	<2.0	0 to <10	0
High Arctic		<0.0	0	0
Mid Arctic		0.0 to <2.0	0	0
Low Arctic		0.0 to <2.0	0 to <10	<10
Subarctic	-7.0 to <2.0	2.0 to <4.0	10 to <80	0 to <55
Cryoboreal	2.0 to <5.5	4.0 to <12.0	80 to <190	55 to <1000
Cold Cryoboreal		4.0 to <8.0	80 to <160	55 to <160
Moderately Cold Cryoboreal		8.0 to <12.0	160 to <190	160 to <1000
Boreal	5.5 to <8.0	12.0 to <18.0	190 to <220	1000 to <1720
Cool Boreal			>190	1000 to <1500
Moderately Cool Boreal			<220	1500 to <1720

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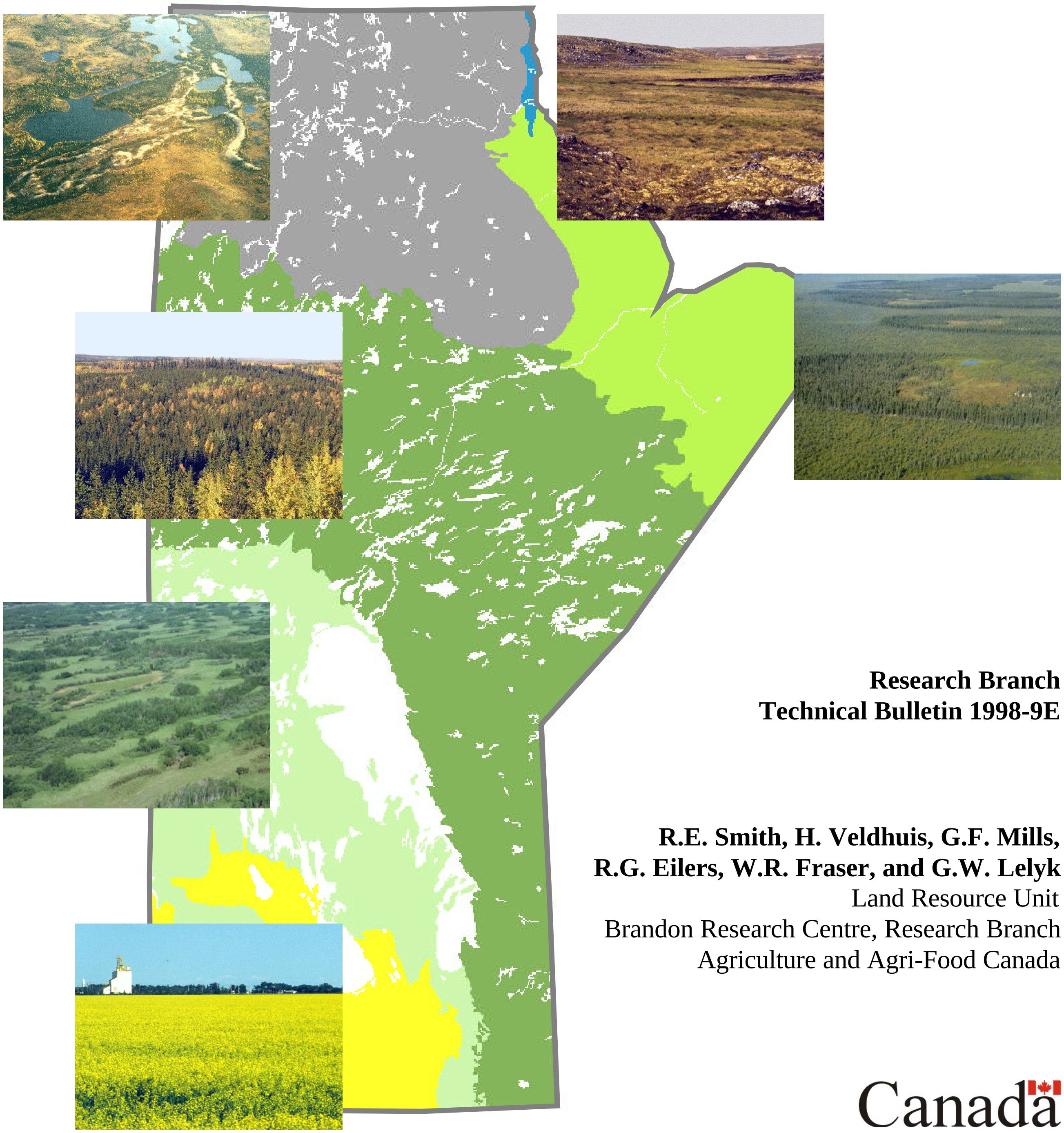
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



Research Branch
Technical Bulletin 1998-9E

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Southern Arctic Ecozone

The Southern Arctic Ecozone is split by Hudson Bay into east and west portions. It covers the northern mainland of Canada from the Richardson Mountains in the Yukon to western shore of Ungava Bay in northern Quebec. This is the area that is often referred to as the “barren lands.” This name reflects the largely treeless nature of the ecozone, as most of it lies north of the tree line. Another characteristic of the ecozone is the presence of large numbers of barren-ground caribou, which use the area for calving and summer range.

Climate

This ecozone has a Low Arctic Ecoclimate characterized by moist and cool summers that are about four months long, and very long, extremely cold winters. The climate is slightly milder and more moist in the eastern sector compared to the area west of Hudson Bay. This may be due to a stronger continental effect in the western sector. Mean annual temperatures range from -12 °C in the northwest to -7 °C in Quebec. Mean summer temperatures range from 4 °C to 6 °C, resulting in a growing season with generally less than 500 growing degree-days in the western section. However, the short growing season is enhanced by long periods of daylight characteristic of northern latitudes.

Annual precipitation is generally less than 250 mm in the west and seldom more than 500 mm in the east. The soil climate is classified as extremely cold, humid, Arctic. Permafrost is almost continuous throughout the ecozone.

Selected Climate Data (Annual Means) for the Western Section of the Southern Arctic Ecozone[1]

Station	Temperature (°C)	Precipitation			Degree Days (>5°C)	Frost Free Period (days)
		Rain(mm)	Snow(cm)	Total (mm)		
Tuktoyaktuk [2]	-10.9	72.3	65.2	137.6	392	56
Coppermine[2]	-11.6	102.7	100.7	202.3	325	59
Contwoyto L.	-12.0	128.8	122.0	251.3	339	47
Baker Lake	-12.2	138.3	100.0	234.6	391	67
Chesterfield[2]	-11.6	145.5	112.5	258.9	270	67

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

[2] Stations located on the coast

Surficial deposits and landforms

The terrain is underlain for the most part by Precambrian granitic bedrock and consists largely of broadly rolling uplands and lowlands. Much of it is mantled by veneers and blankets of glacial till. Other materials consist of glacio-fluvial deposits in the form of eskers, kames and outwash aprons. Although some till was deposited during glaciation, most of the materials were released from the melting ice during the last deglaciation about 7000 to 8000 years ago. Beach ridges, marking former pre-glacial lakes or former marine shorelines, are locally prominent. Near the coasts, fine to medium textured marine sediments cover the surface.

Throughout most of the ecozone, there are exposures of bedrock and shallow deposits of organic materials. This area is also characterized by numerous small to medium size lakes. Where surface deposits are shallow, the lakes have irregular bedrock-controlled shores, and are generally deep and clear. In areas of more extensive overburden, the lakes are shallower and have less convoluted shorelines. The westernmost section of the ecozone from Great Bear Lake to the Richardson Mountains consists of Cretaceous shales covered by thick glacial drift. In this area, bedrock exposures are few and lakes are much less common.

Depending on the texture of soil material, thickness of organic overlay and drainage, permafrost may lie from a few centimetres to more than 100 cm below the land surface. Permafrost acts as a barrier to the downward movement of water and there is a continuous supply of moisture from melting frost. As a result, active soil layers remain wet throughout for most of the growing season resulting in widespread wet soils even though total precipitation is relatively small. The presence of permafrost, the many cycles of freezing and thawing, and the intense cold result in the formation of patterned ground in the form of ice-wedge polygons, earth hummocks, sorted and non-sorted circles, stripes and steps. Frost-heaved boulders and frost-shattered bedrock fragments are common throughout the area.

Soils

Because permafrost is so widespread, most soils in the ecozone belong to the Cryosolic Order. Both Turbic Cryosols, which have distorted, broken, and displaced horizons due to cryoturbation, and Static Cryosols, which show little cryoturbation, are widespread.

Shallow organic surface layers are common. Organic Cryosols are also present, but are much less extensive than in the Taiga Plains, Taiga Shield and especially the Hudson Plain ecozones to the south. Brunisolic soils occur where maximum depth of the annual thaw (active layer) is deep, usually on well drained, coarse textured materials. Regosolic soils occur along the coast on newly emerged land, where permafrost has not yet developed.

Vegetation

While this ecozone lies mostly north of the tree line, forest stands, some separate from, and others contiguous with the Taiga forest, can be found in major river valleys.

Vegetation is largely continuous, except along the coast on newly emerged land and on bedrock exposures. Areas with little to sparse vegetation occur where cryoturbation near the soil surface disrupts rooting, and in areas with more severely restrictive climatic conditions due to aspect and exposure.

Characteristic vegetation consists of dwarf shrubs, which decrease in size northward. Typical shrubs include dwarf birch, willows and heath species, which are commonly associated with various herbs, mosses and lichens.

Wetlands are common in the low-lying areas, and mainly support sedge-moss vegetation.

Wildlife

The western part of the ecozone includes the major summer range and calving grounds for the Bluenose and Bathurst barren-ground caribou herds, two of the largest barren-ground caribou herds found in Canada. Other large mammals include muskox, barren-ground grizzly bear and polar bear (along the coast). Other species of mammals include arctic wolf, arctic fox, arctic hare, arctic ground squirrel, and brown and collared lemmings. In the marine environment bordering this ecozone typical species include walrus, various seals, white whale and narwhal.

This ecozone provides one of the continent's major breeding areas for snow geese along the Hudson Bay coast. It is also a major nesting area for a variety of other birds such as arctic and red-throated loon, whistling swan, old squaw, gyrfalcon, willow and rock ptarmigan, northern phalarope, parasitic jaeger, snowy owl, hoary redpoll and snow bunting.

Lake trout, arctic grayling and arctic char are typical fish species found in the lakes and streams.

Land use

This ecozone is one of the most sparsely populated areas in Canada with a total population of about 10 000 people. The Inuit comprise about 80 percent of the population. Rankin Inlet on the Hudson Bay coast is the largest centre with a population of about 1700. Subsistence hunting, fishing and trapping are the primary land-oriented activities. The mineral and petroleum potential of the area has also led to significant exploration and extraction activity. Other occupations include construction, service industry, and government services.

There is only one ecoregion within the Southern Arctic Ecozone in Manitoba.

The plates depicting landscapes from the Southern Arctic Ecozone are largely from the Nunavut portion of the Maguse River Upland Ecoregion. As only a small part of this ecoregion occurs in Manitoba, some of the landscape characteristics are of limited extent in the Manitoba portion.

Plate SA1.
Wet tundra. The tundra adjacent to Hudson Bay is largely level and poorly drained. Farther inland, the landscape consists of low hills surrounded by wet tundra. The vegetation in the wet areas is dominated by sedges. The aggregation of ice in the form of ice lenses causes subdued, topographic highs, covered by thin peat, to develop in the low-lying areas.

Plate SA2.
Relic Beaches. Since the continental ice sheet disappeared after the last ice age, isostatic rebound along Hudson Bay has been profound. It has resulted in the formation of many parallel beaches, and of closely spaced concentric beaches surrounding isolated highs. The crests of the beaches are usually dry and vegetated with lichens, while the intervening lows support vegetation varying from sedges to shrubs.

Plate SA3.
Tundra fire close to Hudson Bay coast. Although the tundra along the Hudson Bay coast is generally wet for most of the year, farther inland where a thin peat has developed, the peat surface may become dry during the summer. The dessication of the peat surface allows wildfires to occur. These fires sometime are the result of human carelessness, but most fires are caused by lightning strikes.

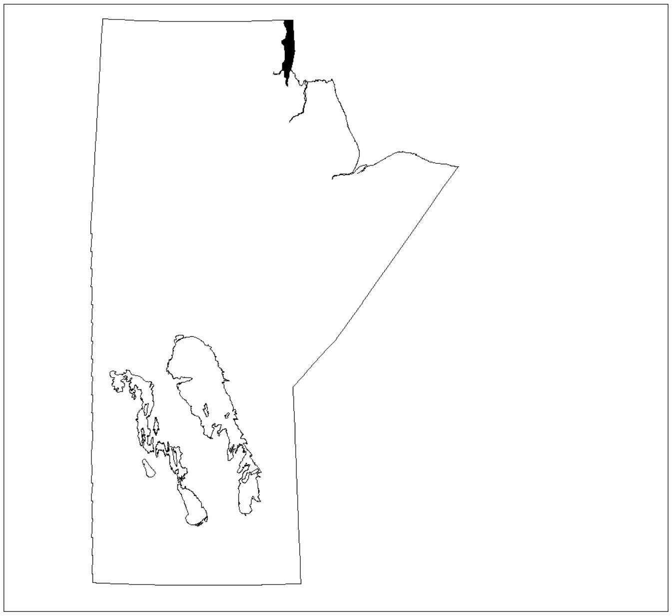
Plate SA4.
Low-centre ice-wedge polygons. Ice-wedge polygons are patterned ground features that are only found in permafrost regions. Ice-wedges form when rapid and severe cold causes the land surface to crack. During spring, meltwater will enter the cracks and freeze, preventing the crack from closing. In subsequent years the cracks will open many times and the ice-wedges increase in size both in lateral and vertical dimensions. The depression that develops above the ice-wedge is called the polygonal trench. Through the increase in ice volume, soil material along the trenches is pushed up and forms shoulders. As a result, an area that was initially level may develop a micro-topography with linear depressions and low lying, polygonal centres. Peat development may take place in these wet centres. If water remains in the trenches for extended periods, the ice-wedges may melt in part or in total.

Plate SA5.
Orthic Dystric Turbic Cryosol on sandy loam till. Soil development in the arctic environment is slow. The most significant conditions affecting soils in this environment are the presence of permafrost and the severe cold. The presence of permafrost prevents the downward movement of water, and during the summer melting frost creates a saturated zone above the permafrost table in most soils. In medium and fine textured soils, the thaw and freeze cycles that occur in fall and spring create cryostatic and hydrostatic pressures that cause the churning of soil materials. At the surface this is often manifested as patterned ground, while in the soil profile it is expressed through the presence of broken, distorted and displaced horizons, and the incorporation of organic surface material as streaks and pockets.

Plate SA6.
Small upland area, with poorly developed circles, surrounded by wet tundra. The processes that result in the formation of cryoturbated soils are also responsible for the formation of some patterned ground features. Circles are formed when material is moved to the surface through hydrostatic and cryostatic pressures, disrupting the surface and killing plant growth. When the circles are active they are unvegetated as plants are prevented from rooting. When they are dormant for long periods, mosses and lichens are able to re-vegetate the sites. Another feature is the frost-heaving of coarse fragments to the surface. Wet sedge areas often have micro-hummocky topography as a result of differential ice formation underneath sedge clumps.

Plate SA7.
Bouldery till upland bordered by wet lowland tundra. The surface of the upland area in the foreground is bouldery. The boulders are moved to the surface by frost heave, the result of the formation of ice-lenses below the coarse fragments. The low areas remain very wet for most of the summer.

45. Maguse River Upland Ecoregion



This ecoregion spans the boundary between Manitoba and the Northwest Territories along the west coast of Hudson Bay. Only the most southern extension of the ecoregion lies within Manitoba. The effect of the cold waters of Hudson Bay extends arctic climate conditions south in a narrow strip along the west coast of the bay.

The ecoregion is underlain by continuous permafrost except for areas recently emerged along the coast and areas below deeper lakes. Soils remain generally frozen within shallow depth (less than 100 cm) for all or most of the growing season.

Climate

The regional climate, classified as Low Arctic Ecoclimate, is marked by summers that are short, moist and cool, and winters that are long and extremely cold. The cold water of Hudson Bay, which doesn't become ice-free until late July, has a strong influence on the climate along the coast. In summer, a shift in wind direction may cause significant changes in air temperature. Mean annual air temperature for the ecoregion is about -12.0^{o}C, average growing season about 100 days, and the number of growing degree-days ranges from about 300 to 400, and slightly higher in the most southern portion.

Average annual precipitation is about 250 mm, but is higher along the coast. It varies greatly from year to year and is highest during the growing season. The average yearly moisture deficit is less than 50 mm.

The ecoregion has an extremely cold, humid, Arctic soil climate. Temperature and precipitation data are available for two stations in the region. Both stations are located along the northern boundary of the region, Baker Lake is located inland and Chesterfield is situated on the coast.

Selected Climate Data[1] for Baker Lake

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-33.0	-32.6	-27.9	-17.3	-6.4	4.1	11.0	9.7	2.3	-7.7	-20.3	-28.2	-12.2
Precip. mm	7.7	4.9	7.6	13.8	12.0	20.9	38.1	37.3	37.0	30.6	16.5	8.2	234.6
Growing degree-days	0.0	0.0	0.0	0.0	0.1	37.6	186.3	148.6	19.2	0.0	0.0	0.0	391.8

Selected Climate Data[1] for Chesterfield

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-31.5	-31.6	-26.5	-16.5	-6.0	2.9	8.9	8.4	2.5	-5.7	-17.4	-26.4	-11.6
Precip. mm	7.6	46	8.3	12.0	15.1	23.1	41.2	38.7	40.6	33.8	19.9	14.0	258.9
Growing degree-days	0.0	0.0	0.0	0.0	0.0	23.3	126.1	108.7	11.8	0.1	0.0	0.0	270.0

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

Surficial deposits and landforms

The ecoregion lies within the Kazan Upland. It consists of crystalline Archaean massive rocks forming broad sloping uplands and lowlands. Elevations range from 210 masl along its western boundary to sea level at Hudson Bay. The upland slopes gently and drains eastward to Hudson Bay via many rivers, creeks and tributaries. The largest rivers crossing the region include the Seal and Caribou rivers in the Manitoba portion and the Thiewiaza, Ta-Anne, McConnell, Maguse and Wilson Rivers in Nunavut.

The ecoregion consists of deep drumlinoid and fluted sandy till in the east and loamy till in the northwest. Eskers and outwash materials are locally prominent. In the section along Chesterfield Inlet, till deposits are very thin resulting in extensive exposed bedrock outcropping. Along the coast, the more common unconsolidated deposits are marine silts and clays. Crevasse fillings and ribbed moraines are common in the area along the Northwest Territories - Manitoba boundary.

As most of the ecoregion was submerged by the Tyrrell Sea after deglaciation, terraces and beaches associated with drumlins, eskers and hills are locally common. Bouldery lag deposits are also locally significant.

Very small, small and medium size lakes are common throughout. The area along Hudson Bay, between the 30 masl contour and the shore extending some distance north of the Maguse River outlet, consists of a marine sand and silt plain with few glacial features. On the bay side this area is bordered by tidal mud-flats and also has many very small, shallow lakes, of which many are ephemeral.

Soils

Most soils in the ecoregion are shallow and weakly developed on sandy and loamy till. The soils are largely Turbic and Static Cryosols, with minor areas of other soil types. Turbic Cryosol soils are especially widespread on the loamy till of the northwest section, and have profiles that exhibit discontinuous, uneven and disturbed soil horizon development, and incorporation of organic material in the form of smears and pockets. They are frequently associated with patterned ground like sorted and non-sorted nets and circles (mud boils). Static Cryosols are permanently frozen soils which lack significant horizon distortion. They are most common on sandy till and other coarse textured deposits.

Dystric Brunisolic soils occur in areas where active layers (thickness of summer thaw) are deep. This condition generally only occurs on coarse textured deposits such as beaches and eskers. Along the coast on extensive areas of newly emerged land, soil development is lacking or weak, and permafrost has not yet formed, Regosolic and Gleysolic soils are common. Organic Cryosols occur in areas of shallow to deep organic materials.

Vegetation

This ecoregion has a nearly continuous cover of dwarf-shrub tundra vegetation usually less than 30 cm tall and includes dwarf birch, willow shrubs, northern Labrador tea and bilberry. Taller (up to 2 m) birch, willow and alder occur on south facing sites, along streams, and in sheltered locations where snow accumulates. Poorly drained areas may have willow shrub vegetation, but more often the vegetation is dominated by sedges and cotton-grass. Herbs, lichens and mosses are also widespread and are often interspersed with shrub cover. Distribution varies with aspect, exposure and drainage.

Wildlife

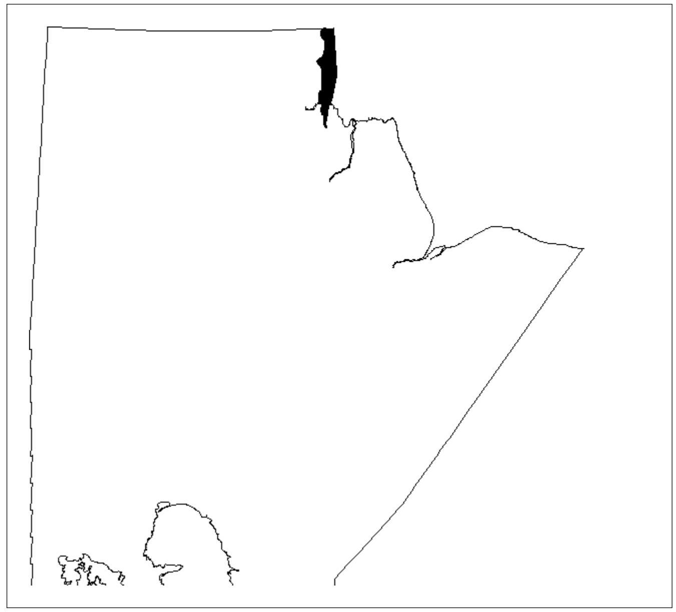
This ecoregion provides important summer range for barren-ground caribou and breeding habitat for snow geese, Canada geese and other waterfowl. Other wildlife includes polar bear in coastal areas, arctic fox, arctic ground squirrel, masked shrew, brown lemming, arctic wolf, weasel, snowy owl, willow and rock ptarmigan, several species of shorebird, and rough-legged hawk. There are walrus, white whale and various seals in the adjacent marine environment.

Land use

This ecoregion is sparsely populated, but contains four communities: Arviat, Whale Cove, Rankin Inlet and Chesterfield Inlet, which are in the Nunavut portion of the ecoregion. Rankin Inlet (population 1700) is the largest and is the trading and administrative centre for an area extending well beyond the ecoregion boundaries. Most of the population is Inuit and land use activities are generally centred around sustenance hunting, fishing, trapping and sealing. Other occupations are in construction and in providing private and government services.

There is only one ecodistrict within the Maguse River Upland Ecoregion in Manitoba.

183. Hubbart Point Ecodistrict (2589 km²)



This ecodistrict spans the boundary between Manitoba and the Nunavut and covers all of the area of the Maguse River Ecoregion in Manitoba. Only the most southern extension of the district is situated in Manitoba. This part of the district is much influenced by the cold waters of Hudson Bay, especially during the summer. Permafrost is almost continuous and is generally less than 100 cm below the surface.

Climate

The Hubbart Point Ecodistrict has a Low Arctic Ecoclimate that is strongly affected by Hudson Bay. The summers are short, cool and moist, with variation in daily air temperature strongly influenced by winds coming from Hudson Bay. The winters are long and very cold. Climatic data from Churchill station, which is situated a short distance east of the most southern extension of the district, are likely more valid for this district than those from Baker Lake or Chesterfield. Mean annual air temperature is approximately -7.1°C along the coast, and is possibly somewhat lower farther inland. The growing season is 100 days, with about 480 growing degree-days.

Average annual precipitation is about 400 mm, which can vary greatly from year to year. About two-fifths of the precipitation falls as snow. Precipitation is highest during the growing season. The average yearly moisture deficit is less than 25 mm. However, only a few soils have a moisture deficit during the growing season, as most soils remain wet well into the growing season due to slow runoff after snowmelt and poor internal drainage because of permafrost. In addition, most soils have moisture supplied from melting frost, which ameliorates potential deficits. Actual moisture deficits are likely only to be encountered on coarse textured, well drained soils which have limited available water holding capacity.

The ecodistrict has a very cold, humid, Arctic soil climate.

Selected Climate Data[1] for Churchill Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-7.1	9.7	6.7	11.8	-26.9
Precip. mm (equiv.)	411.6	155.7	238.8	50.7	17.3
Rain/Snow (mm/cm)	35.4/200.1	151.4/4.2	211.1/29.2	50.7/0.0T	0.0T/20.1
Growing degree-days >5°C	562	489	557	215	0

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

Physiography and Drainage

Most of the ecodistrict, and almost all of the Manitoba section except for some areas along the western portion of the district, was submerged in the Tyrrell Sea following deglaciation 7000 to 8000 years ago.

The Hubbart Point Ecodistrict is largely a coastal lowland that is a level to depressional marine plain and brackish tidal flat along the west coast of Hudson Bay. In Manitoba, the ecodistrict's elevations range from about 30 masl along its western margin to sea level along its eastern boundary, decreasing at the rate of about 1.5 m per km. Shallow horizontal fens, unconnected lakes and undrained ponds are characteristic along its western margin. Some eskers provide locally prominent relief.

The ecodistrict is part of several drainage systems including the Caribou, Seal and Little Seal rivers. These rivers are the primary drainage ways that traverse eastward through the ecodistrict and drain into Hudson Bay. Due to topography, most of the ecodistrict is poorly drained resulting in numerous ponds being formed after snowmelt.

Soils

The almost continuous occurrence of permafrost in this ecodistrict has had a profound effect on soil development. Most soils are classified as Cryosols, and most have permafrost within 100 cm of the surface. However, where soil materials are coarse textured and well drained, the seasonal thaw layer may extend much deeper, and some of these soils are classified as Brunisols. On imperfectly to poorly drained sites, and especially where peat has accumulated at the surface, the annual thaw depth (active layer) only extends to 40 cm or less.

Along the coast the soils are a complex of well to imperfectly drained sandy Regosols and Eluviated Dystric Brunisols on marine beaches, where permafrost has not developed as yet, or where the active layer is deep and poorly drained Gleysols on mud flats. Gleysolic and Regosolic Static Cryosols are found further inland on older marine deposits and on the till deposits both Turbic and Static Cryosols are present. The Turbic Cryosols are associated with sorted and non-sorted circles, nets and stripes, (patterned ground) on loam, sandy loam and loamy sand textured till, while the Static Cryosols are found on coarser textured materials.

Wetlands have formed in depressions and on flat lying terrain where the landscape impedes drainage. Where no peat or only shallow peat has developed, Gleysolic Static Cryosols or Gleysolic Turbic Cryosols have formed, depending on the texture of the material. Organic Cryosols are associated with deeper peat, which area may extend to a depth of 2 m. Peat deposits are either lowland polygon fens, usually composed of moderately decomposed sedge peat, or polygonal peat plateau bogs which may contain extensive amounts of slightly decomposed Sphagnum peat, especially in the surface layer.

The severe climatic conditions prevent the use of the ecodistrict for forestry or agriculture. In addition, lack of rooting depth, limited water and nutrient holding capacity and stoniness further limit the usefulness of mineral soils. Also, poor natural drainage and poor heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation in the Manitoba portion of the ecodistrict is characterized by its lack of trees. Some very open and stunted stands of black spruce and tamarack, with their associated ground cover of dwarf birch, willow, lichens and mosses, occur in some of the most southerly areas. Most of the vegetation is sedges and mosses associated with the extensive wetlands, which include fens and palsas, that have developed in this poorly drained terrain.

Water

Very small to small shallow lakes and ponds are numerous. The water usually contains large amounts of organic and iron compounds, making it less suitable for domestic use. Sources of better quality water are the larger and deeper lakes and the Knife, Seal, and Caribou rivers and other numerous small rivers and creeks draining into Hudson Bay.

Land Use

The ecodistrict has no settlements and the permanent population is consequently very small. It is mainly used for subsistence hunting, trapping and fishing by people from settlements to the north and east. Tourist activities are largely associated with lodges located in the ecodistrict or in adjacent ecodistricts.

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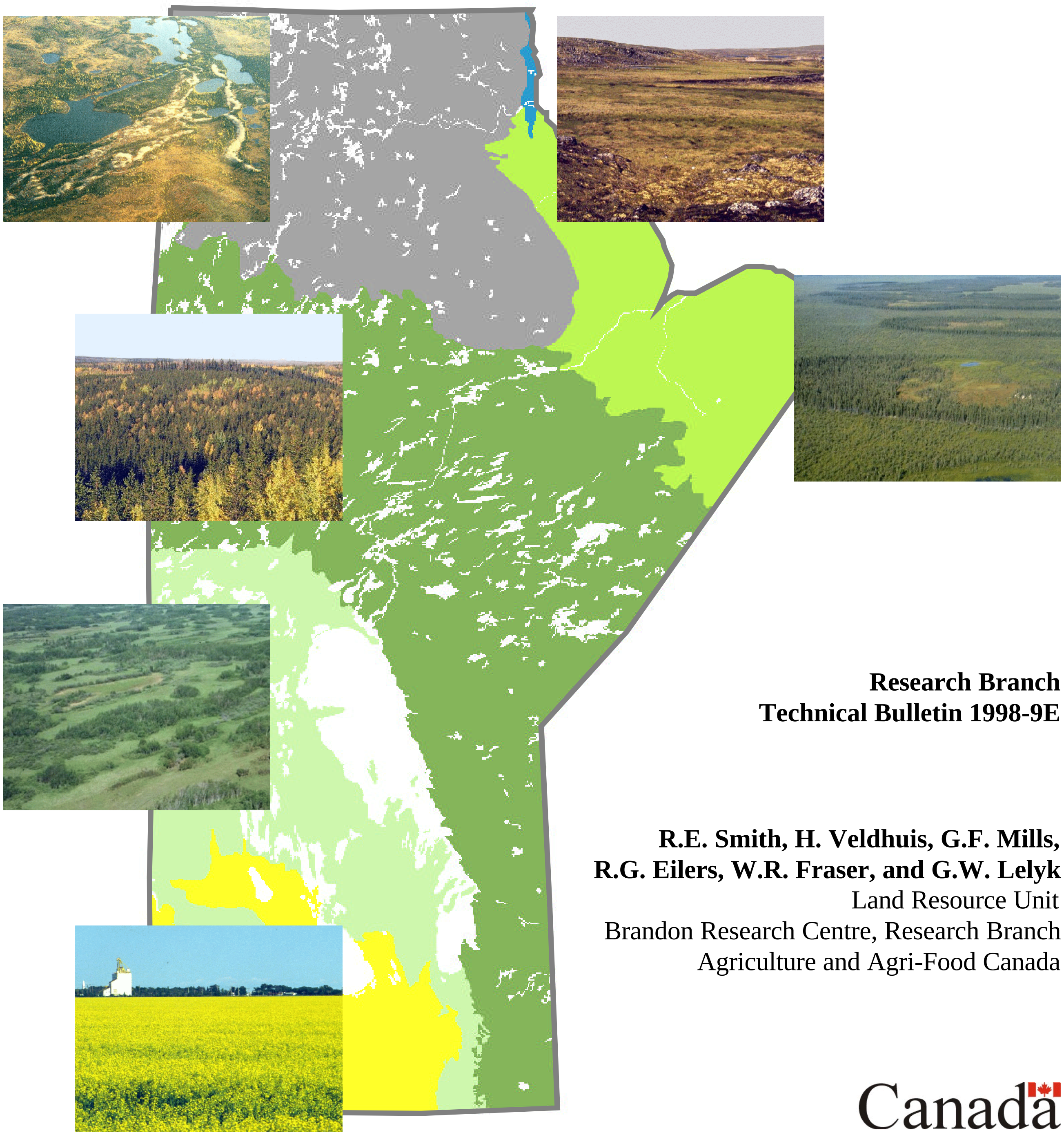

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Taiga Shield Ecozone

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.

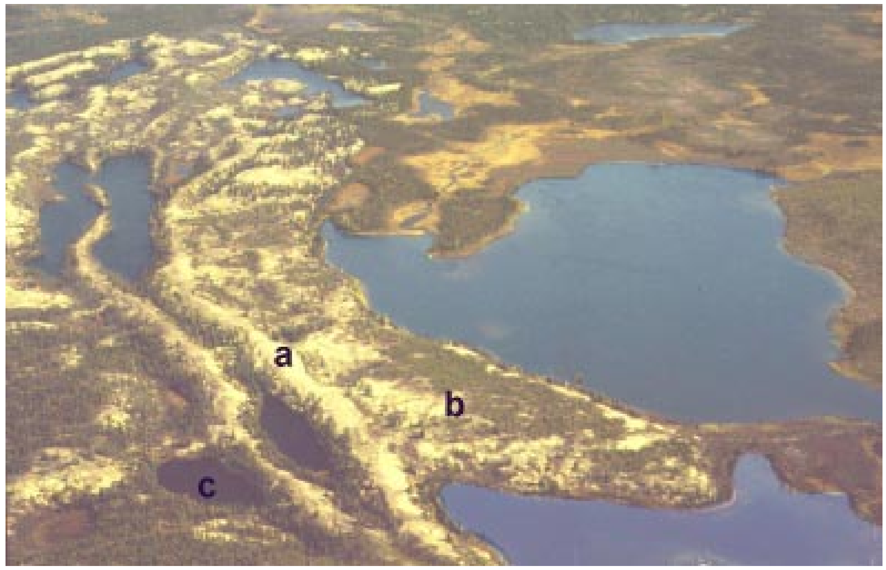
Economic activity is associated primarily with mining and hydro development, government and private service industry, and construction. In a number of southern sectors, forestry provides employment. Tourism is a growing industry and several lodges operate in the ecozone. Although most of the population 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.

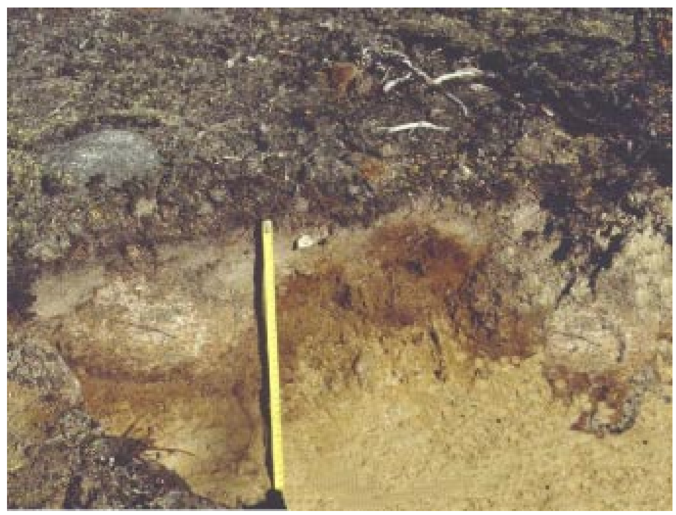


Plate TS6.

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.

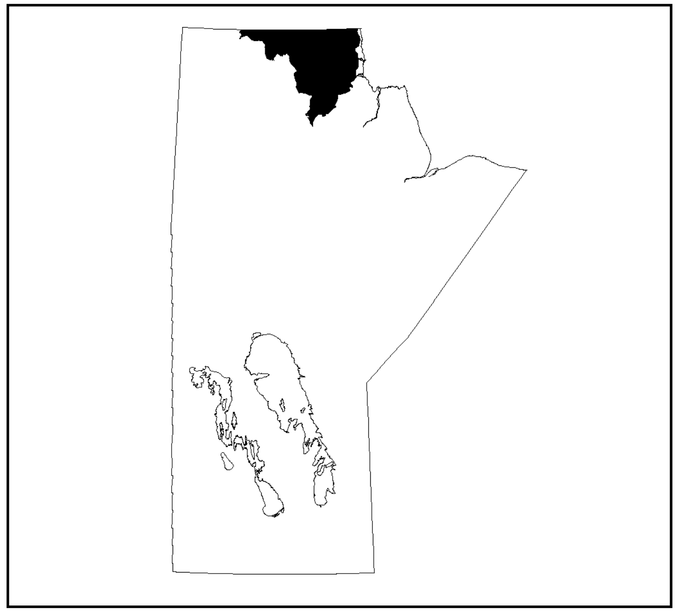
The Tyrrell Sea "Great Beach". The Taiga Shield Ecozone in Manitoba is in part bordered by a complex of Tyrrell Sea beaches, the so-called "Great Beach". After the Wisconsin Continental Ice Sheet vacated the area, the Tyrrell Sea invaded and formed a significant beach complex along its western border. 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^{o}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. ^{0}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 km^2)

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 ^{0}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^{0}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 km^2)

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 ^{o}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

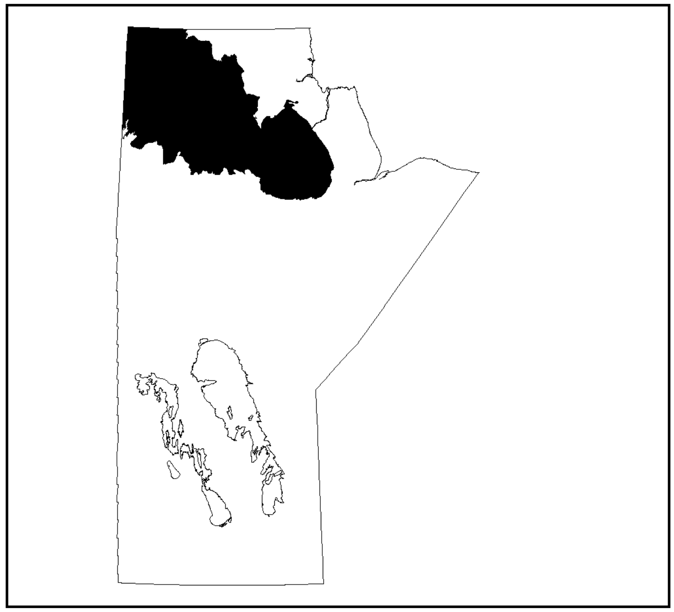
The principal sources of water are the many lakes and ponds, and the Seal and Caribou rivers and their numerous tributary streams that flow through the area.

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^o N latitude in the south to 61^o 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^{o}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

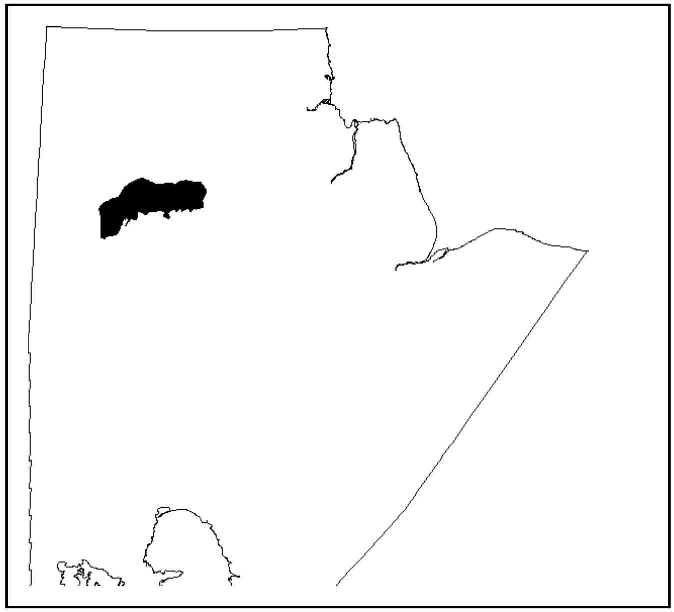
Good sources of water are fairly plentiful and are comprised of the lakes and rivers in the central and western sectors and the rivers in the peatland dominated eastern sector.

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 km^2)

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 ^{o}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.

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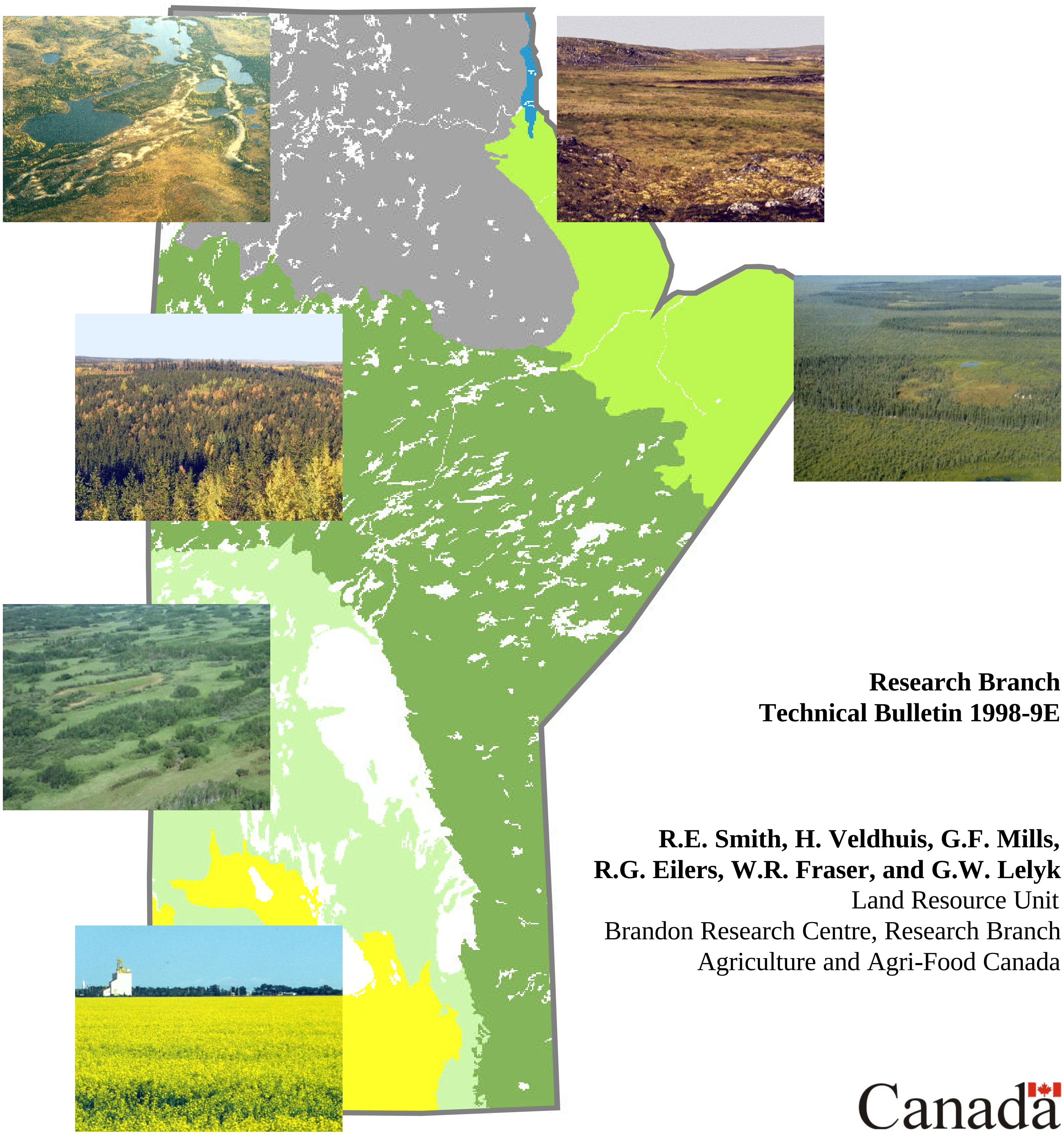
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



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Boreal Shield Ecozone

The Boreal Shield Ecozone is the largest ecozone in Canada, extending as a broad inverted arch from northern Saskatchewan east to Newfoundland, passing north and east of Lake Winnipeg and north of the Great Lakes and the St. Lawrence River. Although in Manitoba, this ecozone covers more area than any other, the Manitoba portion represents only a small part of the vast extent of this ecozone.

Climate

The ecozone has a strong continental climate which is characterized by long, cold winters and short, cool summers in the west, and long, cold winters, but short, warm summers in the east. These climatic conditions are somewhat modified by maritime influences along the coastal regions in Atlantic Canada and the moderating effect of the Great Lakes in central Ontario. The mean annual temperature ranges from about -4°C in northern Saskatchewan to 5.5°C in Newfoundland.

Precipitation increases from west to east. Mean annual precipitation is about 400 mm in northern Saskatchewan and about 1000 mm in Quebec and Labrador, and up to 1600 mm in parts of Newfoundland. The soil climate ranges from humid, cold Cryoboreal in the northwestern half to perhumid, moderately cool Boreal in the eastern section.

Selected Climate Data (Annual Means) for the Boreal Shield Ecozone West of the Great Lakes

Station	Temperature (oC)	Precipitation			Degree Days (>5°C)	Frost Free Period (days)
		Rain (mm)	Snow (cm)	Total (mm)		
Stony Rapids[2]	-4.5	249.6	127.4	376.7	1006	71
Flin Flon A[1]	-0.5	345.3	143.9	484.1	1379	115
Thompson A[1]	-3.4	351.6	200.9	535.6	1038	59
Pinawa WNRE[1]	1.9	429.0	129.5	558.5	1665	110
Dryden A[2]	1.6	527.4	170.8	697.5	1610	125

[1] Canadian Climate Normals, 1961-1990. Atmospheric Environment Service, Environment Canada.
[2] Canadian Climate Normals, 1951-1980. Atmospheric Environment Service, Environment Canada.

Plate BS1.
Peat plateau bog. Bog and fen peatlands are widespread throughout the Boreal Shield Ecozone. A peat plateau bog is a permanently frozen peatland that has permafrost at about 60 cm below the surface by the end of summer. The permafrost is ice-rich and extends into the underlying mineral materials. Peat plateau bogs often occur as islands surrounded by non-frozen fen, and are raised about 100 cm above the surrounding terrain. They are generally flat with a hummocky sphagnum moss surface. Low ericaceous shrubs such as Labrador tea are common and the open tree cover consists of stunted black spruce.

Plate BS2.
Crowning wildfire. Wildfire is a frequent event in the Boreal Shield Ecozone. As a result the forest cover consists of a mosaic of stands of different ages, bedrock outcrops and wetlands. Upland stands are usually less than 150 years old. Older forest is generally found on peatlands and in areas protected by lakes (peninsulas and islands). Wildfires are an integral part of the boreal forest ecosystem and are the major agent in forest renewal. The wildfire in the photo occurred in the Wrong Lake area following a lightning storm. Within a few days the fire had expanded, moving both on the ground and through the tree tops.

Plate BS3.
Jack pine on bedrock. Extensive areas of the Boreal Shield Ecozone are dominated by Precambrian bedrock that is only sparsely covered by thin mineral and organic deposits. After wildfire, jack pine is usually the dominant tree on these sites. It grows in the shallow and deep pockets of mineral soil occurring in small depressions and cracks in the bedrock surface. Black spruce may become part of the mix after some time on sites with deeper soil materials, or where runoff water collects.

Plate BS4
Pisew Falls. Pisew Falls on the Grass River is the largest accessible falls in Manitoba and is located in a provincial park between Setting Lake and Paint Lake. The area near the falls has a more moderate and humid climate than the surrounding upland due to the spray from the falls. Large white spruce and balsam fir dominate the forest along the slopes, while only a short distance away the forest consists of black spruce.

Plate BS5.
Permafrost in veneer bog. Veneer bogs are shallow peatlands that develop on gentle slopes and in depressions in areas of medium and fine textured surficial deposits. Permafrost develops where the peat layer provides sufficient insulation to prevent complete melting of seasonal frost. Thickness of the permafrost ranges from less than 100 cm to several metres. The photo shows the permafrost occurring in the highly decomposed organic layer below an insulating layer of nondecomposed sphagnum peat. The underlying mineral material is frozen glaciolacustrine clay.

Plate BS6.
Palsa bog in fen. Palsas are ice-cored peatlands. They may be raised several metres above the surrounding fen and are usually less than 100 m in diameter. They are formed when ice lenses develop in the peat and in the underlying mineral materials elevating the surface. They are common in the northern part of the glacial Lake Agassiz basin.

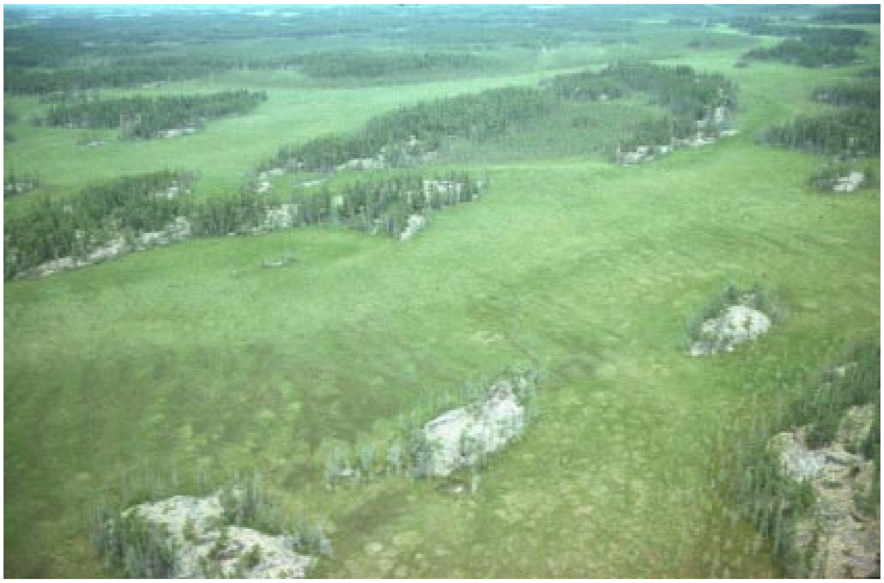


Plate BS7.
Fen-bedrock complex. The lower-lying terrain in the foreground is a deep horizontal and string fen peatland. The upland areas are Precambrian bedrock outcrops, with shallow sandy till or clayey glaciolacustrine deposits. This type of landscape is common in the western part of the Manitoba portion of Ecoregion 90.

Plate BS8.
Black spruce stand. Black spruce stands with an extensive groundcover of feather mosses are common on the clayey sediments of the northern and central portions of the glacial Lake Agassiz basin.

Plate BS9.
Orthic Gray Luvisolic soil on clayey glaciolacustrine sediment. These soils are moderately well drained, and are characterized by a light gray, platy or granular surface horizon, underlain by a strongly structured, brown coloured B horizon enriched in clay. The parent material is varved glaciolacustrine clay, with a clay content commonly higher than 80%.

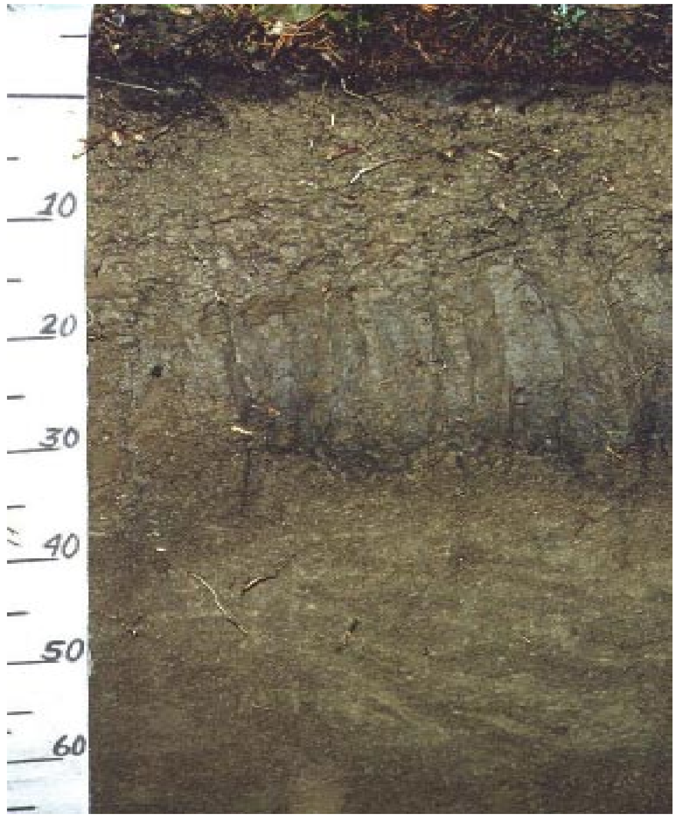


Plate BS10.
Jack pine stand on sandy and gravelly glaciofluvial deposit. Jack pine stands are dominant on sandy and gravelly soil materials. The groundcover is dominated by mosses and lichens, and ericaceous shrubs such as blueberry. These dry sites are prone to frequent wildfires. When moisture holding capacity is higher due to fine sandy or loamy layers in the subsoil, the jack pine stands are soon invaded by black spruce.

Plate BS11.
Eluviated Dystric Brunisolic soil on sandy glaciolacustrine deposit. Eluviated Dystric Brunisols are commonly associated with sandy materials. They are characterized by a grayish upper horizon overlying a brownish B, slightly enriched in iron compounds. The upper 30 cm of the soil is strongly acid.

Plate BS12.
Bouldery till. The till derived from Precambrian Shield bedrock is sandy and contains abundant coarse fragments. Associated soils are Dystric Brunisols.

Surficial deposits and landforms

The ecozone is dominated by a broadly rolling mosaic of uplands and lowlands. Precambrian granitic bedrock outcrops interspersed with ridged to hummocky discontinuous veneers and blankets of glacial moraine, fluvioglacial and colluvium are characteristic surface deposits. Small to large lakes are common throughout the ecozone.

Soils

Because this ecozone is so large, the range of climatic conditions and the variety of mineral and organic deposits is consequently large as well, resulting in a wide variety of soils.

In the northern parts of the ecozone, except for Newfoundland, permafrost is widespread, especially in organic deposits. As a result, Organic Cryosols, and to lesser extent Static and Turbic Cryosols, are important soil components. Organic soils, other than organic cryosols, are also widespread as extensive areas are covered by non-frozen peat deposits. Brunisols characterize coarse to medium textured materials in the northern and western sectors, while Humic Ferric Podzols are dominant in the southern and eastern parts. Luvisolic and Gleysolic soils are generally associated with fine textured materials.

Vegetation

The well to imperfectly drained soils in this ecozone generally support closed, single-species forest stands, or mixed stands of white and black spruce, balsam fir and jack pine. Towards the south, there is a wider distribution of deciduous trees such as white birch, trembling aspen and balsam poplar, with yellow birch and sugar maple to the east. Organic deposits support closed or open stands of black spruce or tamarack. Frequent forest fires in this ecozone have a profound effect on the composition and age distribution of forest stands.

The contrasting areas of exposed bedrock, mineral soils, and peatlands throughout the ecozone create an intricate and varied mosaic of landscape elements. Bedrock outcrops tend to be covered with a range of communities dominated by lichens, shrubs and forbs, with forest vegetation growing on mineral soils.

Wildlife

Characteristic mammals include woodland caribou, moose, black bear, raccoon, marten, fisher, striped skunk, lynx, bobcat and eastern chipmunk. Representative birds include boreal owl, great horned owl, blue jay, white-throated sparrow and evening grosbeak.

Land use

The ecozone supports extensive forestry and mining operations. Water-oriented recreation is locally extensive. Commercial fishing is important on large lakes, while hunting and trapping are important activities throughout. Agriculture is limited and generally restricted to the southern part of the ecozone.

There are four ecoregions within the Boreal Shield Ecozone in Manitoba.

88. Churchill River Upland Ecoregion

This ecoregion is located along the southern edge of the Precambrian Shield in north-central Saskatchewan and Manitoba. In Manitoba, it extends westward from the Grass River to the Saskatchewan border.

Climate

The Churchill River Upland Ecoregion lies in the continuous subhumid, High Boreal Ecoclimatic Region that extends from northwestern Ontario to Great Slave Lake in the southern Northwest Territories. It has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature ranges from -0.9 °C to -3.5°C. The average growing season varies from 135 to 164 days, and the number of growing degree-days ranges roughly from 940 to 1300.

Average annual precipitation is approximately 460 to 525 mm, of which about one-third falls as snow. Precipitation fluctuates greatly from year to year, and is highest during the growing season. Average yearly moisture deficits are between 50 to 100 mm. The region has a cold, subhumid to humid, Cryoboreal soil climate.

Stations at Lynn Lake Airport and Flin Flon Airport provide typical climate data for this ecoregion.

Selected Climate Data[1] for Lynn Lake Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-25.2	-21.2	-13.7	-2.3	6.2	12.5	15.8	14.0	6.9	-0.3	-12.5	-22.5	-3.5
Precip. mm	20.4	16.0	16.2	23.0	44.0	65.2	77.4	73.2	59.4	43.5	31.3	22.8	492.5
Growing degree-days	0.0	0.0	0.0	14.0	89.5	228.4	335.6	282.5	84.8	9.4	0.0	0.0	1044.0

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

Selected Climate Data[1] for Flin Flon Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-22.0	-17.0	-10.0	0.7	8.9	14.7	17.8	16.4	9.4	2.6	-8.4	-19.0	-0.5
Precip. mm	19.3	14.6	20.8	28.7	41.0	70.2	67.1	74.3	60.2	37.1	27.0	23.8	484.0
Growing degree-days	0.0	0.0	0.3	23.5	140.0	291.0	397.0	354.0	144.0	27.8	0.7	0.0	1379.0

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

Surficial deposits and landforms

The ecoregion occupies a portion of the Kazan Upland and is underlain by massive crystalline Precambrian (Proterozoic) rocks that form broad sloping uplands and lowlands. Elevations range from 450 masl in the Reindeer Lake area near the Saskatchewan border to 150 masl along its eastern boundary near Grass River.

Ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic sandy granitic till are dominant in the western section. Depressed to hummocky clayey lacustrine deposits of variable depth are common in the eastern section. However, many of these clays are overlain by peat deposits of varying thicknesses, with the deeper peat usually found in the depressional areas.

Locally prominent fluvioglacial (lateral moraine) deposits, with relief of up to 60 m, border the ecoregion in the east. The upland slopes gently and drains northeastward to Hudson Bay via the Churchill, Grass and Nelson rivers and their bedrock-controlled network of tributary streams and drainage ways. Numerous small to medium lakes are linked by the Churchill and Grass rivers. There are also many large lakes in this ecoregion.

Soils

Dystric Brunisolic soils are dominant on sandy acidic till, while Gray Luvisolic soils dominate on well to imperfectly drained clay deposits. Granitic rock outcrops are co-dominant in the area. Significant areas of shallow and deep organic Mesisols, Fibrisols and Cryosols are associated with basin bogs, peat plateau and veneer bogs. Gray Luvisols, and to a lesser extent Static and Turbic Cryosols, are prevalent on clayey lacustrine deposits along the Churchill River and around Southern Indian Lake, while Eutric Brunisols occur on silty fluvioglacial ridges and on calcareous loamy till.

Permafrost is widespread in organic deposits in the north, but diminishes to sporadic along the southern boundary. Permafrost in mineral soils is much less widespread, and confined mainly to fine textured sediments in the northern half of the ecoregion.

Vegetation

The ecoregion lies between the colder, drier, open coniferous forest region of the Low Subarctic in the north and the warmer, Mid-Boreal, mixed forest region in the south.

The dominant forest cover consists of medium to tall closed black spruce and jack pine stands. White spruce, white birch and especially trembling aspen often form an important component of stands on warm sites in the north and on a variety of sites in the southern part of the region. Understory vegetation consists of feather mosses, rock cranberry, blueberry, Labrador tea and lichen.

The widespread distribution of jack pine, white birch and trembling aspen is largely due to the frequent occurrence of forest fires. Well to rapidly drained sandy sites support pure or mixed open stands of black spruce and jack pine. Bedrock exposures have patchy tree cover and are generally covered with lichens.

Closed and open stands of stunted black spruce, with a ground cover of Labrador tea, blueberry, bog rosemary and sphagnum mosses dominate poorly drained basin bogs and peat plateau bogs. Fen vegetation is dominated by sedges and brown mosses, and may also include tamarack stands and swamp birch shrub cover.

Wildlife

The ecoregion provides habitat for moose, woodland caribou, black bear, lynx, wolf, beaver, muskrat and snowshoe hare as well as winter range for barren-ground caribou. Besides sandhill crane, grouse, waterfowl such as ducks, geese and pelicans, many other birds use the ecoregion.

Land use

Forests in the southern section of the ecoregion contribute significantly to the pulpwood industry and to a lesser degree, local sawlog operations. Mining activities occur throughout, but at present are most prevalent in the southern section. Trapping, hunting, water-oriented recreation and tourism are other important land uses in this ecoregion.

Ten Ecodistricts occur within the Manitoba portion of the Churchill River Upland Ecoregion

Northern Boreal forest

The forest cover of the Churchill River Upland Region consists extensively of jack pine and black spruce, with just a small component of trembling aspen and white birch. The hardwood component shows strongly during the fall when the leaves are turning.

Lake on the Precambrian Shield

Many lakes on the Shield have convoluted bedrock controlled shores and rocky islands

344. Reindeer Lake Ecodistrict (13 476 km²)

The Reindeer Lake Ecodistrict extends east and south from Reindeer Lake along the Saskatchewan border towards the Churchill River. Almost all of the ecodistrict is located within Manitoba, with a limited area extending into Saskatchewan.

Climate

This ecodistrict lies within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. Although summers are still cool and short on average, warm days are quite common. Winters are long and cold. The mean annual temperature is about -3.1°C, average growing season is 136 days, and the number of growing degree-days is around 970.

Mean annual precipitation is about 480 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year, and is highest during late spring through early summer. The average yearly moisture deficit is nearly 60 mm. The ecodistrict has a cold, humid, Cryoboreal soil climate.

Selected Climate Data[1] for Lynn Lake Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-3.5	14.1	11.1	15.8	-12.5
Precip. mm (equiv.)	492.5	215.8	319.4	77.4	20.4
Rain/Snow (mm/cm)	324.1/205.5	213.6/2.1	301.6/17.8	77.4/0.0	0.0/28.8
Growing degree-days >5°C	1044.0	847.0	1021.0	336.0	0.0

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

Physiography and Drainage

The ecodistrict ranges in elevation from about 450 masl near the Saskatchewan border on the west to about 300 masl along its eastern edge. It is an area of prominent hummocky granitoid rock outcroppings thinly covered by discontinuous, stony, sandy morainal veneers and blankets.

Slopes in this ecodistrict are extremely variable and generally range from 10 to 15 percent along irregular, hummocky surfaces with slope lengths from less than 50 m to more than 150 m. Local relief is provided by steeply sloping (greater than 30 percent) rocky ridges that may protrude from 30 to 60 m above lakes and peat-filled depressions.

The ecodistrict forms part of the Churchill River watershed. Drainage is generally to the east over terrain that falls at the rate of about 1 m per km. In addition to Reindeer Lake, many small, medium and large lakes occur throughout the ecodistrict. These lakes drain via an irregular, bedrock-controlled network of streams.

Soils

Most of the Reindeer Lake Ecodistrict is comprised of mineral soils, which are dominantly well to excessively drained Dystric Brunisols. These soils have developed on very shallow to moderately deep, discontinuous, stony, sandy textured veneers and blankets of acidic water-worked glacial till of Precambrian rock origin. Significant areas of bare bedrock also occur.

Most of the soils in peat-filled depressions are a complex of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Widespread patches of Organic Cryosols associated with peat plateau bogs are found in depressional areas as well.

Although climatic constraints are still severe and preclude the use of the ecodistrict for arable agriculture, except for growing some vegetables, limited forestry is possible, especially in the southern sector.

However, lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures and poor water-holding capacity and nutrient retention are additional severe constrains the use of mineral soils for forestry and agriculture. Poor natural drainage and thermal conductance properties limit the use of organic soils.

Vegetation

Since the ecodistrict forms somewhat of a south-north transition from the closed boreal forest to the subarctic, stand closures and stand heights vary considerably from south to north.

In the south, black spruce is the dominant tree species on both mineral and organic soils. On upland sites, it is often replaced or mixed with jack pine due to the frequent occurrence of wild fires. On wetlands, tamarack is often mixed with the black spruce. White birch is also scattered throughout this ecodistrict. On favourable sites such as in river valleys, around lakes and on south facing slopes, white spruce, balsam fir and trembling aspen are found.

In contrast, the forest cover in the north is much more open and stunted. Black spruce is also the dominant tree species here, and again often mixed with tamarack in poorly drained peatland areas. The occurrence of jack pine is much more limited and balsam fir is not present.

Water

The principal sources of water are Reindeer Lake - a very large lake that occupies the western portion of the district - and the many small, medium and large lakes throughout the remainder of the ecodistrict.

Land Use

Lynn Lake is the only town in the ecodistrict and its economic activity is largely mining and the associated service industry. The town is connected by road to Thompson to the southeast. A railroad connects the town of Lynn Lake with Flin Flon and The Pas in the south. The railroad is used to carry mining ore to the smelter at Flin Flon. Black Sturgeon First Nation is the only other settlement. Trapping, hunting, fishing, and water-oriented recreation are significant land uses.

346. Wells Lake Ecodistrict (5972 km²)

The Wells Lake Ecodistrict is located completely within Manitoba, and extends from near Reindeer Lake in the west to south of Big Sand Lake in the east.

Climate

This ecodistrict is situated in a colder, less humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. The climate is characterized by generally cool, moderately short summers and long, cold winters. The mean annual temperature is -3.5 °C, the average growing season is 135 days, and the number of growing degree-days is around 950.

Mean annual precipitation is approximately 490 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year, but is highest from spring through early summer. The average moisture deficit is about 50 mm over the year. The ecodistrict has a cold, humid, Cryoboreal soil climate.

There is no climate station in the ecodistrict. The nearest relevant station is Lynn Lake Airport (344. Reindeer Lake Ecodistrict).

Physiography and Drainage

The ecodistrict is a hummocky morainal plain extensively covered with veneer bogs. The district has a mean elevation of about 365 masl, with elevations ranging from about 450 to 278 masl.

The eastern section is characterized by prominent hummocky granitoid rock outcrops thinly covered by discontinuous stony, sandy morainal veneers and blankets. Slopes in this area are extremely variable and generally range from 5 to 10 percent along irregular, hummocky surfaces ranging from less than 50 m to more than 150 m in length. Local relief is provided by rocky ridges that can stand from 30 to 40 m above lakes and peat-filled depressions.

Most of the ecodistrict is part of the Churchill River drainage system, but the most northerly section lies within the Seal River drainage system. Small and medium sized lakes and an irregular bedrock-controlled network of streams drain generally eastward.

Soils

Widespread permafrost occurs in peatlands and poorly drained Gleysolic mineral soils throughout the ecodistrict. The dominant soils are complexes of poorly drained, deep and shallow Organic Cryosols and Terric Fibrisols on veneer bogs that usually overlie acidic granitoid glacial till. The subdominant mineral soils in the area are well to excessively drained Dystric Brunisols developed on shallow sandy textured, stony veneers of water-worked glacial till.

Severe climate conditions prevent the use of the ecodistrict for arable agriculture, although limited use for forestry is possible.

However, lack of rooting depth to bedrock, low soil temperature, excess cobbles, acidity and stones present additional severe constraints to the use of mineral soils for forestry or agriculture. Poor natural drainage and heat conductance properties are additional limitations to the use of organic soils.

Vegetation

The ecodistrict has closed to semi-open, somewhat stunted forest cover, but on favourable sites, growth can be surprisingly good.

Black spruce is the dominant tree, often mixed with tamarack in poorly drained peatland areas. Jack pine is limited to dry, sandy sites. Balsam fir is not present in the ecodistrict, but stunted aspen and scattered birch are found throughout.

Water

The principal sources of water are the numerous lakes, rivers and streams in the ecodistrict.

Land Use

There are no communities in the ecodistrict. Trapping, hunting, fishing and water-oriented recreation are the dominant land uses.

349. Southern Indian Lake Ecodistrict (12 357 km^2)

The Southern Indian Lake Ecodistrict is wholly within Manitoba and occupies the terrain east, west and south of Southern Indian Lake.

Climate

This ecodistrict is situated within a colder, less humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. The summers are generally cool and short, and the winters are cold and long. The mean annual temperature is -3.4°C. The average growing season is 137 days with about 950 growing degree-days.

The mean annual precipitation is approximately 510 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, but is highest from late spring through early summer. The average moisture deficit over the year is slightly less than 50 mm. The ecodistrict has a cold, humid Cryoboreal soil climate.

There is no climate station in the ecodistrict. The nearest relevant station is located at Lynn Lake Airport (344. Reindeer Lake Ecodistrict) to the west.

Physiography and Drainage

Most of this ecodistrict was once covered by the most northerly extension of glacial Lake Agassiz. As a result, the district is an undulating to hummocky morainal plain covered extensively by clayey glaciolacustrine blankets and veneers, which have smoothed the topography of the underlying materials.

Nevertheless, not all areas have been covered by glaciolacustrine sediments, and steeply sloping, irregular bedrock ridges and outcroppings are common in the area. Stony, sandy textured morainal veneers are commonly associated with these uplands. Large sandy glaciofluvial deposits are also part of the district landscape, especially in the vicinity of the Churchill River.

However, very shallow, shallow and deep organic deposits are the dominant surficial material, occurring in mineral soils with shallow peat surfaces, veneer and peat plateau bogs, and to lesser extent, fens and palsa bogs. The thin peat-covered mineral soils and veneer bogs cover extensive areas of gently to very gently sloping terrain, while the other types of peatlands occupy depressional areas.

The average elevation of the ecodistrict is about 330 masl, with elevations ranging from about 405 masl at the higher points to about 255 masl along Southern Indian Lake. Slopes are variable and range from level in peat-filled depressions to about 10 to 15 percent, and steeper, along irregular, hummocky bedrock-controlled surfaces. Slope lengths range from less than 50 to more than 150 m. Strong local relief is provided by rocky cliffs that can stand some 30 m above lakes and peat-filled depressions.

Only the southern portion of Southern Indian Lake lies within the ecodistrict, but it still forms the largest lake in the ecodistrict. It is part of the Churchill River drainage system, as are the small and medium sized lakes linked by secondary rivers and streams draining into the lake.

Prior to the Churchill River Diversion, drainage was generally northeastward through the Churchill River system over terrain that falls at about 1.0 m per km. However, because of a control dam at Missi Falls, a large quantity of water is now diverted from the Churchill River through South Bay into the Rat River system. The Rat River now drains through an eight-mile long, man-made channel into the Burntwood River, which is part of the Nelson River system. Extensive shoreline erosion has followed the rise in water level in Southern Indian Lake. Only the southeastern corner of the ecodistrict drains naturally through the Nelson River system, while the most easterly section lies within the Owl River system.

Soils

The dominant mineral soils in the ecodistrict are well to imperfectly drained Gray Luvisols that have developed on exposed clayey glaciolacustrine sediments, which occur mainly along the Churchill River and near Southern Indian Lake.

Permafrost is widespread in bog peatlands. It is also found to a limited extent in poorly drained clayey mineral soils with thin peaty surfaces and in well drained clay soils with dense black spruce and feather moss vegetative cover. As a result, mineral soil profiles may exhibit uneven horizon development, and relic earth hummocks are locally prominent. Earth hummocks, a form of non-sorted net, are a periglacial phenomenon and are evidence of the effect of former and present-day permafrost conditions on soil development.

A complex of Organic Cryosols, Typic and Terric Fibrisols and Mesisols occupy significant areas of peat-filled depressions and peat-covered lower slopes, which are generally underlain by clayey and loamy glaciolacustrine sediments. Local areas of Static and Turbic Cryosols may also be found as inclusions. Dystric Brunisols occur on sandy glaciofluvial deposits and in areas of acidic sandy till.

Besides the severe climatic constraints, the lack of rooting depth to dense subsoils, and bedrock prevent the use of mineral soils for agriculture and strongly reduces forest productivity. Poor natural drainage and heat conductance properties limit the use of organic soils.

Vegetation

Black spruce is the dominant tree species and is found both on mineral and organic soils. Stand closure and stand height varies considerably between organic sites and clayey well drained uplands.

On the bog peatlands, black spruce is stunted and open and sometimes mixed with small quantities of tamarack. Associated vegetation includes swamp birch and ericaceous shrubs such as Labrador tea and rock cranberry, with sphagnum mosses and other mosses as the dominant ground cover. On fen peatlands the vegetation consists of stunted tamarack, swamp birch, sedges, and brown mosses.

On clayey sites, black spruce stands are moderately tall and generally have closed canopies. Associated vegetation includes shrubs such as alder and willow, some low ericaceous shrubs, and a ground cover of dominantly feather mosses, with lichens in open areas.

On sandy upland sites, stands are generally jack pine with ericaceous shrubs, lichens and mosses, or a mixture of jack pine and black spruce, depending on time elapsed since the most recent forest fire. White birch is also scattered throughout this ecodistrict.

On favourable sites, such as river valleys, around lakes and on south facing slopes, white spruce of good growth may be found. Trembling aspen occurs mixed with the black spruce, white spruce and jack pine, or as small, pure stands.

In the northern section, the forest cover becomes much more open and stunted and jack pine is less common.

Water

The principal sources of water are Southern Indian Lake - by far the largest lake in the ecodistrict - and the small and medium lakes distributed throughout, as well as the Churchill River and secondary rivers and streams.

Land Use

South Indian Lake and Leaf Rapids are the only communities in the ecodistrict. Leaf Rapids is a mining town, while South Indian Lake is a community where fishing and hunting are the main activities.

Commercial fishing was once the main economic activity in Southern Indian Lake, but the Churchill River Diversion has strongly affected the commercial fisheries, both with respect to quantity and variety of fish species caught. Water-oriented recreation, trapping and hunting are other significant land uses.

Some of the clayey Gray Luvisols and organic soils have some potential for arable agriculture such as vegetable gardens and forage, and limited forestry is possible along the Churchill River.

350. Waskaiowaka Lake Ecodistrict (10 135 km^2)

The Waskaiowaka Lake Ecodistrict is wholly located in north-central Manitoba.

Climate

This ecodistrict is situated in a colder, less humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. It is characterized by short, cool summers and long, cold and snowy winters. The mean annual temperature is -3.5°C. The average growing season is 136 days with about 940 growing degree-days.

Mean annual precipitation is approximately 530 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year, but is highest from late spring through early summer. The average yearly moisture deficit is about 50 mm. The ecodistrict has a cold, humid, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The nearest stations are Thompson Airport (363. Sipiwesk Lake Ecodistrict) to the south, and Gillam Airport (360. Knee Lake Ecodistrict) to the east.

Physiography and Drainage

After deglaciation, most of the Waskaiowaka Lake Ecodistrict was covered by the most northerly extension of glacial Lake Agassiz. As a result, the undulating to hummocky morainal plain is extensively covered and masked by clayey glaciolacustrine blankets and veneers.

A prominent, steeply sloping (15 to 30 percent) upland consisting of a silty and sandy glaciofluvial ridge and kame complex (lateral and end moraine deposits) bounds the area on its southern limit. This upland is from 3 to 10 km wide, and stands some 60 m above the surrounding plain. A secondary ridge trends northward through the centre of the ecodistrict.

Most of the glaciolacustrine deposits and, also to a large extent, the lower, gently sloping, silty morainal deposits, are covered by veneer bogs. Depressions contain complexes of peat plateau bogs, horizontal fens and collapse bogs and fens.

The average elevation over the ecodistrict is about 245 masl and ranges from about 330 masl south of Baldock lake to about 215 masl along the shore of Waskaiowaka Lake. Slopes are variable and range from level in peat-filled depressions to about 10 percent in gently undulating and hummocky terrain. Steeper slopes of 30 percent or more are encountered in irregular, hummocky glaciofluvial terrain. Slope lengths are generally from less than 50 m to 150 m, but can be as long as 500 m and more. Local relief is provided by hummocky highs that generally stand 5 to 20 m, but sometimes as much as 50 m, above lakes and peat-filled depressions.

The southern and far eastern extensions of the ecodistrict are part of the Nelson River drainage system, while the western and eastern portions respectively are part of the Owl River and Churchill River systems. Waskaiowaka and Baldock lakes are the largest but there are also many small and medium sized lakes. An irregular network of secondary streams drains the ecodistrict generally in a northeasterly direction over terrain that falls at about 1.0 m per km.

Soils

The dominant mineral soils are well to imperfectly drained Gray Luvisols that have developed on exposed clayey glaciolacustrine sediments. These clayey soils commonly exhibit profiles with uneven horizon development and are associated with relic earth hummocks, which are a type of non-sorted nets. Periglacial surface forms such as these are evidence of the effect of former and present permafrost conditions on soil development.

Other significant mineral soils include areas of Eutric Brunisols on silty to sandy loam fluvioglacial material and loamy calcareous till, and Dystric Brunisols on acidic sandy materials. Areas of bare rock outcrops occur throughout the ecodistrict, but are limited in extent.

Also widespread are Organic Cryosols on woody, mesic forest peat associated with veneer and peat plateau bogs, Mesic and Fibric organic soils on non-frozen bogs and fens. Permafrost is widespread in peatlands, and is also present in clayey and silty mineral soils although to a much more limited extent.

Climatic conditions prevent the use of the ecodistrict for arable agriculture, and the short growing season reduces forest productivity.

In addition, lack of rooting depth to dense subsoils and bedrock, low soil temperature and poor structure of clay soils severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

Stand closure and stand height varies considerably between organic sites and clayey well drained uplands. Black spruce is the dominant tree species throughout.

On sandy upland sites, black spruce is often replaced by, or mixed with, jack pine due to the frequent occurrence of forest fires. On wetlands, tamarack is often mixed with the black spruce. White birch is also scattered throughout.

On favourable sites, such as in river valleys, around lakes and on south facing slopes, white spruce of good growth may be found. Trembling aspen occurs mixed with the black spruce, white spruce and jack pine, or as small pure stands.

The forest cover becomes much more open and stunted in the northern section, and jack pine becomes less common.

Water

The principal sources of water are the numerous lakes and rivers and streams that flow through the ecodistrict.

Land Use

There are no communities in the ecodistrict. Trapping, hunting, fishing and water-oriented recreation are the dominant land uses. Some of the better drained clayey soils have limited potential for arable agriculture. Locally, forest stands may provide some sawlog timber and timber for local use.

353. Granville Lake Ecodistrict (18 196 km^2)

The extensive Granville Lake Ecodistrict spans the border with Saskatchewan and covers a major portion of the Churchill River Upland Ecoregion. About half of the ecodistrict lies within Manitoba.

Climate

This ecodistrict is located within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. The summers are cool and short, but are also characterized by many warm days, and the winters are cold and long. The mean annual temperature is -1.9 ^oC. The average growing season is 151 days with about 1100 growing degree-days.

The annual precipitation is approximately 530 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, but is highest from spring through early summer. The average moisture deficit over the year is about 70 mm. The ecodistrict has a cold, humid Cryoboreal soil climate.

There are no climate stations in the Manitoba portion of the ecodistrict. The nearest station is Flin Flon Airport (359. Reed Lake Ecodistrict) to the south.

Physiography and Drainage

Although the Manitoba section of the ecodistrict was once part of glacial Lake Aggassiz, extensive glaciolacustrine sediments are only present in the Churchill River basin and in the many peat-filled depressions throughout the ecodistrict.

In Manitoba, the ecodistrict is an undulating to hummocky morainal and bedrock plain covered by extensive clayey glaciolacustrine blankets and veneers at lower elevations. Steeply sloping, irregular bedrock ridges and outcrops with stony, sandy textured morainal veneers are more common in the eastern half of the Manitoba portion. Sandy glaciofluvial deposits are also present, and are locally extensive. Ancient beaches of glacial Lake Agassiz and dune formations are frequently associated with these sand deposits. Peat-filled depressions and peat-covered, gently sloping lower slopes are usually underlain by clayey glaciolacustrine sediments.

Elevations range from about 405 masl near the border with Saskatchewan to about 255 masl in the northeastern section. Slopes in this ecodistrict are variable and range from level in peat-filled depressions to about 30 percent in irregular, hummocky terrain. Slope lengths range from less than 50 to more than 150 m. Locally, strong relief is provided by rocky cliffs that may stand 50 m above lakes and peat-filled depressions.

The western and northwestern part of the ecodistrict are part of the Reindeer Lake division of the Churchill River drainage system. Small to large lakes linked by the Churchill River and an irregular bedrock-controlled network of secondary streams drain generally northeastward from the Saskatchewan border over terrain that falls at about 1.5 to 2.0 m per km.

The eastern section of the ecodistrict is part of the Grass-Burntwood division of the Nelson River drainage system and drains generally in a easterly direction.

Soils

The area is dominated by acidic granitoid bedrock. Associated with the bedrock are well to excessively drained, shallow, sandy and stony veneers of water-worked glacial till on which Dystric Brunisols have developed. Significant areas of Eutric Brunisols and Gray Luvisols can be found on exposed clayey deposits along the Churchill River.

Significant areas of peat-filled depressions form complexes of very poorly drained, Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Widespread patches of Organic Cryosols occur where permafrost is present in peatlands (peat plateau and veneer bogs) and in some clayey mineral soils.

Climate constraints are severe enough to prevent the use of the ecodistrict for arable agriculture, except on favourable sites. The short growing season limits forest productivity.

In addition, lack of rooting depth to bedrock and compact clayey subsoils, poor structure of clay soils, low soil temperature, excess cobbles and stones, coarse surface textures and poor water-holding capacity and nutrient retention of the till all severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation of the ecodistrict is typical of northern Boreal forest. Where soils are deep and well to imperfectly drained, stands are closed. But because of the widespread occurrence of bedrock outcrops and shallow soils, forest cover is often patchy. The forest cover on bog peatlands is open and stunted.

Black spruce is the dominant tree, but due to the frequency of fires, jack pine is widespread, especially on bedrock and shallow soils. Stands of white spruce mixed with balsam fir and trembling aspen are found on the well drained clay soils along the Churchill River and connected lakes. Tree growth of considerable quality for the latitude can be found, especially along the Churchill River. White birch is also scattered throughout.

Water

The principal sources of water are the Churchill River and the many lakes and secondary rivers and streams that flow through the ecodistrict.

Land Use

The Mathias Colomb First Nation communities of Pukatawagan and Highrock are the only settlements in the ecodistrict. The road from Thompson to Lynn Lake crosses the ecodistrict in the northeast section, while the railroad from The Pas to Lynn Lake traverses it from south to north.

While mining is an important activity, most land use is related to trapping and hunting by people living in the ecodistrict. Water-oriented recreation such as fishing and recreational hunting are also important. Forestry is practiced on a limited scale, especially in the area along the Churchill River and south.

This bedrock-dominated ecodistrict is generally not suited to, and is not used for, arable agriculture. However, some of the clayey, sandy and organic soils along the Churchill River have some potential for small scale arable agriculture.

355. Orr Lake Ecodistrict (4110 km²)

The Orr Lake Ecodistrict is situated in north-central Manitoba.

Climate

This ecodistrict lies within a colder, less humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. The summers are cool and short, and the winters are cold and long. Mean annual temperature is -3.4°C, the average growing season is 136 days, and the number of growing degree-days is about 940.

Mean annual precipitation is approximately 530 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year, but is highest from late spring through early summer. The average moisture deficit over the year is less than 50 mm. The ecodistrict has a cold, humid, Cryoboreal soil climate.

There is no climate station located within the ecodistrict. The nearest station is Thompson Airport (363. Sipiwesk Lake Ecodistrict) to the south.

Physiography and Drainage

The Orr Lake Ecodistrict extending westward from Split Lake is an undulating to hummocky morainal plain covered by clayey and silty glaciolacustrine blankets due to its inundation by glacial Lake Agassiz. In turn, the glaciolacustrine sediments are extensively covered by veneer bogs on gentle slopes, and in depressional areas by peat plateau and palsa bogs, and to a more limited extent, basin fens.

The ecodistrict is bounded on the north and west by a prominent, steeply sloping fluvioglacial upland (lateral and end moraine), composed of ridges and kame-like hills. This upland is from 3 to 10 km wide and in some locations, stands 30 to 90 m above the surrounding plain.

The average elevation over the ecodistrict is 215 masl and ranges from about 250 to 185 masl. Slopes are variable and range from level in peat-filled depressions to about 10 to 15 percent in irregular, hummocky and undulating terrain. Slope lengths range from less than 50 m to more than 400 m. Local hummocky relief in the area is generally in the range of 5 to 20 m.

The ecodistrict is part of the Nelson River drainage system and drains generally in an easterly direction over terrain that falls at the rate of about 0.8 to 1.0 m per km.

Soils

The dominant soils are complexes of poorly drained Terric (shallow) Mesisols and Fibrisols, and Organic Cryosolic soils on veneer bogs that overlie varved, clayey to silty loam, glaciolacustrine sediments. Organic Cryosols on peat plateau bogs and Mesisols on fens are dominant in peat-filled depressions.

The subdominant mineral soils in the area are well to imperfectly drained Gray Luvisols that have developed on exposed clayey and silty glaciolacustrine sediments. Clayey soil profiles commonly exhibit uneven horizon development or distorted varves in the subsoil. Relic earth hummocks with low micro relief are common throughout the ecodistrict. These features are evidence of the effect of former and present permafrost conditions on soil development. Permafrost is widespread in peatlands, and is also present in some clayey mineral soils.

Local areas of rock outcroppings occur, as do areas of Eutric Brunisols developed on shallow, sandy textured, stony veneers of water-worked calcareous glacial till.

Besides the climatic conditions, lack of rooting depth, poor structure of clay soils and low soil temperature limit the use of mineral soils for agricultural use. The short growing season limits forest productivity. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation is typical of northern Boreal forest. Uplands support closed forest dominated by black spruce with understories of feather moss and ericaceous shrubs. Due to the frequent occurrence of forest fires, jack pine may appear as pure stands or as part of the mix on upland sites. However, only on dry, sandy sites does jack pine remain part of the mixture for more than one rotation. Trembling aspen is also found on upland sites, but is less common than farther south.

Forest cover on bogs ranges from closed black spruce stands on palsa bogs to stunted, open black spruce on peat plateaus and veneer bogs. Fens usually have no tree cover, but have vegetation dominated by sedges and brown moss with varying distribution of dwarf birch. However, some fens have open tamarack or a patchy cover of tamarack and black spruce.

Water

The principal sources of water are the Burntwood and Odei rivers, the few large lakes and the secondary streams that flow through the ecodistrict.

Land Use

While there are no permanent settlements in the ecodistrict, it is traversed in the southern sector by the road from Thompson to Gillam. The area is used for trapping, hunting and fishing by people from neighbouring aboriginal settlements. Recreational hunting and water-oriented recreation such as sport fishing are also important land uses. Timber and firewood harvesting is locally important, especially in areas were there is road access.

Some of the clayey Gray Luvisols and organic soils have limited potential for arable agriculture.

Collapse fen associated with peat plateau bog

Aggregation of subsurface ice in peat and underlying mineral materials, and the accumulation of Sphagnum peat elevates the frozen bog above the surrounding fen. Ponds (collapse scars) develop when permafrost melts (thermokarsting) due to wildfire and/or aging of the frozen bog. When the collapse scar is wholly confined within a frozen bog it is referred to as a collapse bog. If the collapse is open to neighbouring fens it is called a collapse fen, as there is an exchange of nutrient-rich water between the collapse and the fen. Thermokarsting may progress until all of the frozen peatland has collapsed, or it may halt, allowing for the build-up of Sphagnum peat in the collapse scar, which may lead to the re-establishment of permafrost. The collapsing of treed bogs causes trees to topple or lean, a condition usually referred to as “drunken forest”. In the picture, the trees at the edge of the collapse are leaning severely, but some tops have adjusted to the vertical. This indicates that these parts of the edge have been stable for years.

356. Three Point Lake Ecodistrict (7930 km²)

The Three Point Lake Ecodistrict is located in north-central Manitoba.

Climate

This ecodistrict lies within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. It is characterized by short, cool summers and cold, long winters. The mean annual temperature is -3.2°C. The average growing season is 139 days with about 1000 growing degree-days.

The mean annual precipitation is approximately 530 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, but is highest from spring through early summer. The average moisture deficit over the year is about 50 mm. The ecodistrict has a cold, humid, Cryoboreal soil climate.

The ecodistrict does not have a climate station. The nearest stations are Thompson and Wabowden to the east (See 363. Sipiwesk Lake Ecodistrict).

Physiography and Drainage

Three Point Lake Ecodistrict lies within the glacial Lake Agassiz basin. Because of the inundation by Lake Agassiz, the district is covered largely by a blanket of clayey and silty varved, glaciolacustrine sediments which mask most of the underlying till and bedrock. In turn, these fine textured sediments are largely covered by shallow and deep organic deposits. Hummocky, granitoid bedrock ridges and outcrops covered by stony, sandy morainal veneers are more common in the rugged western part of the area.

Like the adjacent Reed Lake Ecodistrict to the west, the southern limit of the Three Point Lake Ecodistrict marks the boundary between the relatively level Palaeozoic limestone belt (Manitoba Plain) to the south and the hummocky to hilly Kazan Upland section of the Canadian Shield of which this ecodistrict is part.

Elevations range from about 335 masl in the western part to about 235 masl in the northeast. Slopes are variable and range from near level and long in peat-filled depressions, to about 15 to 30 percent in more irregular, hummocky upland areas. Slope lengths range from less than 50 m to well over 150 m, especially in the gently undulating, low relief glaciolacustrine areas. Pronounced relief is provided locally by rocky cliffs that can stand as much as 30 m above lakes and peat-filled depressions.

The whole ecodistrict is part of the Nelson River drainage system. The few small and medium sized lakes and an irregular network of streams, including portions of the Burntwood and Grass rivers, flow generally eastward over terrain that falls at about 0.6 to 1.0 m per km.

Soils

The southern two-thirds of the ecodistrict is dominated by a complex of very poorly drained Typic (deep) and Terric (shallow) Mesisolic organic soils. These soils have formed on sedge peat and woody forest peat, which overlie calcareous, loamy to clayey glaciolacustrine sediments. Widespread areas of Organic Cryosols are associated with permanently frozen peatlands in the form of peat plateau and palsa bogs, and, to a significant but lesser extent, veneer bogs.

Significant areas of Gray Luvisols, developed in calcareous clayey sediments, occur in the northern one-third of the ecodistrict. Local pockets of well to excessively drained Dystric Brunisols are associated with deep glaciofluvial deposits and minor areas of shallow, sandy textured, stony veneers of water-worked glacial till. Bedrock outcrops occur throughout, but are largely capped by clayey glaciolacustrine sediments and some shallow till deposits.

Permafrost is still widespread in the peatlands of the northern sector, but becomes less common to the south. Permafrost in mineral soils is confined to clayey soils in the northern part of the ecodistrict.

Besides climatic limitations, the lack of rooting depth to compact clayey subsoils and bedrock, poor structure and low soil temperature constrain the use of mineral soils for agriculture. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

The short growing season and low soil temperature limits forest productivity.

Vegetation

The vegetation of the ecodistrict is typical of the Boreal forest region. Black spruce with an understorey of mosses and ericaceous shrubs is the dominant forest type on upland sites. However, due to the influence of frequent forest fires, jack pine is commonly part of younger stands and occurs also as pure stands. Trembling aspen with an understorey of alder is widespread, especially in the more southern sectors. Balsam fir and white spruce are common on favourable sites, especially along lakes and rivers.

However, due to the prevalence of peatlands, forest cover is generally stunted. Forest growth on the peatlands is generally poor, except for that on palsa bogs, which may have closed stands of black spruce or white birch. Peat plateau bogs have stunted black spruce, sphagnum moss and ericaceous shrub cover, while fens are covered with either sedge and brown moss, or support tamarack, dwarf birch and a mixture of sedges and herbs.

Water

Three Point and Wuskwatum lakes are the largest lakes in the ecodistrict. These lakes, other smaller lakes, and rivers that flow through the ecodistrict such as the Burntwood River are reliable sources of water.

Land Use

Nisichawayasihk Cree Nation (Nelson House) on the shore of Three Point Lake is the only settlement in the ecodistrict. The community is connected by road to the highway between Thompson and Lynn Lake, which traverses the northern part of the ecodistrict.

Commercial forestry is limited in the area. Although some sawlog timber is available and the production of pulpwood is possible, distance to market has precluded development of this resource. Trapping and hunting are the important dominant land uses. Also, sport fishing and recreational hunting are increasing in the ecodistrict.

Some of the clayey Gray Luvisols and organic soils in this district have limited potential for arable agriculture, such as vegetable gardens and forage production.

357. Wekusko Ecodistrict (3508 km²)

The Wekusko Ecodistrict covers a relatively small area in north-central Manitoba.

Climate

This ecodistrict lies within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. Summers are short and cool, although warm spells are common, and winters are very cold and long. The mean annual temperature is -0.9 °C. The average growing season is 158 days with about 1250 growing degree-days.

The mean annual precipitation is approximately 475 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, but is highest from spring through early summer. The average yearly soil moisture deficit is about 90 mm. The area has a cold to moderately cold, humid, Cryoboreal soil climate.

There is no climate station in the ecodistrict. The now-closed station at Wabowden (363. Sipiwesk Ecodistrict) to the east was the nearest station.

Physiography and Drainage

The ecodistrict extends east from Wekusko Lake and is composed of acidic granitoid bedrock in the form of broad sloping uplands and lowlands. Bedrock highs are thinly covered by stony, sandy morainal veneers while lowlands are comprised of peat-covered clayey glaciolacustrine blankets. Although the district is a part of the glacial Lake Agassiz basin, less of the area is covered with glaciolacustrine sediments than the Three Point Lake Ecodistrict to the north.

The southern limit of the ecodistrict marks the boundary between the relatively level Palaeozoic limestone belt (Manitoba Plain) to the south and the hummocky to hilly Kazan Upland section of the Canadian Shield of which the ecodistrict is part. Steeply sloping, irregular, bare bedrock ridges and outcrops are more common than in the adjacent Reed Lake Ecodistrict to the west. Elevations range from about 335 masl to about 255 masl. Slopes in this area are variable and range from level in peat-filled depressions to about 30 percent along irregular hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. Local relief is provided by rocky cliffs that can rise from 25 to 40 m above lakes and peat-filled depressions.

The ecodistrict is part of the Nelson River drainage system. It drains mainly through Wekusko Lake, a few medium sized lakes, and an irregular bedrock-controlled network of streams that are all part of the Grassy River watershed. Drainage is generally eastward over terrain that falls at about 0.6 to 1.0 m per km.

Soils

The dominant soils are well to excessively drained Dystric Brunisols that have developed on shallow, sandy and stony veneers of water-worked glacial till overlying bedrock.

Significant areas consist of peat-filled depressions with very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Organic Cryosols are associated with widespread, but patchy permafrost in peatlands. Significant areas of Eutric Brunisols, Gray Luvisols and peaty Gleysols can be found on upland areas of clayey and silty glaciolacustrine sediments. These deposits, in the form of veneers and blankets, are common around the lakes and in river valleys. Dystric and Eutric Brunisols are present on local areas of sandy bars and relic beaches.

In addition to climatic constraints, the lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures, poor structure and/or poor water-holding capacity and nutrient retention severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation is typical of the Boreal forest in bedrock-dominated terrain. Although stands of black spruce form a significant part of the forest cover, the frequency of forest fires has created a patchwork forest cover on clayey lands and along lakes and rivers. Many bedrock areas have a patchy cover of small-growth trembling aspen, jack pine stands, areas with birch, or grass or shrub dominated vegetation.

The bog peatlands have stunted black spruce, moss and ericaceous shrub vegetation, while fens have sedge, brown moss, shrub and tamarack vegetation in varying mixtures.

Water

The principal sources of water are Wekusko Lake, the smaller Snow Lake, and other small lakes and rivers tributary to the Grass River that flow through the area.

Land Use

The main settlement in the ecodistrict is the town of Snow Lake, which is an important mining and service centre for the ecodistrict and surrounding area. A few mines operate in the ecodistrict and in adjacent ecodistricts. Ore is shipped via rail and road to Flin Flon. Significant forestry has developed since the opening of the mill at The Pas in the 1970’s.

Herb Lake Landing is another small settlement in the ecodistrict.

Water-oriented recreation, trapping and hunting are other important land uses.

Some of the clayey and organic soils have limited potential for arable agriculture.

Wekusko Falls

Wekusko Falls is one of the many falls and rapids along the Grass River. The Grass River is a scenic river that connects many lakes from its beginning at First Cranberry Lake to where it flows into the Nelson River in north-central Manitoba.

358. Flin Flon Ecodistrict (740 km^2)

The Flin Flon Ecodistrict in west-central Manitoba spans the border with Saskatchewan. Only a very small part of the ecodistrict lies within Manitoba.

Climate

This ecodistrict is located within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. It is characterized by short, cool summers, although warm spells are common. Winters are long, cold and snowy. The mean annual temperature is about -0.9 ^{o}C. The average growing season is 159 days with around 1250 growing degree-days.

The mean annual precipitation is about 490 mm, of which less than one-third falls as snow. Precipitation varies greatly from year to year, but it is highest in the summer months. The average moisture deficit over the year is about 70 mm. The area has a cold to moderately cold, humid, Cryoboreal soil climate.

Selected Climate Data[1] for Flin Flon Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	-0.5	16.3	13.4	17.8	-21.7
Precip. mm (equiv.)	484.1	211.6	312.8	67.1	19.3
Rain/Snow (mm/cm)	345.3/143.9	212.6/0.0T	308.1/5.7	68.2/0.0	0.2/2
Growing degree-days >5^{0}C	1379.0	1043.0	1327.0	397.0	0.0

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

Physiography and Drainage

This ecodistrict is an area of prominent hummocky granitoid rock outcrops thinly covered by discontinuous, stony and sandy morainal veneers and blankets. Peat-covered depressions are usually underlain by clayey glaciolacustrine sediments.

The ecodistrict has a mean elevation of about 335 masl. Slopes are extremely variable and range from level to very gently sloping in peat-filled depressions, to near vertical and more along irregular cliff faces and 60% along hummocky surfaces. Slope lengths range from generally less than 50 m to extremes of more than 150 m. Strong local relief is provided by rocky cliffs that rise 35 to 50 m above lakes and peat-filled depressions.

The ecodistrict is part of the Grassy River watershed. Small, medium and large lakes, some of which are of considerable depth, and an irregular bedrock-controlled network of streams drain generally eastward over terrain that falls at a rate of about 1 m per km.

Soils

Most of the ecodistrict is rockland.

Mineral soils are dominantly well to excessively drained Dystric Brunisols that have developed on very shallow, discontinuous, sandy and stony veneers of water-worked glacial till. Local areas of Eutric Brunisols and Gray Luvisols can be found on local clayey to silty glaciolacustrine sediments, and occasionally on relic beaches.

Most of the soils in peat-filled depressions are complexes of poorly to very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Organic Cryosols are associated with permanently frozen peatlands like palsa and peat plateau bogs. However, permafrost is limited in distribution.

Besides the climatic conditions which result in a short growing season, lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures and poor water-holding capacity and nutrient retention all severely constrain the use of mineral soils. Poor natural drainage and thermal conductance properties are additional limitations the usefulness of organic soils.

Vegetation

The vegetation is typical of Boreal forest in bedrock-dominated terrain. Due to the frequency of forest fires, jack pine stands are the dominant tree cover. Depending on the site and fire history, these stands can range from well stocked stands to stands of stunted over-stocked regeneration. Areas with deeper soils that have escaped fire for some time support stands of black spruce or mixed black spruce and jack pine, as do imperfectly drained sites.

Bogs support open black spruce, except for palsa bogs which may have closed black spruce cover. Associated vegetation are sphagnum and feather mosses and ericaceous shrubs. Fens have tamarack, sedge, brown moss and shrub vegetation.

In the vicinity of Flin Flon, the vegetation, and especially aboreal lichens and lichens on bedrock oputcrops, has suffered considerable damage as result of smelter emissions.

Water

The principal sources of water are the numerous lakes and the rivers that flow through the ecodistrict.

Land Use

The town of Flin Flon is the largest community in the Manitoba portion of the ecodistrict. It is an important mining and service centre. The smelter processes ore from the mine at Flin Flon and from other mines in the surrounding area.

The forest land in the ecodistrict produces pulpwood for the mill in The Pas.

The high quality of sport fishing offered by the lakes in the ecodistrict attracts sport fishers from far away, supporting a well developed tourist industry. Hunting and trapping are other important land uses.

In this bedrock-dominated area some of the organic soils have limited potential for arable agriculture.

Effect of smelter emissions on vegetation

Smelter emissions in Flin Flon have killed off some of the vegetation in the surrounding area, resulting in bedrock outcrops devoid of lichens, mosses and shrubs.

359. Reed Lake Ecodistrict (6491 km²)

The Reed Lake Ecodistrict is located in the northwest-central part of Manitoba. Only a very small portion of the northwest corner of the district extends into Saskatchewan.

Climate

This ecodistrict is situated in a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba. Summers are short and cool, but warm spells are common. Winters are long, cold and snowy. The mean annual temperature is about -0.4 °C, the average growing season is 164 days, and the number of growing degree-days is around 1300.

The mean annual precipitation is approximately 470 mm, of which more than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest during the summer months. Average soil moisture deficit over the year is about 90 mm. The ecodistrict has a cold to moderately cold, humid, Cryoboreal soil climate.

There is no climate station in the ecodistrict, but the station at Flin Flon Airport (358. Flin Flon Ecodistrict) is relevant to the ecodistrict.

Physiography and Drainage

The Reed Lake Ecodistrict is a hummocky to undulating morainal plain. It is thinly covered by stony, sandy morainal veneers and glaciolacustrine blankets.

Its southern limit, from Athapapuskow Lake to Wekusko Lake, marks the boundary between the relatively level, Palaeozoic limestone belt (Manitoba Plain) and the hummocky to hilly Kazan Upland section of the Precambrian Shield.

Steeply sloping, irregular bedrock ridges and outcrops are more common in the eastern one-third of the ecodistrict. Peat-covered depressions are usually underlain by clayey glaciolacustrine sediments. Elevations range from about 335 masl to about 255 masl. Slopes vary from level in peat-filled depressions to about 30 percent along irregular, hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. Strong local relief is provided by rocky cliffs that rise 35 to 40 m above lakes and peat-filled depressions.

The ecodistrict is part of the Nelson River drainage system and forms parts of a number of watersheds, of which the Grassy River watershed is the most extensive. Small, medium and large lakes and an irregular bedrock-controlled network of streams drain generally eastward over terrain that falls at about 0.6 to 1.0 m per km.

Soils

Most of the soils in the Reed Lake Ecodistrict are well to excessively drained Dystric Brunisols that have developed on shallow, sandy textured, stony veneers of water-worked glacial till. Significant areas of bedrock are subdominant. Peat-filled depressions are a complex of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic soils overlying loamy to clayey glaciolacustrine sediments. Local areas of Eutric Brunisols and Gray Luvisols can be found on sandy bars and beaches as well as on exposed clayey deposits. Widely distributed patches of permafrost occur in peatlands.

Climatic conditions result in a short growing season, limiting forest productivity. In addition, lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures and poor water-holding capacity and nutrient retention severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation is typical of the northern Boreal forest region. Forest stand age and composition is very much a reflection of the forest fire history.

Imperfectly drained sites on fine textured materials generally support closed stands of black spruce or mixed stands of black spruce, jack pine and trembling aspen. On favourable sites along rivers and lake shores, white spruce is also present and growth can be very good. Jack pine occupies many sites due to the frequency of forest fires.

Bog peatlands have open stands of black spruce with a moss and ericaceous groundcover, while fens generally support open tamarack, sedge and shrub vegetation.

Water

Water sources include the several large lakes, many smaller lakes, and the rivers that flow through the ecodistrict.

Land Use

The ecodistrict has no permanent settlements. Several mines operate in the ecodistrict and the ore is shipped to Flin Flon. Forestry is largely concerned with the extraction of pulpwood for the mill at The Pas, but some sawlog timber is shipped to The Pas as well.

The ecodistrict is popular with sport fishers and hunters, and several lodges operate in the ecodistrict. Other water-oriented recreation is also popular. Trapping and hunting are other important land uses.

In this bedrock-dominated area, some of the clayey and organic soils have limited potential for arable agriculture.

Effect of permafrost degradation on man-made structures

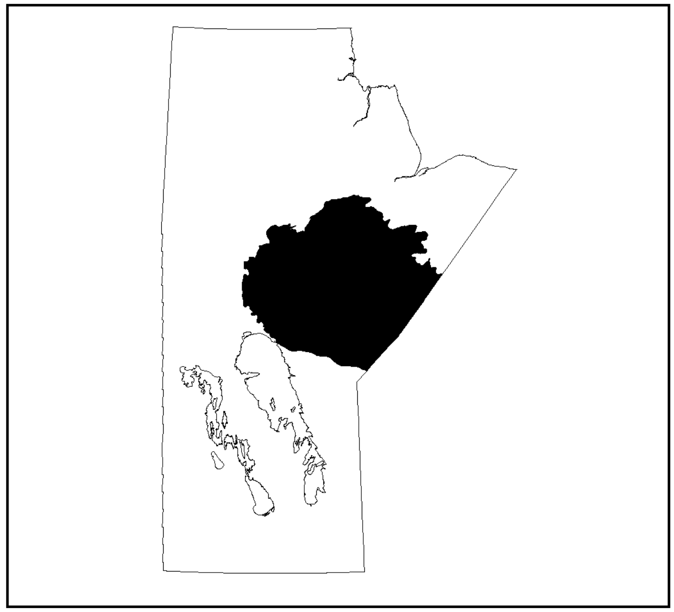
Permafrost in the Churchill and Hayes River Upland ecoregions is most widespread in peatlands and poorly drained clayey soils. The premafrost is very ice-rich (excess ice) in frozen peatlands, and usually extends into the underlying clayey subsoil. When the thermal equilibrium is disturbed by the building of roads, logging, fire, etc. the surface layer that freezes and thaws each year may deepen and progrssively deeper melting of the permfrost may occur (thermokarsting). Thermokarsting may take a considerable time to runs its course. The result is the formation of depressions that are usually filled with water.

The first picture (left) shows the effect of theromkarsting on a railroad that ran from the Soab Lake mine to the Inco smelter at Thompson. This line crossed terrain that contained parts with ice-rich permafrost. The building of the railroad disturbed the thermal balance, causing melting of the permafrost. The rails, with the ties still attached, became suspended when the railroad bed subsided as a result of the melting. When the railroad was in operation, large quantities of aggregate where frequently added to maintain the railroad bed.

Since the first picture was taken (more than 20 years ago) the dip in the railroad bed has developed to the point where a pond has formed, which is still expanding, as can be seen in the second picture (below).

89. Hayes River Upland Ecoregion

This ecoregion extends from the Grass River Basin in east-central Manitoba to Sandy Lake in northwestern Ontario.



Climate

The Hayes River Upland Ecoregion is part of the subhumid, High Boreal Ecoclimatic Region that forms a continuous, extensive belt from northwestern Ontario, across central Saskatchewan to Great Slave Lake in the southern Northwest Territories. It has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperatures range from -0.8 ^{o}C to -4.1^{o}C, the average growing season varies from 131 to 160 days, and the number of growing degree-days ranges from about 880 to 1400.

The mean annual precipitation ranges from 435 to 580 mm and varies greatly from year to year. While precipitation is highest during the growing season, average yearly moisture deficits range from less than 40 mm to almost 100 mm. The region has a cold, subhumid to humid, Cryoboreal soil climate.

Climatic data from stations at Gillam in the north, and at now-closed Wabowden in the southwest, is presented.

Selected Climate Data[1] for Gillam Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-25.7	-22.5	-15.4	-4.8	4.3	11.1	15.3	13.6	6.7	-0.3	-12.0	-23.2	-4.4
Precip. mm	17.8	16.6	19.9	27.7	45.9	53.7	83.5	75.5	53.5	37.9	35.8	26.7	494.4
Growing degree-days	0.0	0.0	0.0	9.7	65.7	189.7	318.0	267.7	81.5	11.7	0.0	0.0	944.0

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

Selected Climate Data[1] for Wabowden

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-24.6	-19.4	-12.6	-2.0	6.3	13.3	16.9	15.1	8.4	2.2	-10.0	-19.4	-2.2
Precip. mm	18.0	16.2	17.2	23.5	43.2	61.3	74.2	59.9	59.0	34.4	30.7	26.6	464.2
Growing degree-days	0.0	0.0	0.0	13.3	87.2	250.8	368.9	313.2	117.7	23.6	0.1	0.0	1174.8

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

Surficial deposits and landforms

In Manitoba this ecoregion, which encompasses part of the Severn Upland, is underlain by crystalline Archean massive rocks that form broad sloping uplands and lowlands. It lies between 285 masl along the Manitoba-Ontario boundary to 210 masl along the Grass and Nelson rivers to the west.

Strongly glaciated, the ecoregion is characterized by ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic sandy till in the south, and calcareous, sandy to loamy cobbly glacial till in the north. Veneer bogs, flat bogs and gently sloping clayey glaciolacustrine blankets and veneers occupy large areas. Local areas of prominent, ridged fluvioglacial deposits (local relief can exceed 30 m) also occur. Slopes range from 10 to 30 percent.

The ecoregion contains many small to medium sized lakes and a large number of medium to large lakes which are linked by the Nelson, Stupart, Hayes and Gods rivers and their tributaries.

Soils

Organic Cryosols associated with veneer and peat plateau bogs are dominant in the northern half of the ecoregion, while in the southern half, Organic Mesisols and Fibrisols are the dominant organic soils. Eutric and Dystric Brunisols on loamy fluvioglacial and glacial till and Gray Luvisols on exposed silty to clayey glaciolacustrine and fluvioglacial deposits are more prevalent in the southern section. Granite bedrock outcrops occur throughout the ecoregion.

Permafrost is widespread in the northern peatlands, but is only sporadically distributed in the south. Permafrost in mineral soils is much less common and is only found in the northern half of the ecoregion. Mineral soil profiles often exhibit uneven, discontinuous or distorted soil horizon development. These properties and such peri-glacial features as relic earth hummocks and non-sorted circles are evidence of past and present effects of permafrost on the landscape surface.

Vegetation

This ecoregion lies between the colder, peatland-dominated Hudson Bay Lowland Ecoregion to the north, and the warmer Lac Seul Upland Ecoregion to the south.

The forest in this ecoregion is dominated by medium to tall closed stands of black spruce, jack pine and some paper birch, with understoreys of feather moss, rock cranberry, blueberry, Labrador tea and lichen. White spruce, balsam fir and trembling aspen occur in the warmer, moister sites in the southern sections, especially along rivers. Black spruce is the climax species, but frequent forest fires have reduced the distribution of mature stands. Drier sites support black spruce and/or jack pine stands with more open canopies. Bedrock exposures have few trees and are covered with lichens.

Stunted closed and open stands of black spruce with Labrador tea, blueberry, bog rosemary and sphagnum mosses form the vegetation on bogs. Sedges, brown mosses, shrubs and tamarack in varying mixtures form the dominant vegetation on fens.

Wildlife

The ecoregion provides habitat for moose, black bear, woodland caribou, lynx, wolf, beaver, muskrat and snowshoe hare. Waterfowl including ducks, geese and pelicans use the region. Other common bird species found include sandhill crane, spruce grouse, willow ptarmigan, raven, Canada jay and many passerine bird species.

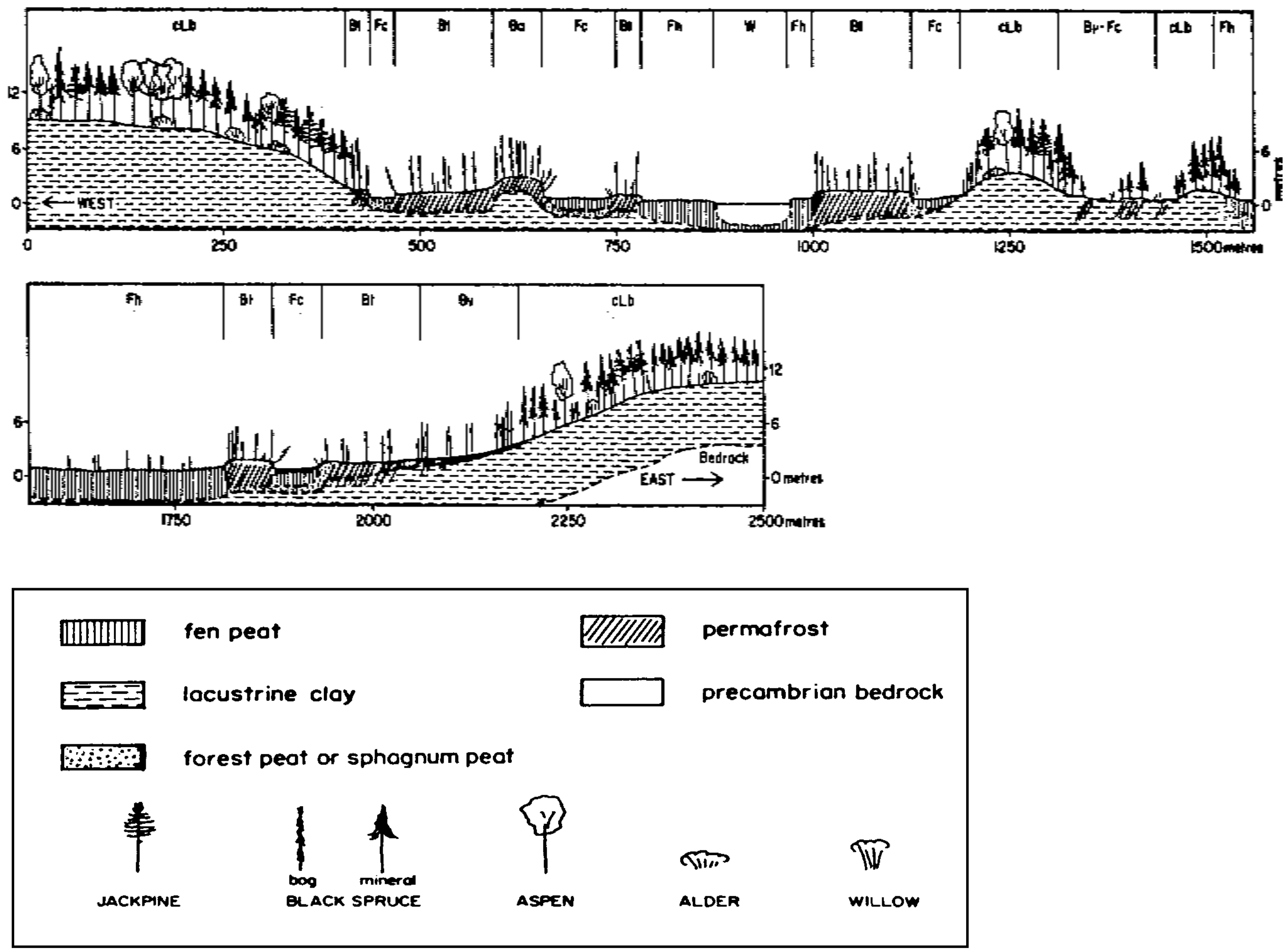
Land Use

The ecoregion is generally sparsely populated. However, there are several communities, including a number of First Nation settlements.

The city of Thompson is by far the largest community with a population of approximately 15,000 which varies with the fortunes of the Inco mining and smelting operation. The western section of the ecoregion supports pulpwood and local sawlog forestry. Trapping and hunting, water-oriented recreation and tourism are other significant natural resource uses in this ecoregion.

There are nine ecodistricts within the Hayes River Upland Ecoregion in Manitoba.

Cross-sections through part of Ecodistrict 363, Sipiwesk Lake



Ba	**- palsa bog**	**cLb**	**- clayey, glaciolacustrine blanket**
Bt	**- peat plateau bog**	**Fc**	**- collapse fen**
Bv	**- veneer bog**	**Fh**	**- horizontal fen**
		W	**- open water**

360. Knee Lake Ecodistrict (23 047 km²)

The Knee Lake Ecodistrict encompasses a somewhat horseshoe shaped area in the northern part of the ecoregion.

Climate

This ecodistrict is located within a colder subdivision of the High Boreal Ecoclimatic Region in Manitoba. The climate is marked by short, cool summers and long, very cold winters. The mean annual temperature is approximately -4.1 °C. The average growing season is 131 days with about 880 growing degree-days.

The mean annual precipitation is approximately 500 mm, of which slightly more than one-third falls as snow. Precipitation varies greatly from year to year, but is highest during the summer months. The average yearly moisture deficit is less than 40 mm. The district has a cold, subhumid to humid, Cryoboreal soil climate.

The climate station at Gillam airport in the northern part provides relevant data for this ecodistrict.

Selected Climate Data[1] for Gillam Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-4.4	13.3	10.2	15.3	-25.7
Precip. mm (equiv.)	494.4	212.7	312.1	83.5	17.8
Rain/Snow (mm/cm)	312.9/222.1	210.5/2.4	287.0/28.4	83.5/0.0T	0.0T/23.5
Growing degree-days >5°C	944.0	775.0	922.0	318.0	0.0

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

Physiography and Drainage

The Knee Lake Ecodistrict is an undulating to ridged, (drumlins) loamy morainal plain, extending from Knee Lake in the south to Stevenson Lake in the north. Elevations in the Knee Lake area are about 213 masl and approximately 150 masl in the vicinity of Stevenson Lake.

Drumlin crests are water-eroded, forming concentrations of boulders and stony lags. Veneer bogs on gently sloping glaciolacustrine blankets and veneers, and on lower slopes of drumlins, are common throughout. Peat plateau bogs and patterned fens occupy extensive areas of depressional terrain, and are usually underlain by clayey glaciolacustrine sediments as well. Local areas of prominent, kettled fluvioglacial deposits (eskers and esker aprons), rising 20 to 30 m above the surrounding plain, and eroded channels along Stupart and Red Fox rivers, create local relief. Slopes in this ecodistrict range from level in peat-filled depressions to about 10 to 30 percent on drumlin ridges, and range from less than 50 m to more than 150 m long.

The northwestern part of the ecodistrict is in the Nelson River drainage system. The southwestern and eastern sections are part of the Hayes River system. Many small to medium sized lakes with shores largely developed in unconsolidated materials, and some large to very large lakes are distributed throughout. Many of the smaller lakes lie between drumlin ridges. Drainage is northeastward through the Hayes, Stupart and Nelson rivers, and a dendritic drainage system consists of many secondary streams. The terrain slopes very gently at about 0.6 m per km.

Soils

The dominant soils in the Knee Lake Ecodistrict are organic soils including Organic Cryosols associated with widespread permafrost in peatlands such as veneer and peat plateau bogs. The non-frozen organic soils are deep and shallow Fibrisols and Mesisols, which are associated with veneer bogs (shallow), and flat bogs and patterned fens (deep). Origin of the organic material is mainly woody, forest peat and sedge peat.

Significant areas of mineral soils are imperfectly drained Eluviated Eutric Brunisols on loamy to sandy calcareous till and sandy to gravelly fluvioglacial deposits. Areas of Gray Luvisols can be found on well to imperfectly drained clayey deposits. Soil profiles on clayey sediments often exhibit uneven horizon development, while the surface shows a pattern of low relic earth hummock. These features are evidence of the effect of past and present permafrost conditions on soil development.

Climatic conditions are sufficiently severe to prevent arable agriculture and to significantly reduce forest productivity. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils while the lack of rooting depth to dense subsoils, permafrost and excessive stoniness severely constrain the use of mineral soils.

Vegetation

Black spruce is the dominant tree species in the ecodistrict. Because of the northern location the stands are generally less than medium height and often more open than stands farther south.

Due to frequent forest fires, jack pine is a common component of the forest stands. In young regeneration stands jack pine is often the only, or the dominant, tree species. Jack pine may remain dominant for one full rotation on dry, sandy soils, but on finer textured soils, black spruce invades the stands fairly early. Bedrock outcrops also favour the development of jack pine-dominated vegetation.

Trembling aspen occurs throughout the ecodistrict, but is only locally prominent. White spruce is largely confined to favourable sites in river valleys and along lakes.

Bog peatlands support stunted black spruce, sphagnum and other mosses and ericaceous shrubs. Fens have vegetation consisting of sedges, brown mosses, shrubs and stunted tamarack.

Water

The principal sources of water are the many large lakes such as Knee, Whitefish, Stupart and Stephens lakes, and the Nelson, Hayes and Stupart rivers, that together with their tributary streams, drain the ecodistrict.

Land Use

Gillam is the largest community in the ecodistrict and serves as the main trading and service centre. Ilford and Split Lake Cree, York Factory, War Lake and Fox Lake First Nations are the other settlements in the ecodistrict. Hydro development and related activities have a major impact on the land along the Nelson River. Trapping, hunting, fishing, and water-oriented recreation are the dominant land uses.

Hydro Development

Over ninety percent of the electric power produced in Manitoba is generated by hydro-stations on rivers in the Boreal Shield and Boreal Plains ecozones.The Kettle Rapids hydro station near Gillma, one of the seberal built on the Nelson River, came on line in the late seventies.

361. Pikwitonei Lake Ecodistrict (4878 km²)

The Pikwitonei Lake Ecodistrict is located in north-central Manitoba north of the city of Thompson.

Climate

This ecodistrict is situated in a colder subdivision of the High Boreal Ecoclimatic Region in Manitoba, which is marked by short, cool summers and long, very cold winters. The mean annual temperature is -3.5 ^{o}C. The average growing season is 136 days with about 930 growing degree days.

The mean annual precipitation is approximately 530 mm, of which one-third falls as snow. Precipitation varies greatly from year to year, but is highest during the summer months. The average moisture deficit is about 50 mm over the year. The district has a cold, subhumid to humid Cryoboreal soil climate.

There is no climate station in the ecodistrict, but the station at Thompson Airport (363. Sipiwesk Lake Ecodistrict), immediately to the south, is relevant.

Physiography and Drainage

The Pikwitonei Lake Ecodistrict is an undulating to hummocky clayey glaciolacustrine plain. Local granitoid rock outcrops and their associated discontinuous blankets and veneers of acidic, sandy, stony glacial till are significant inclusions. Peat-covered glaciolacustrine clay blankets and veneers are more common on level to gently sloping sites.Organic deposits are widespread and consist of shallow veneer bogs on gentler slopes to deep peat plateau bogs and horizontal fens on low-lying terrain.

Prominent glaciofluvial hills and ridges associated with an interlobate moraine that runs in a northeasterly direction from just northwest of Mystery and Moak lakes, contribute the most prominent local relief of up to 75m. Elevations range from about 275 masl on the moraine to 213 masl in the southwestern section of the ecodistrict near Thompson to about 183 masl near Split Lake in the northeast. Slopes range from level in peat-filled depressions to about 10 to 15 percent along irregular, hummocky surfaces to over 30 percent in the fluvioglacial terrain. Slope lengths range from less than 50 m to more than 300 m. Other local relief is provided by rocky hummocky highs that can rise 20 m above lakes and peat-filled depressions.

The ecodistrict is part of a number of watersheds, which are all part of the Nelson River drainage system. Drainage is provided by the Nelson River and Burntwood River and many smaller tributary rivers and creeks. They drain the numerous medium and small lakes and the few large lakes in a generally northward direction over terrain that falls at about 0.6 m per km.

Soils

Most of the soils in the Pikwitonei Lake Ecodistrict are dominantly well to imperfectly drained Gray Luvisols associated with clayey glaciolacustrine deposits. Soil profiles on clayey materials frequently exhibit uneven horizon development, and the surface displays relic earth hummocks. These features are evidence of the effect of former and present permafrost conditions on soil development.

Permafrost is widespread throughout the ecodistrict, but dominantly associated with shallow and deep organic deposits. Significant areas of Organic Cryosols occur on peat plateau bogs, and to a lesser extent in veneer bogs. Veneer bogs are dominantly shallow Fibrisolic or Mesisolic organic soils.

Some Dystric Brunisols are associated with sandy and gravelly glaciofluvial deposits, while areas of loamy glaciolacustrine sediments have Eutric Brunisols or weakly developed Gray Luvisols.

Climatic conditions severely reduce the usefulness of the eocdistrict for arable agriculture and forestry. In addition, lack of rooting depth to dense subsoil, low soil temperature and poor structure severely constrain the use of mineral soils. Poor natural drainage, slow heat conductance properties and presence of permafrost limit the usefulness of organic soils.

Vegetation

Black spruce is the dominant tree in the ecodistrict. Because of the northern location, the stands are generally of medium height and often more open than stands farther south.

Due to frequent forest fires, jack pine is a common component of the forest stands. In young regeneration stands, jack pine is often the only, or the dominant, tree species. Jack pine may remain the dominant species for one full rotation on dry, sandy soils, but on finer textured soils black spruce invades the stands fairly early on. Bedrock outcrops also favour the development of jack pine-dominated vegetation.

Trembling aspen occurs throughout the ecodistrict, but is only locally prominent. White spruce is largely confined to favourable sites in river valleys and along lakes.

Stunted forest is widespread due to the large extent of peatlands. Bog peatlands support stunted black spruce, sphagnum and other mosses and ericaceous shrubs. Fens have vegetation consisting of sedges, brown mosses, shrubs and stunted tamarack.

Water

The principal sources of water are the numerous lakes, rivers and streams that flow through the ecodistrict.

Land Use

Pikwitonei is the only community within the ecodistrict. Hydro development has had an impact. The Hydro generating station at Kelsey on the Nelson River was initially built to provide power for the smelter at Thompson.

Commercial fishing is a limited economic activity on the larger lakes. Trapping and hunting are dominant natural resource uses in this area by First Nations people. Sport fishing, other water-oriented recreation and sport hunting are popular uses of the land by people from Thompson and by tourists. The use of timber is only of local interest.

362. Silsby Lake Ecodistrict (8093 km^2)

The Silsby Lake Ecodistrict is located in north-central Manitoba.

Climate

This ecodistrict lies within a colder subdivision of the High Boreal Ecoclimatic Region in Manitoba, and is marked by short, cool summers and long, very cold winters. The mean annual temperature is -4.1^{o}C. The average growing season is 131 days with 880 growing degree-days.

The mean annual precipitation is approximately 510 mm, of which slightly more than one-third falls as snow. Precipitation varies greatly from year to year, but is highest during the summer months. The moisture deficit over the year is less than 40 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

There is no climate station within the ecodistrict. The nearest stations are Thompson Airport (363. Sipiwesk Lake Ecodistrict) and Gillam Airport (360. Knee Lake Ecodistrict).

Physiography and Drainage

The Silsby Lake Ecodistrict extends from Cauchon Lake northward to Atkinson Lake in east-central Manitoba. It is an undulating to subdued hummocky loamy morainal plain largely covered by clayey, glaciolacustrine veneers and blankets.

Because of the rather level topography, extensive peatlands have developed. Veneer bogs occupy a large portion of the level to gently sloping glaciolacustrine sediments and till materials. Peat plateau bogs and patterned fens occupy depressional areas, and are generally underlain by clayey glaciolacustrine sediments.

Local areas of prominent fluvioglacial deposits also occur. These materials are in the form of outwash deposits and eskers, which may stand 20 to 30 m above the surrounding plain. Elevation ranges from about 220 masl in the southwest to 160 masl in the north. Slopes range from level in peat-filled depressions to about 5 to 15 percent along undulating and hummocky surfaces. Slope lengths range from less than 50 m to more than 400 m. Local relief is provided by morainal and glaciofluvial ridges that may stand 20m above lakes and peat-filled depressions

The ecodistrict is part of two major drainage systems. The western section is part of the Clearwater River watershed, which is part of the Nelson River drainage system. The eastern section is part of the Fox River watershed, which is part of the Hayes River drainage system. The many small to medium sized lakes, and large and very large lakes, are more prevalent in the southern half of the ecodistrict. An irregular network of secondary streams drains the district generally northward over terrain that falls at about 0.6 m per km.

Soils

Most of the soils in the Silsby Lake Ecodistrict are shallow organic soils associated with veneer bogs. The veneer bogs have generally developed on gently sloping clayey glaciolacustrine sediments and on fine loamy till of the lower slopes of drumlins. The associated soils include permanently frozen Organic Cryosols and nonfrozen Terric Fibrisols and Mesisols that have developed on forest and sphagnum peat. Deep Organic Cryosols are associated with peat plateau bogs, and deep Mesisols are found on patterned and horizontal fens, which have developed in depressional areas.

Significant areas of Gray Luvisols and Eutric Brunisols can be found on well to imperfectly drained loamy till and clayey glaciolacustrine deposits. These soils may exhibit uneven horizon development and the surface may have subdued earth hummock micro-topography. These features are evidence of the effect of former and present permafrost conditions on soil development.

Climatic conditions are severe constraints to the use of the ecodistrict for agriculture. A short growing season limits forest productivity. In addition, lack of rooting depth to dense subsoils, permafrost or bedrock, and poor structure severely constrain the use of mineral soils. Poor natural drainage and slow heat conductance properties are additional limitations to the usefulness of organic soils.

Vegetation

Black spruce is the dominant tree species in the ecodistrict. Because of the northern location the stands are generally of medium height and often more open than stands farther south.

Due to frequent forest fires, jack pine is a common component of the forest stands. In young regeneration stands jack pine is often the only, or the dominant, tree species. Jack pine may remain the dominant species one rotation or more on dry, sandy soils, but on finer textured soils, black spruce invades the stands fairly early.

Trembling aspen occurs throughout the ecodistrict, but is only locally prominent. White spruce is largely confined to favourable sites in river valleys and along lakes.

Stunted forest is widespread due to the extend of peatlands in the district. Bog peatlands support stunted black spruce, sphagnum and other mosses and ericaceous shrubs. Fens have vegetation consisting of sedges, brown mosses, shrubs and stunted tamarack.

Water

The principal sources of water are the many lakes, including the large Bear, Utik, Cauchon, Silsby and High Hill lakes, and the Bigstone River and other streams that flow through the ecodistrict.

Land Use

Fox Lake First Nation is the only community in the ecodistrict. Commercial fishing is a limited economic activity. Trapping and hunting are other uses of the land. Water-oriented recreation, especially sport fishing, is on the increase in the district.

Northern transportation

Most of the larger northern communities that are not accessible by road have airstrips which are operational year round, and are used for the transportation of people and the shipping of freight. However, travel to and from remote lakes for recreation, exploration, and hunting still relies on the float plane.

363. Sipiwesk Lake Ecodistrict (15 724 km^2)

The Sipiwesk Lake Ecodistrict is located in north-central Manitoba.

Climate

This ecodistrict lies within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba, which is marked by short, cool summers and long, very cold winters. The mean annual temperature is -2.4 ^{o}C. The average growing season is 149 days with about 1100 growing degree-days.

The mean annual precipitation is about 500 mm, of which one-third falls as snow. Precipitation varies greatly from year to year, and is highest during the summer months. Average yearly moisture deficit is about 70 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

The climate station at Thompson Airport has the most recent data, while the station at Wabowden is not in operation anymore. However, the data collected at Wabowden prior to 1980 is still of value for assessing climate for the southern part of the ecodistrict.

Selected Climate Data[1] for Thompson Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	-3.4	13.9	11.1	15.7	-25.0
Precip. mm (equiv.)	535.6	233.5	342.7	84.3	20.3
Rain/Snow (mm/cm)	351.6/200.9	230.8/2.8	320.8/22.6	84.3/0.0T	0.0T/22.5
Growing degree-days >5^{0}C	1038.0	826.0	1011.0	331.0	0.0

[1] Canadian Climate Normals, 1961-19980. Atmospheric Environment Service, Environment Canada.

Selected Climate Data[1] for Wabowden

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	-2.2	15.1	12.0	16.9	-24.6
Precip. mm (equiv.)	464.2	195.4	297.6	74.2	18.0
Rain/Snow (mm/cm)	315.0/147.6	194.1/1.1	286.7/9.7	74.2/0.0	0.1/18.1
Growing degree-days >5^{0}C	1175.0	933.0	1138.0	369.0	0.0

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

Physiography and Drainage

The Sipiwesk Lake Ecodistrict is part of the glacial Lake Agassiz basin. As a result, this ecodistrict is dominantly a level to undulating clayey glaciolacustrine plain with prominent, hummocky granitoid rock outcrops generally capped by glaciolacustrine blankets and veneers. Exposed bedrock outcrops and outcrops with or without discontinuous veneers of sandy water-worked glacial till also occur.

Organic deposition is extensive on gentle slopes and in depressions. Permafrost is common in bog-type peatlands, but is only very sporadic in mineral soils. Permafrost as deep as 30 metres has been encountered in the district. It is believed that the extent of this permafrost is relic and does not reflect present climatic conditions. However, permafrost will form under the right conditions on suitable sites but will not extend as deep.

Elevations range from about 244 masl in its southwest section to about 195 masl near Partridge Crop Lake to the northeast. Slopes are variable and range from level in peat-filled depressions to about 10 to 30 percent along irregular, hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. Local relief is provided by rocky hummocky highs that may stand 35 to 40 m above lakes and peat-filled depressions.

The ecodistrict lies entirely within the Nelson River drainage system. The western part is drained through the Burntwood River, Grass River and Setting Lake watersheds, while the eastern part is largely within the Cross Lake watershed. The many small, medium and large lakes are drained by an irregular bedrock-controlled network of rivers and secondary streams. Drainage is generally northeastward from Pakwa and Setting lakes over terrain that falls at about 0.5 m per km.

Soils

Most of the mineral soils are dominantly well to imperfectly drained Gray Luvisols and some Eutric Brunisols that have developed on clayey deposits. Soil profiles exhibit uneven horizon development, especially in the northern sector, while the surface often has relic earth hummock micro-topography. These features are evidence of the effect of former permafrost conditions on soil development.

The peatlands are a complex of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Organic Cryosols are associated with widespread tracts of permafrost in deep peats (peat plateau bogs) and shallow veneer bogs on very gently slopes. Some peaty Gleysolic soils that have developed on clayey deposits also contain sporadically shallow permafrost, as do well drained clay soils under dense black spruce stands. Bedrock outcrops occur throughout.

Climate constrains the use of the ecodistrict for arable agriculture, although vegetable crops will do well. The short growing season limits forest productivity. In addition, lack of rooting depth to compact clayey subsoils and bedrock, poor structure and low soil temperature severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties are additional limitations to the use of organic soils.

Vegetation

Black spruce stands form the dominant forest cover. On bog peatlands, the trees are stunted and the stands are open, with sphagnum and feather moss and ericaceous shrub ground cover. On upland sites the forest stands consist of dense, closed black spruce-feather moss vegetation. Where stand closure is more open, shrubs such as green alder and Labrador tea are often present.

Due to the frequency of forest fires, jack pine and trembling aspen are important forest species, either as pure stands or as a mixture with black spruce. Since it is the climax species, black spruce regeneration generally occurs soon after fire. On coarse textured soils and on bedrock outcrops, jack pine may maintain its dominance for a much longer time.

Fens have shrub, sedge, brown moss and tamarack vegetation in varying mixtures, while bogs have black spruce, ericaceous shrubs, sphagnum and feathermoss vegetation.

Water

The principal sources of water are the many lakes, rivers and streams that flow through the ecodistrict.

Land Use

The city of Thompson, which is the largest community in northern Manitoba, is the economic and service centre for the ecodistrict and surrounding area. Other communities include the town of Wabowden and Cross Lake First Nation.

A few attempts at agriculture have been made, but generally have not been successful. However, short-season vegetables are possible. The former experimental station at Wabowden carried out tests on the adaptability of grain, forages aand vegetable varieties.

Activities associated with mining operations and the smelter at Thompson have had a major impact on the land through the construction of roads and railroads and through the effect of emissions on the vegetation. The ecodistrict is traversed by a provincial highway which links the communities with the south. Thompson is also served by air and rail, which links it with the south and the town of Churchill on the Hudson Bay coast. Forestry activity is on the increase and timber is shipped via road and rail to the mill at The Pas.

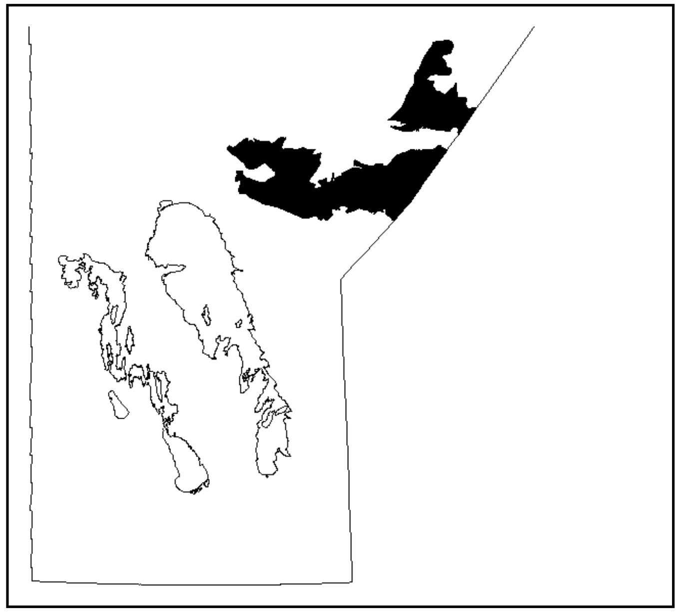
Water-oriented recreation is an increasingly popular pastime for residents and tourists. Paint Lake, which is in part a provincial park, and Setting Lake are especially popular. Both lakes have had significant cottage development along their shores in recent years. Trapping and hunting are the dominant natural resource uses.

Some of the clayey Gray Luvisols and organic soils have some potential for arable agriculture, and attempts have been and are being made to bring some land under cultivation, or into pasture.

Pisew Falls in winter.

Pisew Falls on the Grass River is the largest accessible falls in Manitoba. In winter the spray of the falls covers a band of trees along its shores with a heavy coating of hoarfrost.

364. Island Lake Ecodistrict (27 909 km^2)



The Island Lake Ecodistrict occupies a large tract of land in east-central Manitoba and northwestern Ontario. The Manitoba portion of the ecodistrict is divided into northern and southern sections by the Gods Lake Ecodistrict (365).

Climate

The northern section of this ecodistrict is situated in a cooler, less humid subdivision of the High Boreal Ecoclimatic Region in Manitoba, while the southern section lies in a warmer, more humid subdivision of the same ecoclimatic region. Both sections are marked by short, cool summers and long, very cold winters. The mean annual temperature varies from about -4.1 in the north to about -1.5^{o}C in the south. The average growing season is 131 days in the north and 154 days in the south. Growing degree-days number from about 900 in the northern section to about 1200 in the south.

Mean annual precipitation is about 500 mm in the north to about 560 mm in the south. About one-third of the precipitation falls as snow. Precipitation varies greatly from year to year, and is highest in the summer months. Average moisture deficits during the year are about 40 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

Island Lake Airport is the only climate station in the ecodistrict. Data from this station is relevant for the southern section. Data from Gillam Airport (360. Knee Lake Ecodistrict) has some relevancy for the northern sector.

Selected Climate Data[1,2] for Island Lake Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	-1.2	15.8	12.9	17.6	-22.8
Precip. mm (equiv.)	N	236.1	N	88.8	21.6
Rain/Snow (mm/cm)	N/N	235.8/0.3	N/N	88.8/0.0	0.0T/30.2
Growing degree-days >5^{0}C	1315.0	1001.0	1264.0	391.0	0.0

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

[2] Data for period 1970-1990.

Physiography and Drainage

The Island Lake Ecodistrict consists of two parts. The northern section is located north of the Gods Lake Ecodistrict and the southern section lies around and includes Island Lake.

The northern section is an undulating to subdued hummocky morainal plain consisting of calcareous, loamy glacial till. Areas of marine sediments, especially in the form of relic beaches are present, as are lateral or interlobate moraines and minor glaciofluvial deposits. It is extensively covered by deep and shallow peatlands in the form of peat plateau bogs, collapse bogs and, to a lesser extent, patterned fens and horizontal fens. Lower slopes are extensively covered by shallow peat in the form of veneer bogs. Permafrost is widespread in the deep peat bogs, but is more discontinuous in the veneer bogs.

Elevations range from about 180 masl in the southern part of this northern section to 150 masl in the north. Slopes generally range from level in peat-filled depressions to between 5 and 10 percent in upland areas. Slope lengths are from 50 m to more than 400 m.

This northern section is part of the Hayes River drainage system and lies largely in the Gods River watershed. Several large lakes and many small lakes are present, along with several rivers in defined valleys, and many streams. Drainage is in a northeasterly direction over terrain that falls at a rate of less than 0.5 m per km.

The southern section of the ecodistrict consists of an undulating to hummocky till plain. Uplands are characterized by granitoid rock outcrops, discontinuous blankets and veneers of acidic to weakly calcareous, sandy, stony glacial till. Calcareous, clayey glaciolacustrine blankets and veneers are common around Island Lake, but in most other areas, shallow to deep peat covers glaciolacustrine clayey sediments on level, gently sloping sites and in depressions. Permafrost is much less widespread than in the northern section, and is quite often relic. Permafrost is confined to peat plateau and veneer bogs.

Elevations range from about 260 masl in the southwestern part of this southern section to about 215 masl near Sharp Lake in the northeast. Slopes range from level in peat-filled depressions to about 10 to 20 percent along irregular, hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. Local relief is provided by rocky hummocky highs that can stand 20 m above lakes and peat-filled depressions.

The southern section of the ecodistrict lies for the most part in the Hayes River watershed. Only a small part in the west lies in the Nelson River watershed. Many small, medium, large and very large lakes and an irregular bedrock-controlled network of secondary streams drain over terrain that falls at about 0.6 m per km.

Soils

Exposed granitoid bedrock and bedrock-covered by discontinuous veneers and blankets of glaciolacustrine and till deposits dominate the western half of the southern section of the ecodistrict. In the remainder of the southern section, till and glaciolacustrine deposits, the latter especially in the Island Lake basin, are the dominant unconsolidated mineral materials. Soils in this section of the ecodistrict are well to excessively drained Dystric Brunisols on stony, acidic, sandy till. Gray Luvisols are found on well to imperfectly drained clayey deposits near Island Lake. Clayey soil profiles may exhibit uneven horizon development and/or cryoturbated subsoils, which are evidence of past permafrost conditions.

Significant areas of peat-filled depressions form a complex of poorly to very poorly drained bogs and fens. The soils consist of deep (Typic) and shallow (Terric) Fibrisolic and Mesisolic Organic soils, composed of sedge, forest and sphagnum peat, overlying loamy to clayey glaciolacustrine sediments. Permafrost is found in peat plateau and palsa bogs, and sporadically in veneer bogs developed on gently sloping clayey sediments. Permafrost is less widespread than in adjacent ecodistricts to the north.

In the northern section of this ecodistrict, organic soils (Mesisols and Fibrisols) and Organic Cryosols are dominant. Eutric Brunisols, and to lesser extent, Luvisols are found on upland calcareous, loamy till. Permafrost is widespread in peat plateau, palsa bogs, and discontinuous in veneer bogs. Infrequently, peaty Gleysols have permafrost in most northern sectors.

Climatic conditions are not favourable for arable agriculture. However, the production of short-season vegetables is possible. The short growing season also limits forest productivity. In addition, lack of rooting depth to bedrock, excessive stoniness, lack of water-holding capacity and low nutrient retention severely constrain the use of till soils. Massive subsoils, poor structure and low soil temperature are additional constraints to the use of clay soils. Poor natural drainage and heat conductance properties limit the use of organic soils.

Vegetation

Black spruce is the dominant tree species in the ecodistrict.

In the northern section, most stands are stunted and open because of the prevalence of poorly drained organic soils. On upland sites, the stands are taller and more closed. Due to frequent forest fires, jack pine is a common component of the upland forest stands.

Trembling aspen occurs throughout the northern section of this ecodistrict, but is only locally prominent. White spruce is largely confined to favourable sites in river valleys and along lakes.

Bog peatlands support stunted black spruce, sphagnum and other mosses and ericaceous shrubs. Fens have vegetation consisting of sedges, brown mosses, shrubs and stunted tamarack.

The vegetation in the southern section is very similar to that of the northern section. However, the upland stands in the southern section are generally taller and more productive, and balsam fir becomes part of the forest mix, especially in stands around lakes and along rivers.

Water

The principal sources of water are the many lakes, of which Island Lake is the largest, and the rivers and streams that flow through the ecodistrict.

Land Use

There is no road access to the area except in the winter via winter roads. Besides the settlement of Island Lake, there are also Garden Hill, Wasagomack and St. Theresa Point First Nation communities on the shore of Island Lake, and Red Sucker Lake First Nation to the north. There are no communities in the northern sector of the ecodistrict.

The forests of the southern section can support a limited forestry, but access and distance to mills are the limiting factors at present. The use of forest for fuel and construction timber is important locally. Island Lake and some of the other large lakes support commercial fishing. Water-oriented recreation such as sport fishing, trapping and hunting are other significant natural resource uses in this ecodistrict.

Although rock outcrops are widespread, some of the clayey Gray Luvisols and organic soils, especially in the area around Island Lake, have some potential for arable agriculture.

365. Gods Lake Ecodistrict (17 670 km²)

The Gods Lake Ecodistrict occupies the central portion of the Hayes River Upland Ecoregion and lies almost entirely within Manitoba.

Climate

This ecodistrict lies within a warmer, and more humid, subdivision of the High Boreal Ecoclimatic Region in Manitoba. The climate is marked by short, cool summers and long, very cold winters. The mean annual temperature is -1.5 °C. The average growing season is about 155 days with about 1200 growing degree-days.

The mean annual precipitation is about 560 mm, of which one-third falls as snow. Precipitation varies greatly from year to year, and is highest during the summer months. The average moisture deficit over the year is about 45 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The data from the station at Island Lake (364. Island Lake Ecodistrict) is relevant to the district.

Physiography and Drainage

The Gods Lake Ecodistrict, which extends from the Ontario boundary westward to Landing Lake, is an undulating to hummocky morainal plain of calcareous, sandy to loamy till deposits. Clayey glaciolacustrine veneers and blankets occur throughout, and are common on lower slopes and in depressions, especially in the eastern section. The fine textured glaciolacustrine sediments are often covered by shallow peat materials (veneer bog) and deep peat deposits (northern plateau bog, peat plateau bog, flat bog, and patterned and horizontal fens). Local areas of prominent kettled fluvioglacial deposits also occur. Elevations range from about 274 masl in the southwestern section to about 183 masl near Kistigan Lake in the northeast. Slopes range from level in peat-filled depressions to about 10 to 15 percent along irregular, hummocky surfaces, and to over 20 percent along some drumlin and bedrock slopes. Slope lengths generally range from less than 50 m to more than 150 m. Local relief is provided by rocky hummocky highs and drumlins that can stand 20 m above lakes and peat-filled depressions.

Except for the most westerly section, which lies in the Nelson River drainage system, the ecodistrict is part of the Hayes River drainage system. The many small to medium lakes, and a few large to very large lakes, are drained generally northward by an irregular network of rivers and secondary streams over terrain which falls at about 0.6 m per km.

Soils

Mineral soils are dominantly well to imperfectly drained Eluviated Eutric Brunisols and Gray Luvisols developed on loamy to sandy till. Significant areas of Gray Luvisols are found on upland clayey glaciolacustrine deposits. Clayey soil profiles may exhibit uneven horizon development with cryoturbated subsoils. Relic earth hummocks may be present at the surface. These features are evidence of past permafrost conditions.

Significant areas consist of peat-filled depressions that form a complex of poorly drained bogs and very poorly drained fens. The soils on the bogs consist of deep, slightly decomposed sphagnum and feather moss peat (Fibrisols) and moderately decomposed moss and forest peat (Mesisols). Areas with permafrost have Organic Cryosols.

The peat in fens varies also from slightly decomposed to moderately well decomposed, with the deeper peat generally more decomposed than the surface peat.

Shallow peat soils are found on gentle slopes and consist of slightly to moderately decomposed Sphagnum, feather moss and/or forest peat. Some Organic Cryosols are associated with these peatlands. Most organic deposits rest on clayey subsoils.

Permafrost is more common in the northern section and is largely associated with organic materials. Peaty Gleysols and upland soils under dense forest cover may have very sporadic permafrost distribution.

Climate severely constrains the use of the ecodistrict for arable agriculture. The short growing season also limits forest productivity. Lack of rooting depth to dense subsoils or bedrock, poor structure, low soil temperatures, excessive stoniness, or lack of water-holding capacity and low nutrient retention are additional severe constraints to the use of mineral soils. Poor natural drainage and slow thermal conductance properties are additional limitations to the usefulness of organic soils.

Vegetation

Black spruce is the predominant tree species in the ecodistrict and is found both on upland and organic sites. As a result of forest fires, the upland black spruce is often replaced by jack pine and, to a lesser extent, trembling aspen. Tamarack is found on fens and mixed with black spruce in transitional bog peatlands. Along lakes and rivers, white spruce, balsam fir, trembling aspen and balsam poplar occur as mixed stands showing better growth than is the norm for the ecodistrict.

Water

The principal sources of water are the many lakes, of which Gods and Oxford lakes are the largest, and rivers and streams that flow through the ecodistrict.

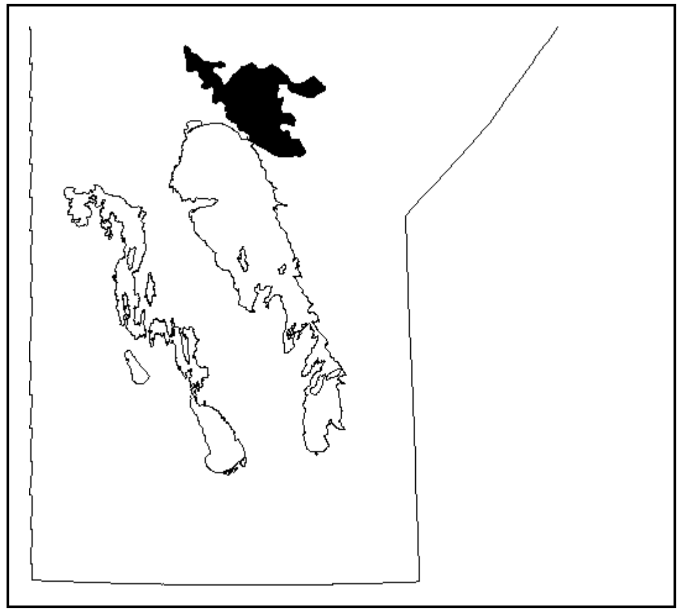
Land Use

Oxford House, God’s Lake and God’s Lake Narrows First Nation are the settlements in the ecodistrict. Fishing, trapping and hunting are the dominant land uses. Forestry and water-oriented recreation are other, although limited, uses of the land.

In this ecodistrict dominated by till deposits, poorly drained organic materials and bedrock, agricultural development potential is limited. Some of the clayey Gray Luvisols and organic soils have some potential for arable agriculture.

366. Norway House Ecodistrict (8594 km²)

The Norway House Ecodistrict is situated just north of Lake Winnipeg.



Climate

This ecodistrict is located in a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba, and has short, cool summers and long, very cold winters. The mean annual temperature is -0.8°C. The average growing season is about 160 days with about 1400 growing degree-days.

The mean annual precipitation is about 440 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, and is highest during the summer months. The average moisture deficit over the year is about 100 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

There is a climate station at Norway House (Norway House Forestry), but the data is very incomplete and therefore not presented.

Physiography and Drainage

The Norway Lake Ecodistrict is a level to undulating peat-covered clayey glaciolacustrine plain broken occasionally by hummocky granitoid rock outcrops that are associated with discontinuous veneers of sandy, water-worked glacial till. The peatlands consist of deep horizontal fens and patterned fens in the southern section. In the northern half, northern plateau bogs and basin fens are more prevalent.

The ecodistrict forms part of the zone where permafrost is only sporadic and is only present in peatlands. The peat plateau bogs and palsa bogs are extensively thermokarsted. Therefore, collapse bogs and collapse fens are very common features, which may indicate a diminishing distribution of permafrost.

Elevations range from about 240 masl near the southern boundary at Gunisao River to about 210 masl in the north. Long, smooth slopes are dominant and range from level in peat-filled depressions to about 2 to 5 percent . In irregular hummocky terrain, the slopes range from 10 to 15 percent and are from less than 50 m to more than 150 m in length. Local relief is provided by a few rocky, hummocky highs and along river and lake shorelines that can range from a few metres to 20 m above lakes and peat-filled depressions.

The ecodistrict is located at the northeast corner of Lake Winnipeg, at the headwaters of the Nelson River drainage way. It includes Playgreen, Kiskitto, and Kiskittogisu lakes, which occupy a significant portion of the ecodistrict. Drainage is northeastward over terrain that falls at about 0.5 m per km.

Soils

The dominant soils are poorly to very poorly drained Typic (deep) and Terric (shallow) Mesisols associated with fens and bogs, which overlie calcareous, clayey glaciolacustrine sediments. Upland areas consist locally of granitoid rock outcrops, but most bedrock is covered by clayey glaciolacustrine and occasionally sandy to loamy till deposits. Gray Luvisols are associated with well to imperfectly drained clayey mineral deposits, while Dystric Brunisols are associated with the till material.

Organic Cryosol soils are locally common, but are generally much less widespread than farther north. In the southeastern section, permafrost is very sporadic. Poorly drained, peaty Gleysolic soils and Terric (shallow) Organic soils have developed on gently sloping glaciolacustrine sediments. Poor natural drainage and heat conductance properties limit the forest growth capability of organic soils.

Climate constrains the use of the ecodistrict for arable agriculture. However, vegetable crops can be grown. The short season also limits the productivity of forests.

In addition, dense subsoils, poor structure and low soil temperature are severe constraints to the use of the clayey minerals soils. Poor natural drainage and low thermal conductance properties are additional limitations to the use of the organic soils.

Vegetation

Black spruce stands form the dominant forest cover. However, due to the extent of bog peatlands, most black spruce stands are open and stunted. On uplands, black spruce stands are closed and medium tall. Along rivers and lakes, white spruce and balsam fir are important components and may show good growth.

Due to fires, jack pine is an important forest component on uplands, especially in bedrock-controlled areas and on sandy deposits. Trembling aspen and white birch are present on upland sites throughout the ecodistrict as well.

A significant portion of the ecodistrict consists of very poorly drained fens which do not support trees at all or at best, very sparse stands of tamarack or a mixture of tamarack and black spruce. Therefore, the vegetation in these fen peatlands is dominantly sedge and shrub vegetation.

Water

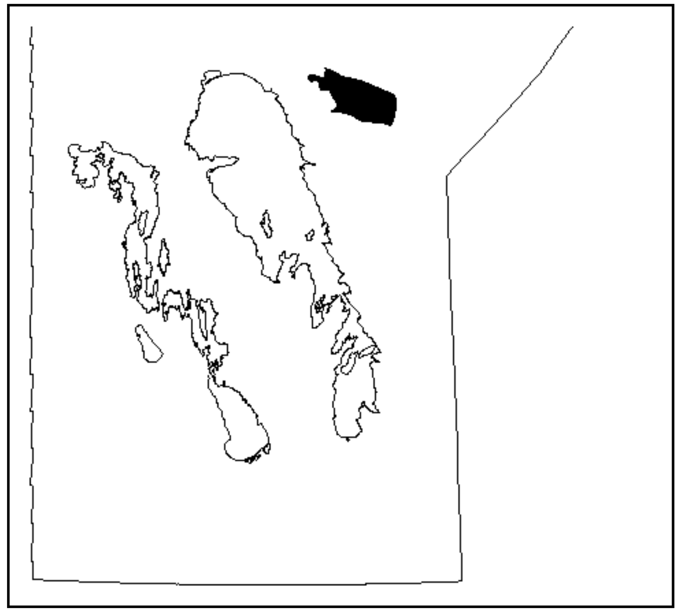
The principal sources of water are the many lakes, rivers and streams that flow through the ecodistrict.

Land Use

Norway House First Nation is the only community, and is accessible by road. Forestry and fishing are the major land use activities. Sport fishing, trapping and hunting are the other important natural resource uses. Some of the clayey Gray Luvisols and organic soils have some potential for arable agriculture.

367. Gunisao Lake Ecodistrict (2989 km²)

The Gunisao Lake Ecodistrict is located in east-central Manitoba.



Climate

This ecodistrict is situated in a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba, and has short, cool summers and long, very cold winters The mean annual temperature is -0.9°C. The average growing season is 159 days with about 1350 growing degree-days.

The mean annual precipitation is about 470 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, and is highest during the summer months. The average moisture deficit over the year is about 65 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The nearest long term station is at Island Lake (364. Island Lake Ecodistrict), which provides only moderately relevant data.

Physiography and Drainage

The Gunisao Lake Ecodistrict is an undulating to hummocky bedrock morainal plain. Granitoid rock outcrops associated with discontinuous blankets and veneers of glaciolacustrine clay are common. Depressional areas are generally occupied by deep peatlands in the form of basin fens and flat bogs.

Elevations range from about 270 masl to about 230 masl. Slopes range from level in peat-filled depressions to about 10 to 15 percent along irregular, hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. Local relief is provided by rocky hummocky highs that can stand 20 m above lakes and peat-filled depressions.

For the most part, the ecodistrict lies within the Nelson River drainage system, but the most northerly fringe is part of the Hayes River drainage system. The many small, and the few medium and large lakes are drained by an irregular bedrock-controlled network of secondary streams. Drainage is generally west and north over terrain that falls at about 0.8 m per km.

Soils

Granitoid bedrock outcrops are a widespread feature of the Gunisao Lake Ecodistrict, but many outcrops are covered by sandy till, and more commonly, clayey glaciolacustrine blankets and veneers.

Upland soils are dominantly well to imperfectly drained Gray Luvisols that are associated with clayey sediments, while Dystric Brunisols are associated with till materials and local glaciofluvial deposits. Clayey soil profiles may exhibit cryoturbated subsoils, which are a relic of the effect of past permafrost conditions.

Significant areas consist of peat-filled depressions. Peatland soils are a complex of poorly to very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying clayey glaciolacustrine sediments. Permafrost is limited to peatlands and is not widespread, as the southern boundary of the ecodistrict marks approximately the southern extent of permafrost.

Only very isolated patches of permafrost are found in the most southerly fringe, and likely consist of relic permafrost. Collapse features in peatlands are widespread, and signify a possibly diminishing distribution of permanently frozen peatlands.

Climate constrains the use of this ecodistrict for arable agriculture and the short growing season also limits forest productivity. In addition, lack of rooting depth to compact clayey subsoils and bedrock, poor structure and low soil temperature severely constrain the use of mineral soils. Poor natural drainage and heat conductance properties are further limitations to the use of organic soils.

Vegetation

Black spruce stands form the dominant forest cover. However, due to the extent of peatlands, most black spruce stands are open and stunted. On uplands, black spruce stands are closed and medium tall. Along rivers and lakes, white spruce and balsam fir are important forest components and may show good growth.

Due to fires, jack pine is an important component on uplands, especially in bedrock-controlled areas and on sandy deposits. Trembling aspen and white birch are also present on upland sites throughout the ecodistrict. A significant portion of the ecodistrict is very poorly drained and consists of fen peatlands which do not support trees at all or, if so, very sparsely. The vegetation in these fen peatlands is therefore dominantly sedge and shrub vegetation.

Water

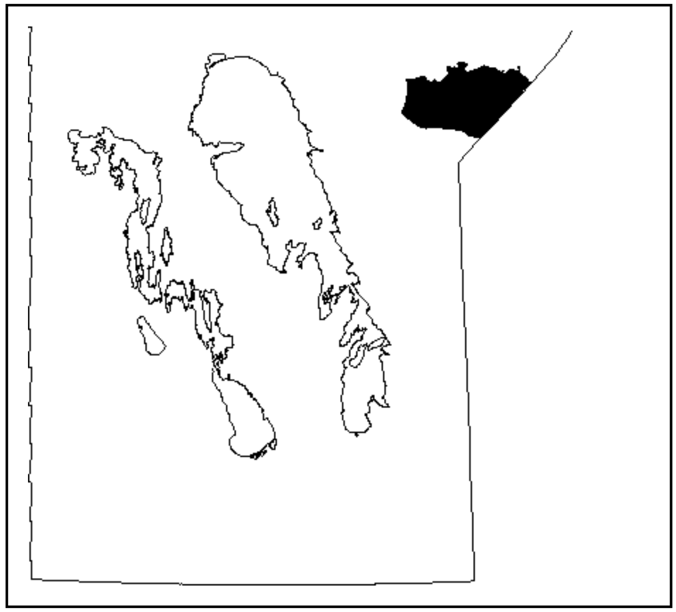
The principal water sources are lakes, rivers and streams.

Land Use

There are no settlements in the ecodistrict. Although the forests in the area will support a limited commercial forestry, the lack of road access and distance to mills have precluded its development. Resource use is largely related to trapping, hunting and fishing. Sport fishing is also an important resource use. Some of the clayey Gray Luvisols and organic soils have a limited potential for arable agriculture.

368. Cantin Lake Ecodistrict (6547 km²)

The Cantin Lake Ecodistrict extends from northeastern Manitoba into northwestern Ontario.



Climate

This ecodistrict is situated within a warmer, more humid subdivision of the High Boreal Ecoclimatic Region in Manitoba, and has short, cool summers and long, very cold winters. The mean annual temperature is -1.2°C. The average growing season is 156 days with about 1200 growing degree-days.

The mean annual precipitation is about 580 mm, of which more than one-third falls as snow. Precipitation varies greatly from year to year, and is highest during the summer months. The moisture deficit over the year is about 30 mm. The ecodistrict has a cold, subhumid to humid, Cryoboreal soil climate.

There is no climate station in the ecodistrict, but data from Island Lake (364. Island Lake Ecodistrict) is relevant.

Physiography and Drainage

The Cantin Lake Ecodsitrict is an undulating to hummocky clayey glaciolacustrine plain that spans the border with northwestern Ontario. The topography is strongly controlled by the underlying Precambrian bedrock. The bedrock appears frequently as outcrops, increasing in occurrence towards the Ontario border. Associated with the bedrock, and frequently covering it, are blankets, veneers and hummocky deposits of neutral to acidic, sandy glacial till largely derived from granitic rock. Depressional areas and lower slopes have respectively deep to shallow peat deposits in the form of flat bogs, northern plateau bogs and horizontal and string fens. Permanently frozen peat deposits are very limited in their distribution.

Elevations range from about 305 masl in the southern section to about 244 masl near Island Lake to the north. Slopes range from level in peat-filled depressions to about 5 to 15 percent along irregular hummocky surfaces. Slope lengths range from less than 50 m to more than 150 m. The longer slopes are generally associated with peatlands and glaciolacustrine deposits. Local relief is provided by rocky hummocky highs that can stand 30 m above lakes and peat-filled depressions.

The ecodistrict is part of the Hayes River drainage system. The many small lakes and the few medium to large lakes are drained by an irregular, bedrock-controlled network of secondary streams. Drainage is generally northward over terrain that falls at about 0.8 m per km.

Soils

The soils in the Cantin Lake Ecodistrict are dominantly well to imperfectly drained Gray Luvisols on clayey upland. Soil profiles may exhibit cryoturbated subsoils, which are a relic feature of past permafrost conditions. Dystric Brunisols are the dominant soils associated with the glacial till materials and with the infrequent sandy glaciofluvial materials. Exposed granitoid bedrock outcrops occur throughout the ecodistrict.

Peat-filled depressions are a complex of poorly to very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Permafrost is very limited and only found in peat deposits. The southern boundary of this ecodistrict marks the southern limit of permafrost. Poorly drained, peaty Gleysolic soils and very shallow Terric Mesisolic and Terric Fibrisolic soils are common on level to gently sloping, clayey mineral soils.

Climatic conditions constrain the use of the ecodistrict for arable agriculture and the short growing season also limits forest productivity. Also, lack of rooting depth due to compact clayey subsoils and bedrock, poor structure and low soil temperature severely constrain the use of mineral soils. Poor natural drainage and thermal conductance properties are further limitations to the use of organic soils.

Vegetation

Black spruce stands form the dominant forest cover. Upland stands are closed and moderately tall. Due to frequent forest fires, jack pine, and to a lesser extent, trembling aspen, are widely distributed on most upland sites. Along rivers and lakes, white spruce and balsam fir are important forest components and may show good growth. White birch is also present throughout on upland areas.

Bog peatlands support open stands of black spruce, while fens may have very open stunted tamarack. However, most fens have vegetation dominated by shrubs and sedges.

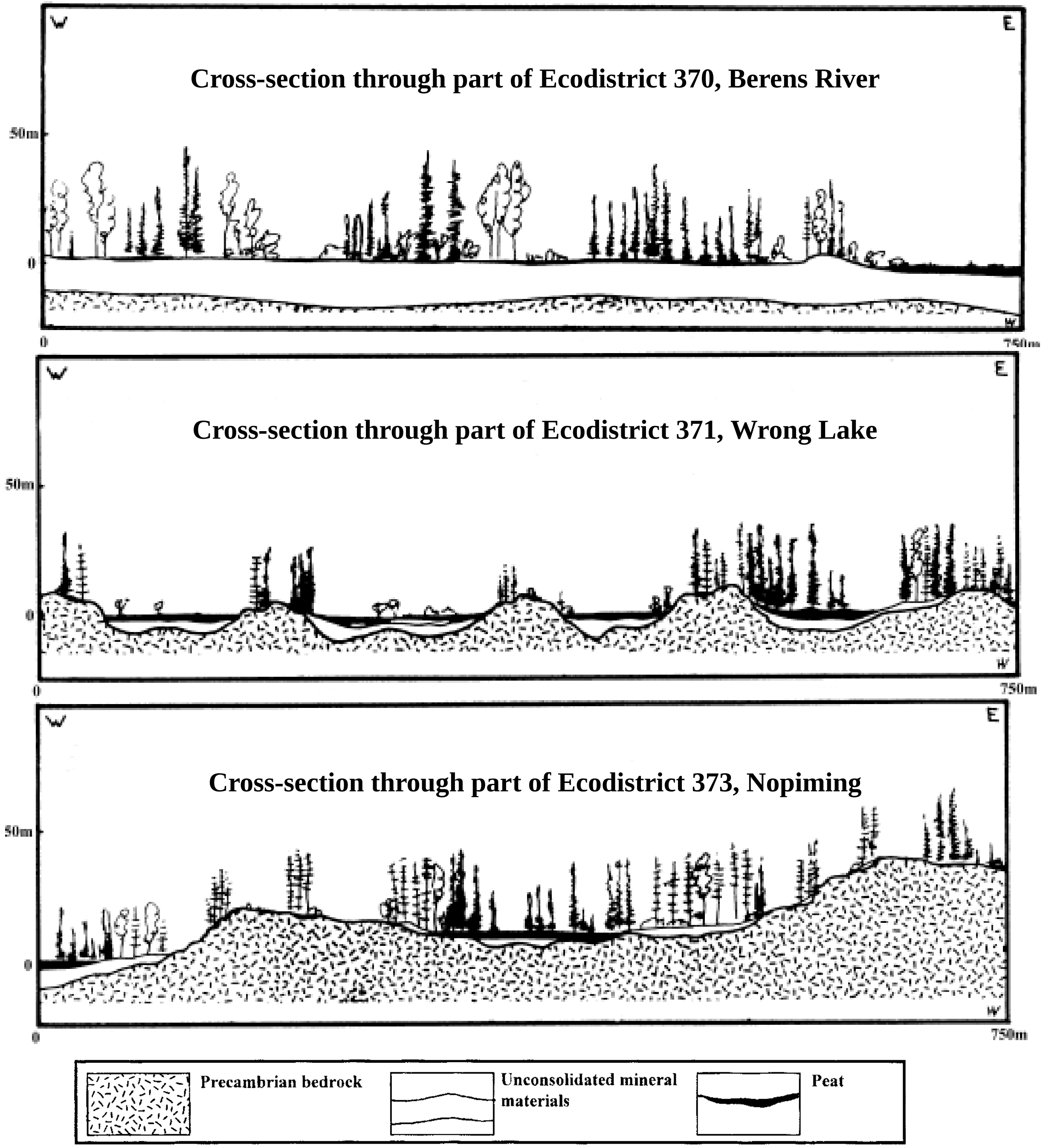
Water

The principal water sources are the lakes, rivers and streams that flow through the ecodistrict.

Land Use

There are no settlements in the ecodistrict. The forest in this district can support a commercial forestry, but lack of access and distance to mills has precluded its development. Trapping and hunting are the dominant use of natural resources in this area. Some of the clayey Gray Luvisols and some organic soils in the district offer limited possibilities for arable agriculture.

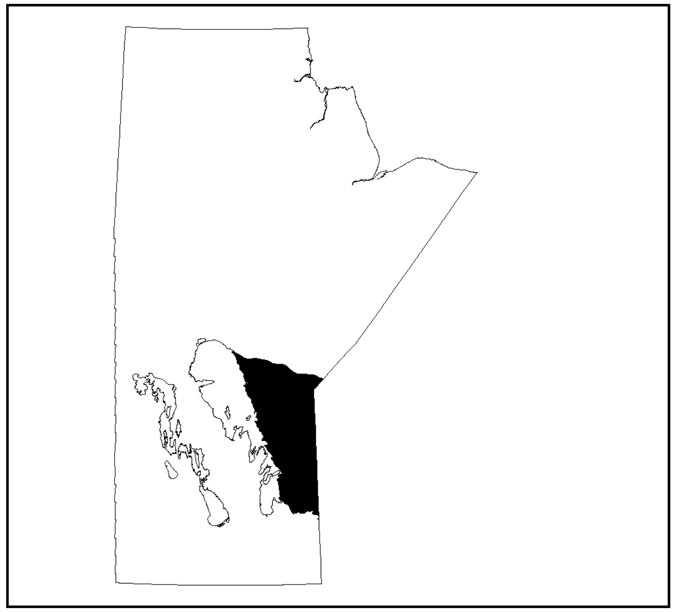
Schematic depiction of selected landscapes in the Lac Seul Upland Ecoregion.



The cross-sections shown above depict small landscape segments in the three ecodistricts that compose the Lac Seul Upland Ecoregion in Manitoba. The cross-sections show the change in general landscape characteristics from west to east through the ecoregion approximately along the 52^{nd} parallel. In Ecodistrict 370, the landscape is dominated by nearly level peatlands and poorly drained clayey glaciolacustrine uplands. In Ecodistrict 371, the landscape is still dominated by peatlands, but there are an increasing number of hummocky bedrock outcrops with thin clayey glaciolacustrine veneers and thin till deposits. In Ecodistrict 373, the landscape is dominated by hummocky bedrock, lakes in bedrock basins, peat-filled depressions, and shallow to deep sandy till deposits. Vertical scale is exaggerated 2x, and the vegetation is not drawn to scale.

90. Lac Seul Upland Ecoregion

In Manitoba, the Lac Seul Upland Ecoregion extends from the eastern shore of Lake Winnipeg to the Manitoba-Ontario border. Only about twenty-five percent of the region lies within Manitoba.



Climate

This ecoregion forms a portion of the Mid Boreal Ecoclimatic Region that extends westward from Lac Seul in northwestern Ontario, across central Manitoba and Saskatchewan to the foothills of the Rocky Mountains in northern Alberta and southern Yukon. The climate is marked by short, warm summers and very cold winters. In the Manitoba portion of the ecoregion, the mean annual air temperature ranges from 0.3 °C to 1.1 °C. The average length of the growing season varies from 166 to 173 days. The number of growing degree-days ranges from about 1400 to 1475.

The average annual precipitation varies from about 540 mm in the northwest to over 580 mm in the southeast and varies greatly from year to year. About one-third of the precipitation falls as snow. Precipitation is highest during the growing season. Moisture deficits range from less than 20 mm to about 60 mm. The ecoregion has a moderately cold to cold, subhumid to humid, Cryoboreal soil climate. The ecoregion has few climate stations. The only long term climate data in the Manitoba part of the ecoregion is from the now-closed station at Bissett. The Ontario portion has several stations, among them Red Lake Airport, Sioux Lookout Airport and Pickle Lake. The data from these stations is likely not representative of the more northern sectors. Below is data from Bissett and Red Lake, which are both located in the southern part of the ecoregion.

Selected Climate Data[1] for Red Lake Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. °C	-21	-16.8	-8.9	1.4	9.2	15.3	18.2	16.9	10.8	4.5	-5.8	-15.8	0.7
Precip. mm	28.7	20.6	26.1	34.1	48.4	84.0	86.9	78.1	62.7	50.5	39.9	28.5	588.5
Growing degree-days	0.0	0.0	0.4	27.4	151.4	302.8	423.3	368.2	187.9	55.8	2.7	0.0	1519.9

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

Selected Climate Data[1] for Bissett

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. °C	-20.9	-16.7	-9.2	1.8	10.0	15.3	18.3	16.7	10.7	4.9	-5.8	-16.1	0.8
Precip. mm	29.4	18.7	25.4	42.1	59.7	93.8	71.3	77.9	67.3	47.3	33.7	22.3	588.9
Growing degree-days	0.0	0.0	0.2	30.1	180.0	313.7	409.3	358.5	178.9	60.9	1.8	0.0	1533.4

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

Surficial Deposits and Landforms

The Lac Seul Upland Ecoregion takes in a portion of the southwestern section of the Severn Uplands of the Canadian Shield. Bordering on the eastern shore of Lake Winnipeg, that marks the boundary of the Interior Plains to the west, the Severn Plain is a region consisting of crystalline Archaean massive rocks that form broad sloping uplands and lowlands. This section of the upland lies between 335 masl along the Manitoba-Ontario boundary to 218 masl along the shore of Lake Winnipeg.

Ridged to hummocky bedrock outcrops covered with discontinuous veneers and blankets of acidic, sandy to coarse loamy granitic till are dominant along the provincial border. Level to gently undulating organic deposits overlying clayey glaciolacustrine sediments, broken by local bedrock ridges and knolls, are characteristic of the terrain approaching Lake Winnipeg. Permafrost, which is very likely relic, is very sporadically distributed in peatlands in the northern section of the ecoregion.

Small, medium and large lakes are numerous in the eastern, bedrock-dominated section. Lakes of significant size are few in the peatland-dominated western section, but small lakes and pools collectively cover a significant surface area.

The Manitoba portion of the ecoregion lies within the Nelson River watershed. Drainage is into Lake Winnipeg via a large number of streams which are irregular, bedrock-controlled in the eastern section, but evolve into slower, westward-flowing drainage ways crossing the peatland-dominated terrain along Lake Winnipeg. Major rivers are the Bloodvein, Pigeon, Berens and Poplar.

Soils

In the eastern section, rock outcrops and shallow and deep Dystric Brunisolic soils developed on well to rapidly drained, sandy glacial till are co-dominant. Deep organic Mesisols and Fibrisols are dominant on peatlands that developed in bedrock-controlled depressional areas.

Towards the west, Gray Luvisols associated with well to imperfectly drained calcareous loamy to clayey textured glaciolacustrine soils become co-dominant with shallow and deep organic Mesisols and Fibrisols, although bedrock outcrops and Dystric Brunisols associated with glacial till remain as significant inclusions. The most westerly section is dominated by shallow and deep Mesisols and Fibrisols associated with extensive peatlands, and Gleysolic soils developed on poorly drained glaciolacustrine sediments. Significant inclusions of Gray Luvisolic soils are associated with moderately well to imperfectly drained glaciolacustrine blankets and veneers overlying bedrock.

Vegetation

The forest cover is dominated by coniferous species, but is more mixed than the forest farther north. Black spruce is the dominant tree species and is especially widespread on imperfectly drained uplands and bog peatlands. But due to extensive and repeated fires, the forest cover is very fragmented. As a result, jack pine, and to a lesser extent trembling aspen, are common on upland sites. Where drainage is good, and where soil and climate conditions are more favourable, as in river valleys, around lakes and on south-facing slopes, white spruce, balsam fir, trembling aspen and balsam poplar may form mixed stands of good growth. Deciduous species tend to be less abundant in the Manitoba section of the ecoregion.

On uplands, deciduous and mixed stands have diverse understorys of shrubs and herbs, while coniferous stands tend to have a feather moss ground cover. Bedrock outcrops have patchy tree growth, which is often dominated by jack pine with a understory of low shrubs and a groundcover of low ericaceous shrubs, mosses and lichens.

Poorly to very poorly drained fens have sedge and brown moss vegetation and may have a shrub layer, or may support a tamarack-dominated tree cover with varying components of shrubs, herbs and sedges. Poorly drained bogs generally support open to closed stands of stunted to medium tall black spruce, with understorys of dwarf birch, ericaceous shrubs, and a moss ground cover. Peatlands that are transitional in development from fen to bog are common and the vegetation reflects the transitional aspects in its community composition.

Wildlife

Characteristic wildlife includes moose, black bear, wolf and woodland caribou. White-tail deer has been expanding its range into the more southern areas in recent years. Other wildlife in the region includes lynx, ermine, fisher, mink, red squirrel, beaver, muskrat and snowshoe hare. Birds include waterfowl such as ducks and geese, raptors such as bald eagle, great horned owl and red-tailed hawk, as well as spruce grouse, herring gull, double crested cormorant and turkey vulture.

Land use

The major communities are Bissett in Manitoba and Red Lake and Sioux Lookout in Ontario. The Manitoba portion of the ecoregion has several First Nation communities, a number of which are located on the shore of Lake Winnipeg.

The most significant economic land use is forestry. Pulpwood and local sawlog forestry are extensively developed in the southern section. Mining is another important activity. Tourism and water-oriented recreation, such as sport fishing and boating are significant uses of natural resources in the region. The Berens, Bloodvein and Poplar rivers provide excellent canoeing opportunities. The Bloodvein has been declared a Heritage River. Other important land use activities are hunting, trapping and fishing, and the gathering of herbs for various uses by the First Nations people.

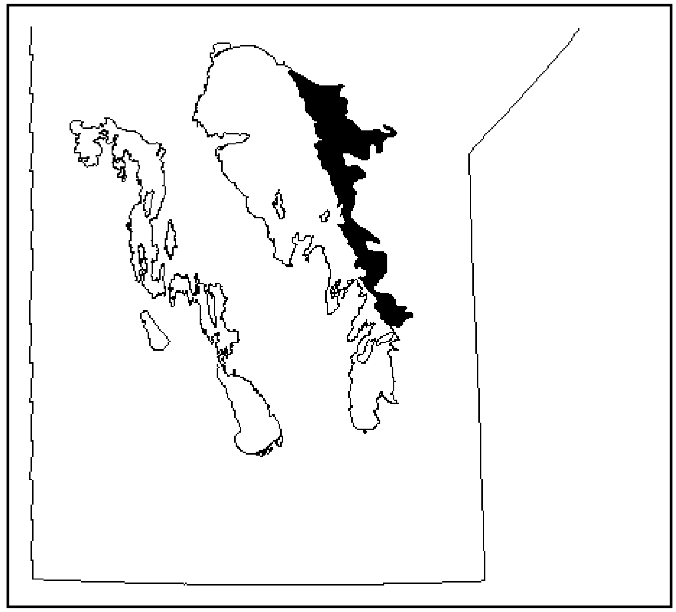
There are three ecodistricts within the Lac Seul Upland Ecoregion in Manitoba.

Headframe of mine

Mining for gold has been a long time activity in Ecoregion 90. The headframe shown in the picture is from the mine at Bissett as it appeared about 25 years ago.

370. Berens River Ecodistrict (7466 km²)

The Berens River Ecodistrict is located wholly within Manitoba. Its western boundary is the shore of Lake Winnipeg.



Climate

This ecodistrict lies within a cooler and most humid subdivision of the Mid-Boreal Ecoclimatic Region that occurs in Manitoba. The climate of the area is characterized by short, warm summers and long, cold winters. The mean annual temperature is 0.3°C. The average growing season is 166 days with about 1450 growing degree-days.

The mean annual precipitation is approximately 540 mm, of which less than one-third falls as snow. Precipitation varies greatly from year to year, and is highest from spring through summer. The average moisture deficit over the year is nearly 60 mm. However, it should be noted that because of its north-south orientation, the climatic means for northern and southern sectors of the ecodistrict will vary significantly from the means presented, which are for the district as a whole. This ecodistrict has a cold to moderately cold, humic, Cryoboreal soil climate.

No climate stations are located within the ecodistrict.

Physiography and Drainage

The Berens River Ecodistrict is, for the most part, a level, extensively peat-covered lowland broken occasionally by small to large uplands of Precambrian rock outcrops thinly covered by glaciolacustrine sediments. It lies between the east shore of Lake Winnipeg at 220 masl and the approximate 245 masl contour to the east. It is an area bounded to the north by the Gunisao River and to the south by the Bloodvein River, and drains westward to Lake Winnipeg over terrain that falls at the rate of 0.5 to 1.0 m per km. Lakes are few and most are of limited area. Most of the surface waters in the district are associated with the very small lakes and pools found in the peatland-dominated terrain, and with the many rivers.

Drainage is poor to very poor in most of the ecodistrict due to the low relief and the widespread occurrence of deep and shallow peatlands. Slopes range from level to less than 5 percent and are generally 150 m to more than 1000 m long. The longest unbroken slopes occur in the northern section on extensive horizontal fen peatlands.

Soils

Most of the soils in this lowland are a complex of poorly to very poorly drained Typic (deep) and Terric (shallow) Mesisol organic soils overlying clayey to loamy glaciolacustrine sediments. Extensive areas have soils developed on mesic peat composed of brown mosses and sedges (horizontal and ribbed fens). Mesisols and Fibrisols are also found on flat bogs, which generally have a sphagnum moss surface peat overlying sedge and brown moss peat, or peat derived from mosses and forest debris.

Local areas of Dystric Brunisols occur on sandy, very stony, water-modified till and on wave-built sand and gravel bars and beaches marking ancient shorelines of glacial Lake Agassiz. Loamy to clayey poorly drained peaty Gleysols also occur as locally significant areas and have developed on fine textured, calcareous glacial Lake Agassiz sediments. Sporadic patches of permafrost occur in the north end of this ecodistrict, but the permafrost is likely relic.

Severe climatic conditions and lack of natural drainage and poor thermal conductance properties of the organic soils are the major limiting factors to arable agriculture. Under natural conditions, the fen peatlands have no capability to produce forest stands. However, the flat bogs, especially the shallow bogs bordering on uplands, have the capability to produce commercial forests. The clayey soils have relative high capability to produce commercial stands of both soft and hard woods.

Vegetation

The vegetation of the ecodistrict reflects the poor drainage and dominant organic nature of the soils. The fen peatlands support vegetation dominated by sedges and brown mosses, with varying quantities of dwarf birch shrub and stunted tamarack. The bog peatlands have black spruce vegetation with ericaceous shrubs and mosses. Transitional peatlands often support vegetation consisting of a mixture of fen and bog species. Uplands support black spruce, alder and willow shrubs, and a ground cover of feather mosses or stands dominated by trembling aspen, balsam poplar, usually associated with a shrub layer of hazel and alder.

Water

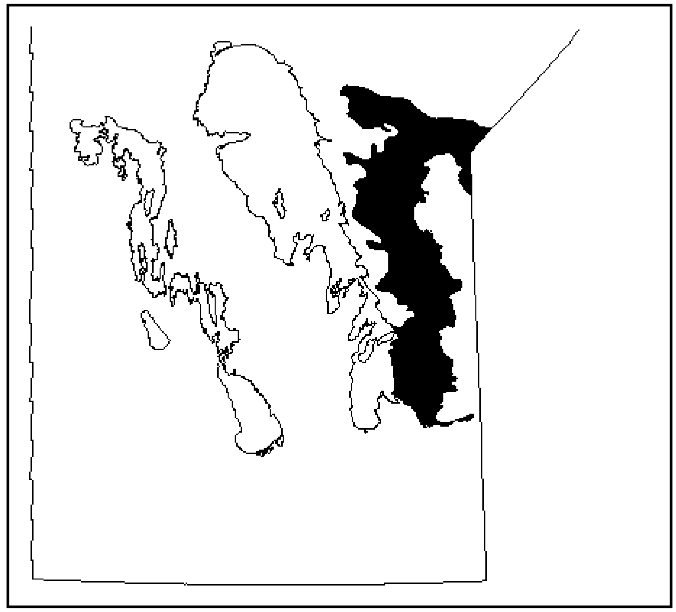
The principal sources of water are Lake Winnipeg and the many rivers that flow into Lake Winnipeg.

Land use

Poplar River, Berens River and Bloodvein First Nations are the only communities in the ecodistrict. Most economic activity is centred around the fishing industry which is carried out largely on adjacent Lake Winnipeg. The major land-based natural resource uses are hunting, trapping, fishing and pulpwood forestry. Forestry activities in the southern part of the ecodistrict support the pulp mill located at Pine Falls on the Winnipeg River. The peatlands are of limited importance as habitat for waterfowl breeding, but provide habitat for moose and woodland caribou.

371. Wrong Lake Ecodistrict (21 501 km²)

The Wrong Lake Ecodistrict extends into Ontario, but most of the ecodistrict is located in Manitoba. This ecodistrict extends from the northern to the southern boundaries of the Lac Seul Upland Ecoregion.



Climate

This ecodistrict lies for the most part in a cooler, and the most humid, subdivision of the Mid-Boreal Ecoclimatic Region in Manitoba. The southern part of the ecodistrict lies in the cooler portion of the subhumid Transitional Low Boreal. The climate is marked by short, warm summers and cold, long winters. The mean annual temperature is 0.5°C. The average growing season is 168 days with about 1400 growing degree-days.

The mean annual precipitation ranges from approximately 460 mm to 600 mm, of which about one-third falls as snow. Precipitation varies greatly from year to year, and is highest from spring through summer. The average soil moisture deficit over the growing season is about 150 to 200 mm. However, it should be noted that because of its north-south orientation, the climatic means for northern and southern sectors of the ecodistrict will vary significantly from the means presented, which are for the ecodistrict as a whole. The ecodistrict has a cold to moderately cold, humid, Cryoboreal, soil climate. Climatic data is available from the now-closed station at Bissett. The station is located in the southern part of the ecodistrict, and therefore the climatic data is likely not relevant for the northern sector.

Selected Climate Data[1] for Bissett Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	0.8	16.8	14.1	18.3	-20.9
Precip. mm (equiv.)	588.9	243.0	369.9	71.3	29.4
Rain/Snow (mm/cm)	433.7/170.5	242..3/0.7	364.5/4.7	93.1/0.0	0.1/33.7
Growing degree-days >5°C	1533.0	1082.0	1440.0	409.0	0.0

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

Physiography and Drainage

The Wrong Lake Ecodistrict is transitional between the peat-covered lowland area of the Berens River Ecodistrict to the west, and the bedrock-dominated Nopiming Ecodistrict that forms its eastern boundary.

Gently to steeply sloping outcrops of Precambrian bedrock thinly covered by glacial drift deposits are dominant in the eastern part of the ecodistrict. To the west, the bedrock is increasingly covered by blankets and veneers of clayey and silty, glaciolacustrine sediments. The amount of terrain covered by organic deposits also increases from east to west and from south to north. The level to very gently sloping peat-covered depressions are usually underlain by clayey glaciolacustrine sediments.

The ecodistrict lies between the 245 masl contour along its western boundary, but in the south extends to Lake Winnipeg, and the 305 masl contour, that forms the eastern boundary with the bedrock-dominated Nopiming Ecodistrict. Long (more than 150 m), smooth slopes range from level in the peatland terrain to less than 5 percent in the associated upland areas. Moderately long (50 to 150 m), hummocky or irregular slopes range from 10 to 15 percent in the bedrock-dominated areas, while short, steep slopes are associated with bedrock outcrops.

This ecodistrict, bounded to the south in part by the Winnipeg River and to the north by the Gunisao River, drains westward to Lake Winnipeg over terrain that slopes at an average of 1.0 to 2.0 m per km. It contains a number of large to very large lakes, which are mostly situated in the eastern sector. Small and medium lakes occur throughout, and very small lakes are associated with peatlands in the western sector. Many rivers, including the Bloodvein, Pigeon, Berens, Poplar, Wanipigow, Manigotagan and Black, and tributary streams flow through the ecodistrict from east to west. All are part of the Lake Winnipeg east drainage division, which is part of the Nelson River drainage system.

Soils

Bedrock and well drained Dystric Brunisols that have developed on thin, discontinuous, very cobbly and stony morainal veneers are dominant, especially in the eastern half. Significant areas of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments occur in the peatlands, which are increasingly more widespread towards the west. Poorly drained Gleysols and moderately well to imperfectly drained Gray Luvisolic soils are associated respectively with lowland and upland glaciolacustrine sediments.

Lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures, poor water-holding capacity and nutrient retention severely constrain the use of soils on till deposits. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

Due to extensive and repeated fires, the forest cover is very fragmented. As a result, jack pine, and to a lesser extent, trembling aspen, is common on upland sites. However, black spruce is the dominant tree species, and is especially widespread on imperfectly drained uplands and bog peatlands.

Where drainage is good, and where soil and climate conditions are more favourable, as in river valleys, around lakes and on south-facing slopes, white spruce, balsam fir, trembling aspen and balsam poplar may form mixed stands of good growth. Deciduous and mixed stands have diverse understorys of shrubs and herbs, while coniferous stands tend to have feather moss ground cover. Bedrock outcrops have patchy tree growth, which is often dominated by jack pine with an understory of low shrubs and a groundcover of low ericaceous shrubs, mosses and lichens.

Poorly drained bogs generally support open to closed stands of medium tall to stunted black spruce, with understorys of dwarf birch, ericaceous shrubs, and a moss ground cover. Fens have a vegetative cover of sedges, shrubs and tamarack.

Water

The principal sources of water are the many lakes and the rivers that flow through the ecodistrict to Lake Winnipeg.

Land Use

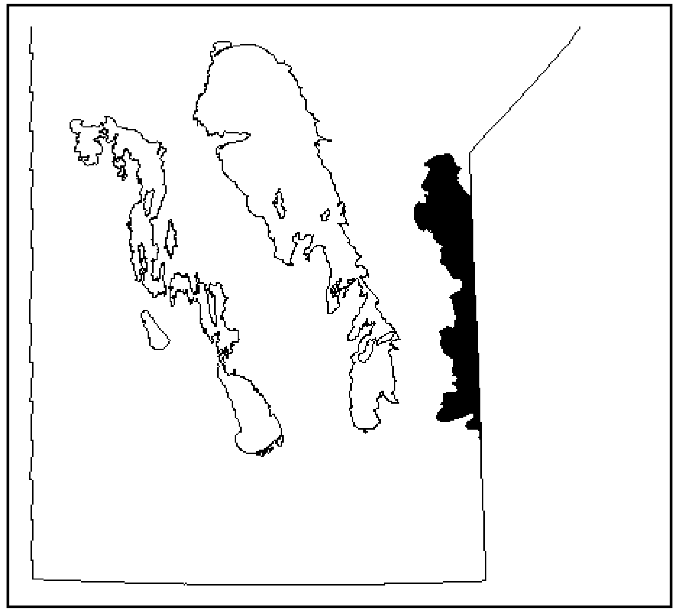
The largest community in the ecodistrict is the mining town of Bissett, whose gold mine has opened and closed many times. The mine is not currently in operation.

The Hollow Water, Little Black River and Sagkeeng First Nation communities are located close to the shore of Lake Winnipeg and derive economic benefits from the Lake Winnipeg fishery. Significant pulpwood and local sawlog forestry is conducted in the southern part of the ecodistrict. Water-oriented recreation and trapping and hunting are other important natural resource uses.

As the wetlands in the ecodistrict are dominantly peatlands, they are of limited importance as habitat for waterfowl, but provide habitat for moose and woodland caribou. Limited agriculture, largely in the form of native hay and alfalfa production, takes place in the most southwestern part of the ecodistrict. In the southern portion, some of the organic soils have potential for arable agriculture.

373. Nopiming Ecodistrict (8819 km²)

The Nopiming Ecodistrict straddles the border with Ontario, and extends from the southern to close to the northern boundary of the Lac Seul Upland Ecoregion.



Climate

This ecodistrict lies in the cooler, and the most humid, subdivision of the Mid-Boreal Ecoclimatic Region in Manitoba. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is 0.8°C. The average growing season is 173 days with about 1473 growing degree-days.

The mean annual precipitation is approximately 580 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is greatest from spring through summer. However, it should be noted that because of its north-south orientation, the climatic means for northern and southern sectors of the ecodistrict will vary significantly from the means presented, which are for the district as a whole. The district has a cold to moderately cold, humid, Cryoboreal soil climate.

There are no climate stations in the Manitoba portion of the ecodistrict. The data from the climate station at Bissett Airport (371. Wrong Lake Ecodistrict) is relevant for the southern part of the ecodistrict.

Physiography and Drainage

The Nopiming Ecodistrict is an area of prominent hummocky granitic rock outcrops thinly covered by stony, sandy glacial drift deposits, numerous wave-built sand and gravel bars and beaches marking ancient shorelines of glacial Lake Agassiz and numerous small and medium-sized lakes. The peat-covered depressions are usually underlain by clayey glaciolacustrine sediments. Elevations in the Manitoba part of the ecodistrict range from 305 masl along its lower western boundary, to 360 masl locally along the Manitoba-Ontario border. Slopes range from 15 to 30 percent and are from less than 50 m long, while in less steep terrain, slopes are between 50 m to 150 m long. Slopes on peatlands are less than 1 percent.

The ecodistrict contains a large number of small and medium lakes as well as a few large to very large lakes. Of the large number of rivers and tributary streams that flow from east to west, the Bloodvein, Pidgeon, and Poplar rivers are the largest. The ecodistrict contains sections of the Manigotogan, Bloodvein, Berens and Poplar river watersheds that drain westward to Lake Winnipeg over terrain that falls at about 1.0 to 2.0 m per km. These watersheds form part of the Lake Winnipeg East drainage division, which is part of the Nelson River drainage system.

Soils

The ecodistrict, which consists mainly of bedrock-dominated terrain, is composed of a mixture of exposed bedrock, shallow to very shallow till deposits overlying bedrock, pockets of deeper till, and large and small peatlands in bedrock-controlled depressions.

Mineral soils are dominantly well to excessively drained Dystric Brunisols developed on the acidic, sandy and stony, water-worked glacial till deposits. Gray Luvisols are found on local glaciolacustrine, calcareous clay deposits. Most of the soils in peat-filled depressions are a complex of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments.

Lack of rooting depth to bedrock, excess cobbles and stones, coarse surface textures and poor water-holding capacity and nutrient retention severely constrain the use of mineral soils on glacial till. Poor natural drainage and heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation reflects in part the nature of the soils and the occurrence of bedrock at or near the surface. As large tracts of the ecodistrict are well to excessively drained, the ecodistrict is very prone to wild fires. As a result, the forest cover is very fragmented, both with respect to species and age distribution.

Jack pine is the dominant species on shallow sandy soils (till) and on bedrock outcrops. Understories are generally low ericaceous shrubs with a ground cover of lichens and mosses. On deeper sandy soils, black spruce is more prevalent, but jack pine often appears as pure stands or in association with spruce. Fine textured soils tend to support black spruce.

Peatlands are dominantly deep basin bogs and support black spruce stands that vary from very open and stunted stands to stands with relative good growth. Ericaceous shrubs and feather mosses or sphagnum mosses are associated. On deeper soils, especially along rivers and lakes, white spruce, balsam fir and trembling aspen of good growth may be found.

Water

The principal sources of water are the many lakes and the rivers that flow through the ecodistrict.

Land Use

The settlement of Little Grand Rapids and the Little Grand Rapids and Pauingassi First Nations are the only settlements in the Manitoba portion of the ecodistrict. Significant pulpwood and local sawlog forestry takes place in the southern part of the ecodistrict. The pulpwood is supplied to the paper mill at Pine Falls.

Water-oriented recreation such as fishing and boating is an important activity. The rivers are noted for their beauty and the quality of canoeing they provide. Trapping, fishing, hunting and forestry are the dominant land uses by the First Nations people.

In this bedrock-dominated ecodistrict, the potential for arable agriculture is very limited, although some of the organic soils could have potential.

The Bloodvein River

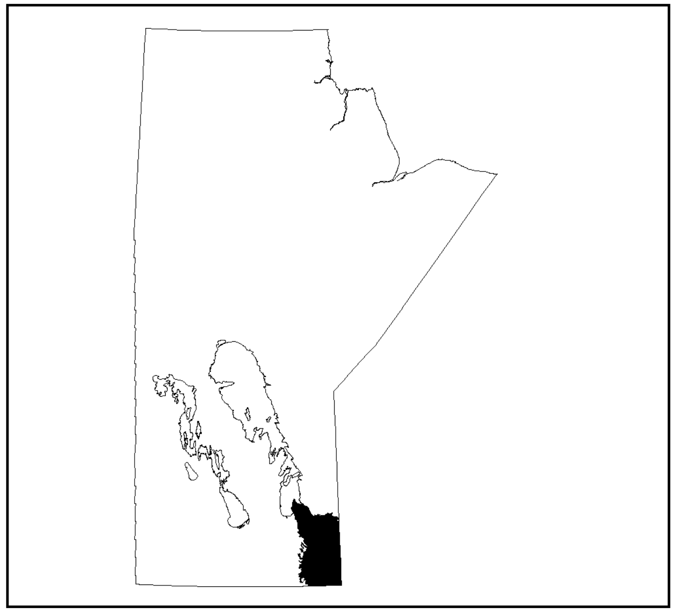
Several large rivers traverse the Manitoba portion of the lac Seul Upland Ecoregion. In the eastern portion (Nopiming Ecodistrict 373) they flow over the rugged bedrock terrain of the Precambrian Shield. These rivers are prized by the canoeing recreationist for the challenges the many rapids and falls offer. The Bloodvein River has been designated a Canadian Heritage River.

Whiteshell Provincial Park

Whiteshell Provincial Park is a popular vacation destination for campers and cottagers. Hiking trails in rugged bedrock country provides callenges, the many streams and lakes provide good fishing opportunities, while ski-trails provide winter recreation. The Great Grey owl, Manitoba's provincial bird, is a year-round resident of the denser coniferous forests.

91. Lake of the Woods Ecoregion

The Lake of the Woods Ecoregion encompasses the southeastern corner of Manitoba and extends a considerable distance into northwestern Ontario. The region is more closely identified with the warmer, more humid southeastern mixed forest region than with the colder, drier, closed, mixed Boreal forest to the north.



Climate

The geographic extent of the ecoregion results in significant variation in climate between the western and eastern sectors.

The Manitoba portion of the ecoregion has a climate marked by short, warm summers and long, cold winters. The mean annual air temperature ranges from about 1.9°C to 2.3°C. The average growing season is around 180 days. The number of growing degree-days is about 1600.

The average annual precipitation ranges from about 540 to 650 mm, and varies greatly from year to year. Precipitation is highest during the growing season. Moisture deficits range from about 45mm to around 95 mm. The ecoregion has a moderately cold, subhumid to humid, Cryoboreal soil climate.

There are several climate stations located within the ecoregion. Data for two stations in Manitoba is presented below.

Selected Climate Data[1] for Pine Falls

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-19.1	-16.0	-7.5	3.2	11.1	16.1	19.3	17.7	11.8	5.5	-4.4	-15.2	1.9
Precip. mm	21.8	17.3	19.2	28.6	58.3	83.6	70.3	72.9	60.5	42.4	25.6	21.9	522.5
Growing degree-days	0.0	0.0	1.4	45.6	208.3	336.1	451.5	393.3	214.3	68.4	4.6	N	N

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

Selected Climate Data[1] for Indian Bay

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-19.2	-16.0	-7.4	2.5	10.6	15.9	18.8	17.2	11.3	5.2	-4.8	-15.2	1.6
Precip. mm	29.8	23.0	28.4	35.8	59.7	97.2	93.7	79.8	59.7	36.1	30.1	29.5	602.9
Growing degree-days	0.0	0.0	1.2	34.4	182.9	324.5	427.9	373.3	192.6	61.8	3.8	0.0	1603.0

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

Surficial deposits and landforms

The Lake of the Woods Ecoregion occupies the southwestern section of the Severn Uplands and, along its western boundary, a small portion of the flat, limestone-dominated Manitoba Plain. Therefore, the ecoregion's underlying bedrock consists mainly of massive crystalline Archean rocks that form broad sloping uplands and lowlands, but it also contains some prominent Palaeozoic limestone erosion remnants along its northwestern boundary.

The ecoregion lies between the 215 masl (Whitemouth Lowland) and 390 masl (Bedford Hills) elevations. It is mantled with thick to thin glacial till, fluvioglacial, and dominantly peat-covered, glacial Lake Agassiz deposits. Bedrock outcroppings occur throughout the region, but are increasingly more frequent in the central and eastern portions.

The English, Winnipeg, and Rainy rivers are the dominant drainage ways. The ecoregion contains many small to large lakes with bedrock-controlled shores in the northern part.

Soils

Poorly drained Organic Mesisols and Fibrisols are widespread due to the many, frequently extensive, peatlands. Limited areas of Eutric Brunisols occur in the western section and are associated with calcareous mixed till and calcareous glaciofluvial deposits. Dystric Brunisols are widespread and are associated with the neutral to slightly acidic coarse till derived from the Precambrian bedrock, and with acidic glaciofluvial deposits. Gray Luvisols are also widespread and are associated with well and imperfectly drained clayey to loamy calcareous glaciolacustrine sediments. Significant inclusions are well to imperfectly drained Dark Gray Chernozemic soils in the west, and poorly drained Gleysolic soils on calcareous, loamy to clayey glaciolacustrine deposits.

Besides moderate climatic constraints, the more severe limitations to agriculture are dense subsoils and poor structure of clay soils, poor nutrient retention and water-holding capacity, coarse fragments, and coarse surface texture of till soils. Organic soils have poor natural drainage and are slow to warm, severely reducing their usefulness to agriculture.

Vegetation

The forest cover is very mixed, characterized by tall, closed stands of jack pine, trembling aspen, paper birch, white spruce, eastern white cedar, black ash and white elm. Red pine and eastern white pine are also present in the Manitoba section. Bur oak, trembling aspen, red (green) ash and jack pine are more common on warmer, drier sites in western section of the ecoregion.

Poorly to very poorly drained sites, especially areas of shallow and deep peat, have a tree cover dominated by black spruce and/or tamarack.

Wildlife

Characteristic wildlife includes mammals such as moose, black bear, wolf, lynx and snowshoe hare. Birds in the region include ruffed grouse, hooded merganser, pileated woodpecker, bald eagle, turkey vulture, herring gull as well as many waterfowl and songbird species.

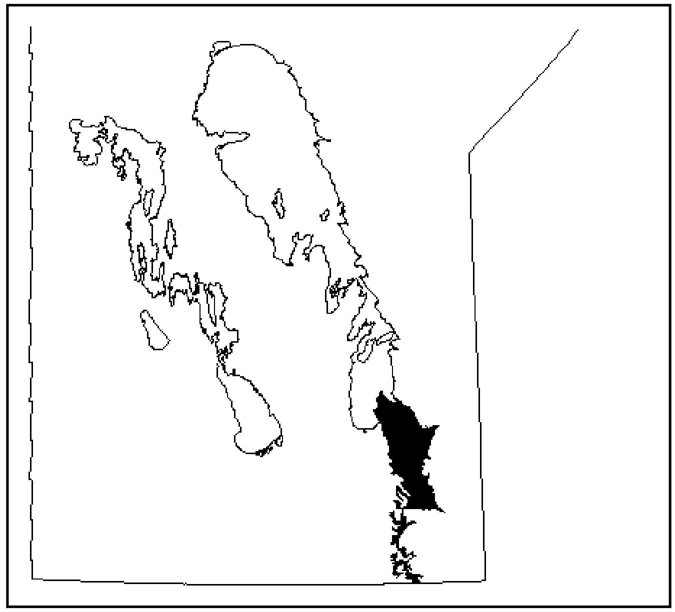
Land use

Pulpwood extraction and the associated paper product industry, and local sawlog forestry, are the dominant uses of the natural resources. Camping, cottaging and water-oriented recreation, especially fishing and boating, are also very important activities in the ecoregion. Trapping and hunting are the significant land uses, and of special importance to First Nations people.

Arable agriculture is limited to small holdings on mainly clayey glaciolacustrine soils in the lowlands along rivers and streams where drainage has been improved. Grains for livestock feed, oilseeds and hay crops are the crops most likely grown in the region.

There are five ecodistricts within the Lake of the Woods Ecoregion in Manitoba.

375. Stead Ecodistrict (4855 km^2)



The Stead Ecodistrict is the most western ecodistrict of the Lake of the Woods Ecoregion, and extends from the region's northern boundary to the International Boundary with the United States.

Climate

This ecodistrict lies in a more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 1.9°C. The average growing season is 180 days with about 1600 growing degree-days.

The mean annual precipitation is approximately 530 mm with greater amounts locally east of Lake Winnipeg. About one-fifth falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average moisture deficit over the year is nearly 90 mm. The ecodistrict has a moderately cold, humid, Cryoboreal soil climate.

The climate data from the Pine Falls station is relevant to the ecodistrict.

Selected Climate Data[1] for Pine Falls

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.9	1.7	15.2	19.3	-19.1
Precip. mm (equiv.)	522.5	226.8	345.6	70.3	21.8
Rain/Snow (mm/cm)	14.3/106.6	226.8/0.0	344.4/1.1	70.3/0.0	21.8
Growing degree-days >5°C	N	1181.0	1604.0	452.0	0.0

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

Physiography and Drainage

The Stead Ecodistrict is situated entirely within the borders of ancient glacial Lake Agassiz basin. Elevations range from about 290 to 221 masl.

The physiography varies from a level to depressional glaciolacustrine plain dominated by peatlands, to a smooth, level to gently undulating water-worked glacial till and fluvioglacial outwash plain, to irregular hummocky morainal uplands near Lake Winnipeg in the northern section. Slope lengths range from about 50 m to more than 150 m. The ecodistrict slopes approximately 1.0 m per km northwestward from its eastern edge toward Lake Winnipeg. Strong local relief of approximately 5 to 30 m occurs along a series of sandy and gravelly ridges and uplands near Lake Winnipeg.

Based on its physiography, the ecodistrict may be divided into four sections.

The central section, extending from north to south, consists of a flat, poorly drained, depressional area which was once covered by the deep waters of glacial Lake Agassiz. The major portion of this section consists of thin to very deep glaciolacustrine clay deposits. Extensive areas are covered by shallow and deep peat, and, to a lesser extent, by deltaic and glaciofluvial deposits. An extensive artificial drainage system has been constructed in this section, and a large part of the area is now in agricultural cropping. Slopes are typically smooth and level.

Two other sections include the two heights of land that lie above the 245 m contour - the Winnipeg Lake Terrace in the northwest corner of the ecodistrict, and the South-Eastern Lake Terrace in the more central portion. These sections have complex landforms that originated from deposition of loamy to sandy, strongly calcareous glacial till, sandy to gravelly glaciofluvial materials, shallow, loamy to clayey glaciolacustrine sediments as well as organic deposits. Therefore, the terrain varies from level to gently undulating plains to irregular hilly topography in the Grand Beach-Victoria Beach area. Some of the sandy deposits have been modified by wind. Slopes in these areas vary from 5 to 10 percent along sloping upland faces, to locally much steeper slopes in the Grand Beach area.

The fourth and most easterly section of the ecodistrict is largely underlain by Precambrian bedrock and outcrops of bedrock are common, but become less and less prominent from east to west. This section was also affected by glacial Lake Agassiz, as is evident from the discontinuous clay deposits along the Winnipeg River and in local depressions.

This ecodistrict has few lakes. The major rivers are the Winnipeg and Brokenhead, which drain into Lake Winnipeg. The western part of the ecodistrict lies in the Lake Winnipeg south drainage division, while the eastern section is part of the Winnipeg River division, which are both part of the Nelson River drainage system.

Soils

The soils in the Stead Ecodistrict have developed on a variety of materials under a variety of drainage conditions.

Most of the soils in the depressional lowland areas are poorly drained peaty Gleysols and Typic (deep) and Terric (shallow) mesisols developed on dominantly sedge peat. However, in upland areas, soils are dominantly well to imperfectly drained Dark Gray Chernozems that have developed on variably calcareous, sandy to loamy, thin and discontinuous veneers overlying extremely calcareous, loamy to clayey, water-worked glacial till.

Dark Gray Chernozems, Eutric Brunisols and Gray Luvisols are associated with the loamy, calcareous till uplands, while Dark Gray Chernozems and Eutric Brunisols are associated with calcareous sandy till and sandy and gravelly glaciofluvial materials. Associated smaller areas of Gleysols and Mesic Organic soils occur in depressional locations.

Vegetation

The vegetation of the ecodistrict varies with surficial materials and drainage. Under natural conditions, native vegetation on poorly drained clayey soils consisted of meadow grasses, sedges, meadow prairie grasses and tall prairie grasses, while trees grew along streambanks. Since settlement, much of the native vegetation on these soils has been replaced by agricultural crops. Fen peatlands support sedge-dominated vegetation with minor components of tamarack and shrubs, while bog peatlands have black spruce, shrub and moss vegetation. Extensive areas of fen have been converted to the commercial production of sod in the Stead area.

In the southern section of the ecodistrict, eastern white cedar and alder and other shrubs are locally common on shallow organic soils and in swamps. The upland areas and the area along the eastern margin of the ecodistrict have mixed vegetation consisting of upland forest and peatland vegetation. Jack pine, trembling aspen and white birch are the dominant tree cover on coarse textured soils. Balsam fir and white spruce are found throughout on favourable sites. Balsam poplar is common on wetter sites, and deciduous trees such as white elm, ash and bur oak are found along streams.

Water

The principal source of water for domestic and livestock use is the variable quality groundwater found in small, sandy and gravelly aquifers associated with glacial till, inter-till, beach and fluvioglacial deposits. Limited supplies of fair to good quality groundwater under artesian pressure is available from Ordovician limestone bedrock and from Winnipeg Formation sandstone along the western edge of the ecodistrict.

Land Use

The ecodistrict contains several towns, the major ones being Lac du Bonnet and Pine Falls and the Sagkeeng First Nation (Fort Alexander) community. All are well served by a network of all-weather roads.

Through the development of an artificial drainage system, most of the level to depressional glaciolacustrine soils are now cropped, as are the better drained and smooth till areas. These soils are used for the production of spring wheat and other cereal grains, oil seeds and hay crops. A large percentage of the sedge fens, generally consisting of uniform, moderately decomposed (mesic) fen peat, has been drained and converted to the production of sod. Where organic deposits were thin, the soils have lost their peat cover and are now being farmed as mineral soils. The Julius Bog west of Elma is used for the production of sphagnum moss peat for horticultural use. Areas where drainage has not been improved, or where the soils are too cobbly and stony to cultivate, are used for native pasture and hay.

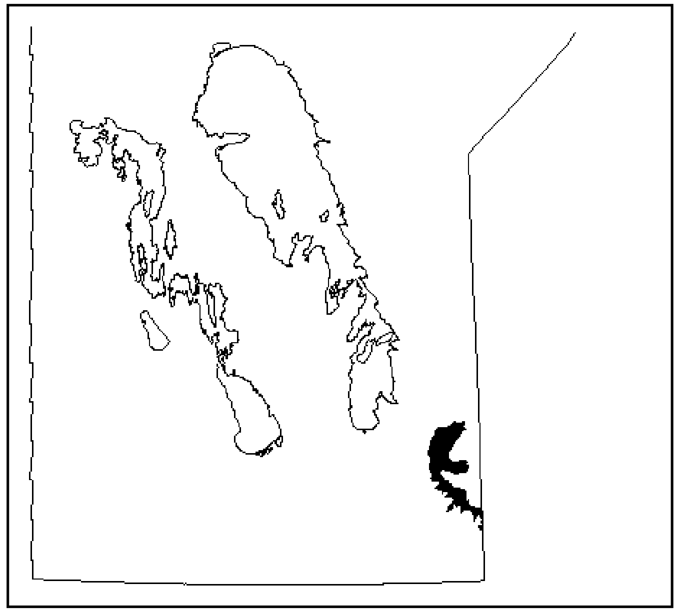
Forested areas support a limited pulpwood and sawlog forestry. Wooded areas also provide wildlife habitat for white-tailed deer, black bear, ruffed grouse. Wetlands in the area, although dominantly consisting of peat-filled depressions, provide habitat for moose and waterfowl.

Recreation is a major land use in the ecodistrict. The quality beaches along the Lake Winnipeg shore are a favourite destination for large numbers of people from Winnipeg during the summer months, while the undulating terrain of Grand Beach Provincial Park is valued by cross-country skiers in winter. The Winnipeg River system offers good sport fishing.

Beaconia beach

Beaconia beach is one of the beaches along the west side of the Stead Ecodistrict where it borders Lake Winnipeg. The beaches are a very popular destination in the summer, with Grand Beach to the north attracting the largest number of people.

376. Pinawa Ecodistrict (2155 km^2)



The Pinawa Ecodistrict is largely within Manitoba with only a small part located in Ontario. The ecodistrict is transitional from the Stead Ecodistrict to the west and the Kenora Ecodistrict to the east.

Climate

This ecodistrict lies within the Subhumid Transitional Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.07°C, the average growing season is 179 days, and the number of growing degree-days is about 1600.

The mean annual precipitation is approximately 550 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest during late spring and summer. The average moisture deficit over the year is nearly 80 mm. The ecodistrict has a moderately cold, humid, Cryoboreal soil climate.

The climatic data from the station at Pinawa WNRE is moderately relevant to this ecodistrict.

Selected Climate Data[1] for Pinawa WNRE

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.9	17.4	15.0	19.0	-18.4
Precip. mm (equiv.)	58.5	5.9	358.4	70.6	0.5
Rain/Snow (mm/cm)	429.0/129.5	5.9/0.0	356.0/2.5	70.6/0.0	0.5/24.6
Growing degree-days >5°C	1665.0	1142.0	1548.0	434.0	0.0

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

Physiography and Drainage

The Pinawa Ecodistrict marks the southeastern margin of the Canadian Shield in Manitoba. It is an area of transition from the more rugged lake and bedrock-dominated Kenora Ecodistrict on the east to the more subdued Stead Ecodistrict on the west.

Although hummocky granitic rock outcrops thinly covered by discontinuous, very stony to bouldery, sandy glacial drift deposits are predominant, wave-built sandy and gravelly bars and beaches marking ancient shorelines of glacial Lake Agassiz also occur. Peat-filled depressions are usually underlain by clayey glaciolacustrine sediments. The area lies between the 305 masl contour along its western boundary and the 350 masl contour along its eastern margin. Slopes range from 10 to 15 percent and from about 50 to 150 m long. This ecodistrict forms part of the Winnipeg River watershed that drains westward to Lake Winnipeg over terrain with an average slope of 2.0 m per km.

Soils

Most of the ecodistrict is bedrock-controlled terrain in which bedrock outcrops are frequent.

Mineral soils are dominantly well to excessively drained Dystric Brunisols that have developed on discontinuous, sandy textured, stony veneers of water-worked glacial till. Local areas of Eutric Brunisols occur on sandy bars and beaches, while Gray Luvisols are found on clayey glaciolacustrine sediments along the Winnipeg River and in low-lying areas throughout the ecodistrict. Most of the clayey sediments in depressions are covered by shallow to very deep peat deposits. The soils in these peatlands are dominantly Typic (deep) and Terric (shallow) Mesisols and Fibrisols, and have developed on materials from sedge to sphagnum moss peat.

Vegetation

Most of the ecodistrict is forested, although a limited area is in agriculture and used largely for forage production. Vegetation varies with site conditions and reflects the transitional nature of the ecodistrict.

Deciduous trees such as bur oak and ash grow along streams, especially in the western sector. Jack pine is found primarily on bedrock and sandy deposits, or in combination with black and white spruce, balsam fir and trembling aspen on clayey and loamy upland sites. Bog and transitional peatlands support black spruce, alder and other shrubs, and a ground cover of moss. Sedge with tamarack, alder and birch shrub form the dominant vegetation in fens.

Water

The principal sources of water are the Winnipeg River, the many small and medium sized lakes along the eastern margin of the ecodistrict and groundwater from sandy and gravelly aquifers associated with the glacial till, inter-till, beach, and fluvioglacial deposits.

Land Use

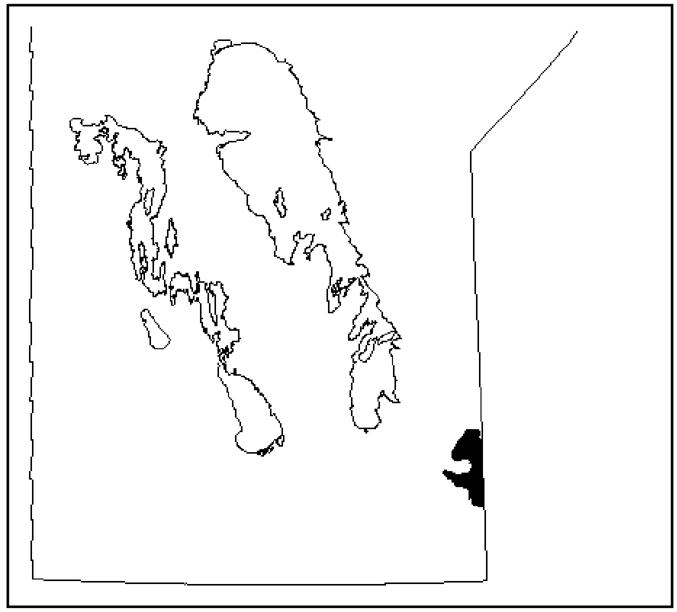
The largest communities in the ecodistrict are Pinawa, Seven Sisters and the settlement at Falcon Lake. Cottaging is a significant land use and is tied to extensive water-oriented recreation along the Winnipeg River system. Limited pulpwood and local sawlog forestry is important to the local economy. The ecodistrict provides habitat for moose and waterfowl.

Water-oriented recreation

The large number of lakes and streams on the Precambrian Shield offer great possibilites for water-oriented recreation. Although many lakes and rivers require float-plane or helicopter access, there are also many lakes and streams that can be easily reached from roads or via short portages. Especially in the provincial parks access is made easy through the provision of ramps and parking facilities for vehicles and trailers.

377. Kenora Ecodistrict (1698 km²)

The Kenora Ecodistrict straddles the border with Ontario and extends well into that province.



Climate

This ecodistrict lies in the Subhumid Transitional Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.3°C. The average growing season is 179 days with about 1600 growing degree-days.

The mean annual precipitation is approximately 650 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest in spring and early summer. The average moisture deficit over the year is about 45 mm. The ecodistrict has a moderately cold, humid, Cryoboreal soil climate.

There is no climate station in the Manitoba portion of the ecodistrict. The Kenora station in Ontario is the nearest station, but because of its proximity to Lake of the Woods the data may not be fully relevant.

Selected Climate Data[1] for Kenora Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.1	17.6	15.0	19.2	-18.5
Precip. mm (equiv.)	623.1	261.1	387.6	91.8	28.2
Rain/Snow (mm/cm)	450.7/187.7	261.1/0.0	381.8/6.0	91.8/0.0	0.3/31.2
Growing degree-days >5°C	1670.0	1167.0	1552.0	440.0	0.0

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

Physiography and Drainage

The Kenora Ecodistrict forms a portion of the southern boundary of the Canadian Shield in Manitoba and northwestern Ontario. It is an area of broadly to steeply sloping uplands, lakes with bedrock shores, and peat-filled basins characteristic of the Shield.

Rugged, hummocky granitic rock outcrops thinly covered by discontinuous, very stony to bouldery, sandy glacial drift deposits are predominant. Numerous wave-built sandy and gravelly bars and beaches mark ancient shorelines of glacial Lake Agassiz. While the Lake of the Woods dominates the ecodistrict, small and medium sized lakes abound. Peat-covered depressions are usually underlain by clayey glaciolacustrine sediments.

In Manitoba, the ecodistrict lies between the 305 masl contour along its western boundary and 360 masl along the Manitoba-Ontario border. Slopes range from level in peatlands and gently sloping on sandy outwash plains, to 10 to 30 percent and steeper in bedrock and till areas. Slopes are generally short in the broken topography and from 50 to 150 m long elsewhere.

Major rivers in the ecodistrict are the Winnipeg and Whiteshell rivers. The ecodistrict forms part of the Winnipeg River drainage division, which in turn is part of the Nelson River drainage system, and drains westward to Lake Winnipeg over terrain that declines 2.0 m per km on average.

Soils

Most of the ecodistrict is rockland consisting of bedrock outcrops and thin to very thin till veneers, deeper pockets of till, and shallow peat in undrained depressions. The bedrock, very shallow till and very shallow peatland areas are referred to as non-soil areas. These areas cover a large percentage of the ecodistrict and although the unconsolidated materials are very shallow, they support extensive, but open or patchy, forest cover. On shallow and deep, discontinuous, sandy, stoney and often water-worked till materials, the soils are dominantly well to excessively drained Dystric Brunisolic, lithic phase, soils on the shallow materials and Dystric Brunisolic soils on the deep till. Local areas of Eutric Brunisols can be found on sandy bars and beaches, and Gray Luvisols occur on moderately to imperfectly drained clayey, glaciolacustrine sediments.

The soils in peat-filled basins and larger depressions are a complex of very poorly drained Typic (deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. The kinds of peat in the peatlands are dependent on the developmental history of these peatlands. Sedge and brown moss peats mixed with remnants of shrubs and/or tamarack develop in fens, while sphagnum moss peat and peat derived from feather mosses and black spruce debris are associated with bogs.

Vegetation

Because of the predominance of bedrock with shallow till overlays and rapid drainage of the deeper till deposits, jack pine is the most common tree in the ecodistrict. Jack pine stands generally have a low ericaceous shrub layer, and a lichen and moss groundcover. In areas where forest fires have not occurred for a long time, black spruce, and to some extent balsam fir and white spruce, may be part of the stand mixture. White spruce is most likely to be found on more favourable sites.
Loamy and clayey sites tend to support vegetation dominated by black spruce, trembling aspen, balsam fir and white spruce. These stands usually have a shrub understory consisting of hazel, cherries and dogwood, and a groundcover of herbs, forbs and grasses.

Vegetation on the peatlands is dominantly black spruce, shrubs and mosses in the bogs, black spruce, tamarack, shrubs, mosses and forbs in transitional peatlands, and sedges, brown mosses and shrubs in the fen areas.

Water

The principal sources of water are Lake of the Woods, the Winnipeg River and its tributaries, and the many small and medium sized lakes within the ecodistrict.

Land Use

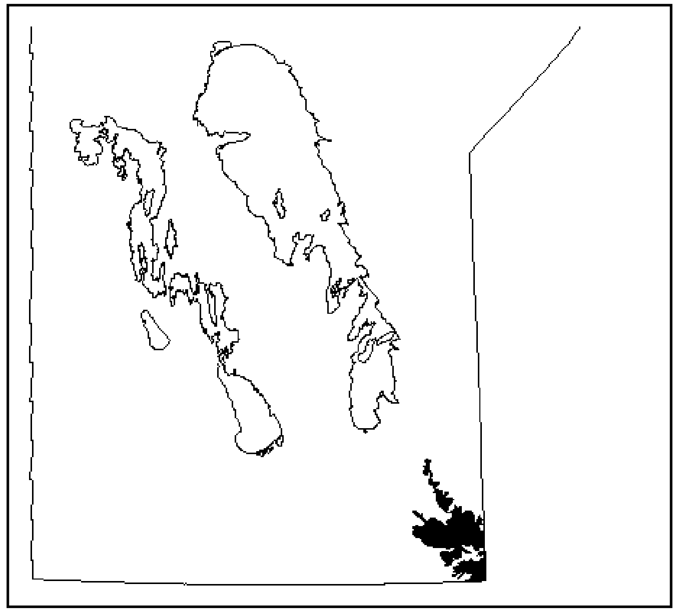
In Manitoba, a large part of the ecodistrict is occupied by Whiteshell Provincial Park. Cottaging and camping are the dominant land use around many lakes and along rivers, which tie to extensive water-oriented recreation. These recreational opportunities also support resorts, some of which operate in year-round, catering to cross-country skiing and snowmobiling enthusiasts in the winter.

Rennie is the only community in the ecodistrict.

Limited pulpwood and, locally, sawlog forestry, as well as trapping and hunting are common both within and outside the park area. The ecodistrict provides extensive habitat for moose, white-tailed deer, black bear, snowshoe hare, bobcat and other small mammals and many bird species.

379. Whitemouth Ecodistrict (3468 km^2)

The Whitemouth Ecodistrict occupies the south-central part of the southeastern portion of the Lake of the Woods Ecoregion located in Manitoba. Although it extends into Ontario along the north shore of Lake of the Woods, by far the larger part of the ecodistrict lies within Manitoba.



Climate

This ecodistrict lies within the Subhumid Transitional Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized short, warm summers, and long, cold winters. The mean annual temperature is 1.9^{o}C. The average growing season is 179 days with about 1560 growing degree-days.

The mean annual precipitation is approximately 590 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest in late spring and summer. The average moisture deficit over the year is about 75 mm. The district has a humid, moderately cold, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The station at Pinawa (376. Pinawa Ecodistrict) and at Sprague (380. Piney Ecodistrict) are relevant respectively for the northern and southern parts of the ecodistrict.

Physiography and Drainage

For the most part, the Whitemouth Ecodistrict is comprised of a vast peat-covered lowland consisting of fens and bogs, broken occasionally by small islands of very stony, water-modified till and by numerous wave-built sand and gravel bars and beaches marking ancient shorelines of glacial Lake Agassiz. The ecodistrict is located between the 320 masl and 350 masl contours.

The beaches and bars are relatively long, narrow ridges that are 2 to 3 m high and about 30 to 100 m wide. On uplands, slopes range from level to less than 5 percent and are more than 150 m long, while peatlands are nearly level. The ecodistrict drains from its centre northward via the Whitemouth River over terrain that declines 0.8 m per km, and southeast toward Lake of the Woods, where it declines 1.5 m per km on average. The ecodistrict is part of the Winnipeg River watershed, which in turn is part of the Nelson River drainage system.

Soils

Most of the soils in this depressional lowland are a complex of very poorly drained Typic (deep to very deep) and Terric (shallow) Fibrisolic and Mesisolic Organic soils overlying loamy to clayey glaciolacustrine sediments. Most of the peat material is derived from sedges and brown mosses, although in the bogs, surface layers are generally derived from sphagnum and feather mosses with varying quantities of woody debris.

Mineral soils are dominantly well to imperfectly drained Gray Luvisols that have developed on variably calcareous, loamy to clayey textured, thin veneers overlying extremely calcareous, loamy to clayey textured, water-worked glacial till. Local areas of Eutric Brunisols are found on sandy bars and beaches. Some loamy to clayey, gleyed Chernozemic Dark Grey and poorly drained peaty Gleysolic soils are distributed throughout.

Vegetation

The vegetation reflects the predominance of the peatlands.

Bog peatlands are dominated by black spruce, associated ericaceous shrubs such as Labrador tea, bog rosemary, and sphagnum mosses. Fens have dominantly vegetation of sedges, reeds and brown mosses, shrubs such as willow and dwarf birch and tamarack on slightly drier fens. Many peatlands are in transition from fen to bog, which is reflected in the presence of representative vegetation from both types.

Upland areas have mixed forest vegetation including jack pine, black spruce and trembling aspen.

Water

The principal sources of water are Whitemouth Lake, Whitemouth River and Lake of the Woods as well as fair quality groundwater from sandy and gravelly aquifers associated with glacial till, inter-till, beach, and fluvioglacial deposits.

Land Use

Middlebro and Buffalo Point First Nation are the only settlements in the ecodistrict.

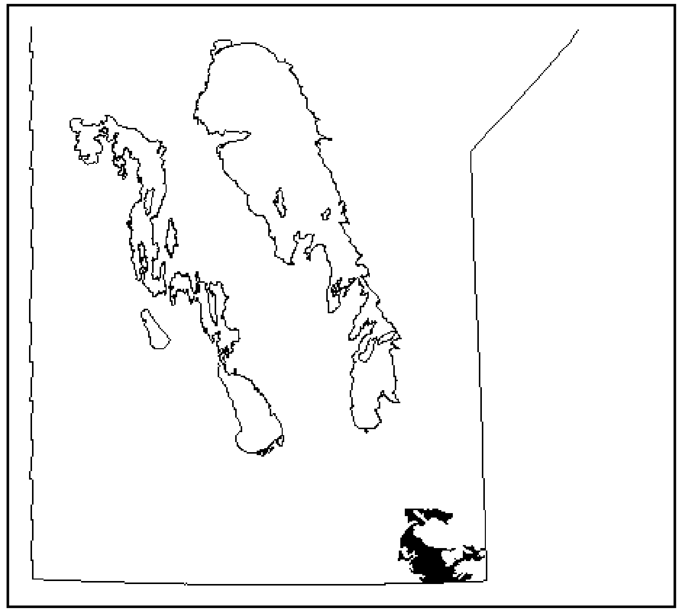
For the most part, surface drainage has not been artificially altered. The ecodistrict is currently used as a source for pulpwood and, locally, sawlogs. The wooded areas also provide wildlife habitat for white-tailed deer, moose, black bear, ruffed grouse and many other mammals and birds. Except for the few lake margins, wetlands in the area are dominantly peatlands and are of little importance as habitat for waterfowl.

Western painted turtle

The Western painted turtle is one of two species of turtles in Manitoba, the other being the Snapping turtle. The Western painted turtle occurs throughout Manitoba where there are bodies of water with sedges and reeds. Because it likes to bask in the sun, this is the turtle most commonly seen.

380. Piney Ecodistrict (2464 km^2)

The Piney Ecodistrict occupies the southwestern part of the Manitoba portion of the Lake of the Woods Ecoregion.



Climate

This ecodistrict lies within the Low Boreal, Subhumid Transitional Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.1^{o}C. The average growing season is 180 days, and growing degree-days number about 1600.

The mean annual precipitation is approximately 580 mm, of which about one-fifth falls as snow. Precipitation varies greatly from year to year, and is highest in late spring and summer. The average soil moisture deficit over the year is about 80 mm.

Climatic data from the Sprague station is presented below.

Selected Climate Data[1] for Sprague

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.1	17.5	14.9	18.9	-18.1
Precip. mm (equiv.)	605.3	270.0	399.2	93.3	26.7
Rain/Snow (mm/cm)	484.0/121.3	270.0/0.0	396.5/1.7	93.3/0.0	0.2/26.4
Growing degree-days >5^{0}C	1656.0	1145.0	1541.0	430.0	0.0

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

Physiography and Drainage

For the most part, the Piney Ecodistrict is comprised of the sandy Bedford Hills - Whitemouth Lake upland situated above the 320 masl contour and rising to a height of 396 masl.

The ecodistrict ranges from a smooth, level to gently undulating and hummocky (in places duned) upland. Wave-cut terraces occur along sharply sloping faces. Slopes range from level to more than 10 to 15 percent, and range in length from about 50 m to more than 150 m. Local relief along upland faces is more than 60 m above surrounding lowlands. From the highest point, relief falls at an average rate of approximately 3.2 m per km to the northwest, and at the rate of 6.0 m per km southwestward. Some minor relief of approximately 1 to 3 m occurs along terrace faces.

The northern and central parts of the ecodistrict are drained by the Whitemouth River, which is part of the Winnipeg River drainage division. The remainder of the district is drained via the Sprague River, which drains into the Roseau River, which is part of the Red River drainage division. Both systems are part of the Nelson River drainage system.

Soils

Soils on the sandy, weakly calcareous to neutral glaciofluvial, morainal and eolian deposits are generally well to excessively drained Dystric Brunisols. Eutric Brunisols and Gray Luvisols have developed on variably calcareous, sandy to loamy thin veneers overlying extremely calcareous, loamy to clayey textured water-worked glacial till. Local areas of Regosols are found in areas where dune formation has occurred in the not-too-distant past.

Most of the soils in depressional lowland areas are poorly drained, peaty Gleysols and complexes of deep (Typic) and Terric (shallow) organic soils overlying loamy to clayey lacustrine sediments.

Vegetation

Vegetation varies with drainage and soil texture. Sandy and gravelly, well to excessively drained soils support forest vegetation dominated by jack pine with low ericaceous shrubs such as blueberry and bearberry, and a ground cover of lichens and mosses. Medium to fine textured soils support various mixtures of jack pine, black spruce, balsam fir, trembling aspen, white birch with alder, willow and other shrubs, and ground cover varying from mosses to grasses and forbs.

The organic soils support black spruce, tamarack, sedge and moss vegetation depending on the hydrology of the peatlands.

Water

The principal sources of water for domestic and livestock use are good quality groundwater from sandy and gravelly aquifers associated with the glacial till, inter-till, beach, and fluvioglacial deposits.

Land Use

Woodridge and Sprague are the largest communities in the eocdistrict.

A limited portion of the mineral soils is cultivated. Only those soils with improved drainage in the lowland areas are cultivated for the production of spring wheat and other cereal grains, oil seeds and hay crops. Areas where drainage has not been improved or where the soils are too droughty or too cobbly and stony to be cultivated, are used mainly for pulpwood and local sawlog forestry, or for native pasture and hay production.

The wooded areas provide wildlife habitat for white-tailed deer, black bear, bobcat, ruffed grouse and many other birds and small mammals. Wetlands are dominantly peatlands and only provide limited habitat for waterfowl, but provide important habitat for moose.

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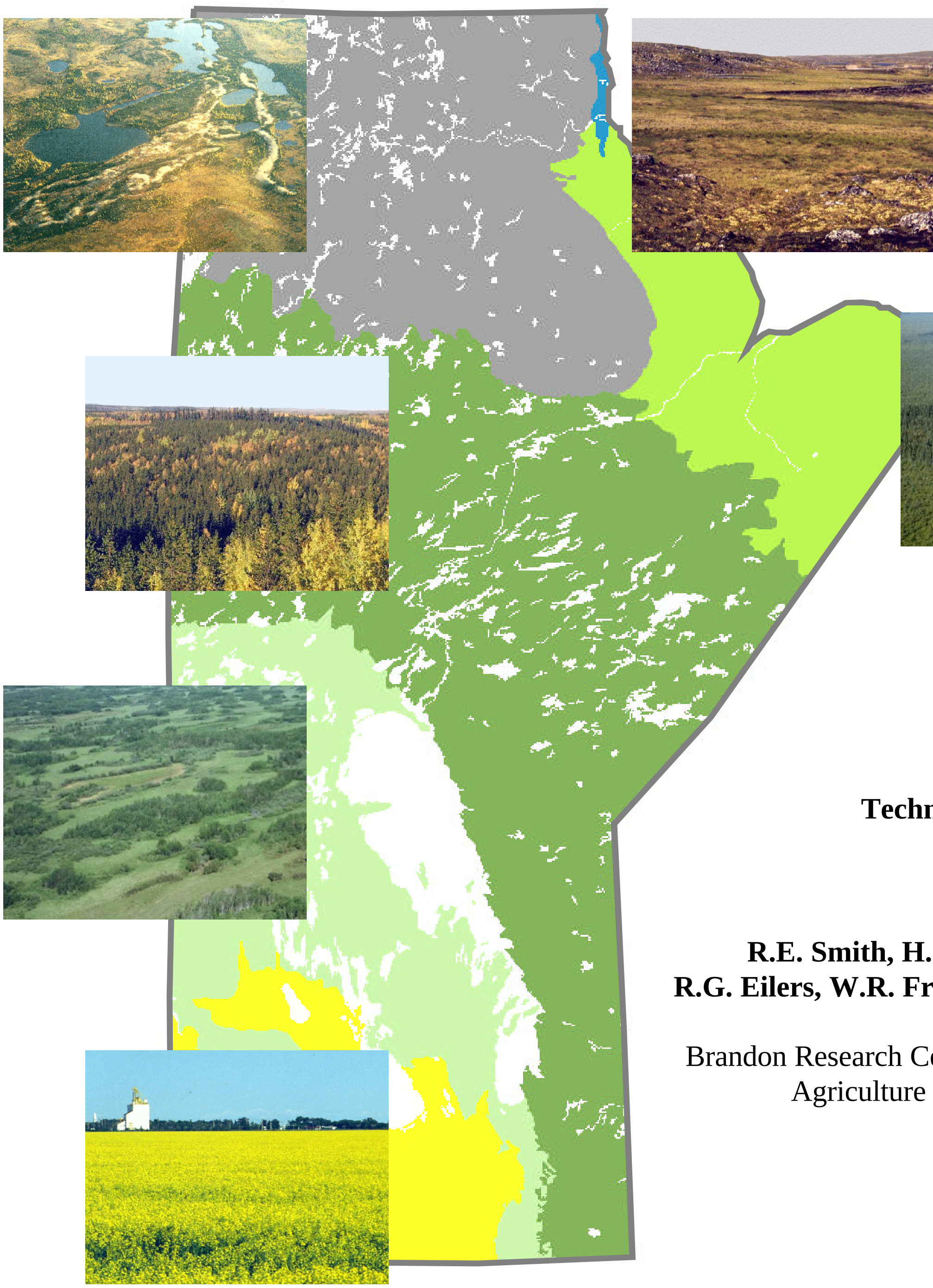
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



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Boreal Plains Ecozone

The Boreal Plains Ecozone extends as a wide band from the Peace River area of British Columbia in the northwest to the southeastern corner of Manitoba. Unlike the neighbouring Boreal Shield, this ecozone is not strongly bedrock controlled, has few bedrock outcrops and has considerably fewer lakes than the Boreal Shield.

Climate

The climate of this ecozone is strongly influenced by continental climatic conditions and is typified by cold winters and moderately warm summers. The mean annual temperature ranges from between -2°C to 2.5°C. The mean annual precipitation increases from 300 mm in northern Alberta to 600 mm in southeastern Manitoba. The average number of effective growing degree-days over 5°C ranges from 1000 to 1200. The ecozone has a subhumid, moderately cold Cryoboreal soil climate.

Data from climate stations at The Pas and Steinbach represent respectively the northern and southern sections of the Manitoba portion of this ecozone.

Climate Data[1] (Annual Means) for the Manitoba portion of the Boreal Plains Ecozone

Station	Temperature (°C)	Precipitation			Degree-Days (>5°C)	Frost FreePeriod[2] (days)
		Rain (mm)	Snow (cm)	Total (mm)		
The Pas A.	-0.3	323.3	170.2	451.9	1395.0	114.0
Steinbach	2.4	405.1	122.3	527.3	1771.0	114.0

[1] Canadian Climate Normals, 1960-1990. Atmospheric Environment Service, Environment Canada.
[2] Canadian Climate Normals, 1950-1980. Atmospheric Environment Service, Environment Canada.

Surficial Deposits and Landforms

The ecozone is underlain by Cretaceous shales and Palaeozoic limestones and dolomites. The landscape is a composite of nearly level to gently rolling plains consisting largely of hummocky and kettled to gently undulating morainal till deposits and level to depressional glaciolacustrine sediments. Surface materials are usually deep, tending to mask the underlying bedrock topography. Wetlands, including peatlands, cover between 20 to 50 percent of the ecozone.

Soils

The dominant soils of this ecozone are Luvisols, but in the southern portion, Dark Gray and Black Chernozems become more widespread. In the north, Brunisols and organic soils are increasingly more prominent.

Vegetation

White and black spruce, jack pine and tamarack are the main coniferous species. Broadleaf trees, particularly white birch, trembling aspen and balsam poplar are most numerous in the transitional section leading to the Prairie Ecozone. Black spruce and tamarack increase strongly in dominance in the northerly sections of the ecozone.

Wildlife

Characteristic mammals in the Manitoba section of the ecozone include woodland caribou, white-tailed deer, moose, wapiti, coyote, black bear, marten, fisher, lynx and chipmunk. Representative birds include boreal owl, great horned owl, red-tailed hawk, blue jay, rose-breasted and evening grosbeak, Franklin's gull and brown-headed cowbird. White pelican, cormorant, herring gull, heron and tern are also prominent.

Land Use

Agricultural development has made inroads into the southern and northwestern areas of this ecozone. However, the principal use of this region remains the sustainable use of the forest resource for pulpwood and sawlogs. Hunting and trapping are also on-going activities, as are commercial fishing operations on the larger lakes. Tourism and recreation are growing industries and are centred primarily on water-oriented recreation and the use of provincial and national parks.

There are four ecoregions within the Boreal Plains Ecozone in Manitoba.

Boreal Plains Ecozone

The Boreal Plains Ecozone contains a large variety of landscapes. The two upper pictures are from the Cedar Lake Ecodistrict, part of the Mid-Boreal Lowland Ecoregion. The jack pine stand in the picture to the left is growing on deep, well-drained, extremely calcareous, sandy loam till. The picture above shows a site with extremely shallow soils. The soil material consists of shallow rubble over limestone bedrock. Wild fire is a common occurrence on both land types, but forest regeneration is much better on the site shown in the left picture.

The first of the two lower pictures shows an area in the Gypsumville Ecodistrict. A shrub fen (with some late spring snow remaining) is in the foreground, and mixed coniferous forest on higher till is seen in the background. Most of this ecodistrict consists of forested lands or peatlands, although some of the area has been cleared for the production of cereals and tame hay. The second picture shows the pothole landscape in the Swan River Ecodistrict west of the Riding Mountain Upland Ecodistrict.

Plate BP1.

Carbonate bedrock. The Boreal Plains Ecoregion is underlain by dolomite and limestone in the northern and eastern sectors. These carbonate rocks are bordered to the west and south by a mixture of limestone, dolomitic and shale bedrock, while the uplands in the southwestern sector are underlain by shales. The carbonate rock was severely eroded by glacier ice. The materials were reworked and deposited as the characteristically high lime tills of the Interlake, and were mixed with shale materials and deposited as mixed tills in southwestern Manitoba. The carbonate rock is usually very strongly fractured, which allows for vertical and horizontal drainage.

Plate BP2.

Forest stand on high-lime till. The high-lime till is sandy loam to loam textured. Soil development is generally shallow due to the amount of free carbonates present, and the soils may still be calcareous in the surface. Forest growth is variable due to variation in carbonate levels, texture, drainage and depth to bedrock. In the Interlake stands are dominated by trembling aspen while farther north they consist of largely of black spruce and/or jack pine with varying admixtures of trembling aspen and white birch.

Plate BP3.

Ridge and swale landscape. Ridge and swale topography is common in the Interlake. The glaciers created this landscape of semi-parallel highs and lows. As the landscape pattern is perpendicular to the general slope of the land, the lows are very wet. The lows are dominated by sedge, meadowgrass and reed vegetation, while the ridges support trembling aspen, balsam polar and a variety of shrubs.

Plate BP4.

Garter snakes in limestone sinkhole. Rainwater percolating through limestone bedrock results in the formation of sink-holes or caverns. Some of these sinkholes are used by garter snakes to hibernate below the frost-line. In spring they emerge to mate, and to migrate to the swales, where they hunt frogs and insects. Significant concentrations of garter snakes are found in sinkholes near Narcisse in the Manitoba Interlake region.

Plate BP5.
Shallow Orthic Dark Gray Chernozemic soil on high-lime till. The soils on the high-lime till are generally very shallow and stony. High levels of free carbonates retard soil development, especially the movement of sesquioxides and clay.

Plate BP6.
Interlake landscape. Some of the high-lime till areas have been cleared for arable agriculture, but significant areas remain as forest and wetlands. Significant areas have reverted back to shrub-land after clearing. Cereal and hay production are major agricultural land uses, when soil drainage and stoniness are relatively favourable. Less favourable areas are commonly used for livestock grazing.

Plate BP7.
Mixed forest on Duck Mountain. The Porcupine Hills, and Duck and Riding Mountain ecodistricts contain some of the most productive forest stands in Manitoba. The forest consists predominantly of mixed stands of hardwoods and softwoods.

Plate BP8.
Orthic Gray Luvisolic soil on clayey till. Some glacial till deposits on the uplands are clay textured, and are derived from the local shale mixed with minor quantities of high-lime materials from the lowland plains. On well to imperfectly drained sites , the soils have distinct, well developed A and B horizons. They are very productive for forest growth.

Plate BP9.

Orthic Gray Luvisolic soil on loamy till. Glacial till deposits on the slopes of the uplands consist of a mixture of materials derived from carbonate bedrock, shales and Precambrian bedrock. These productive forest soils are generally loamy, moderately well drained, moderately to strongly calcareous and contain moderate quantities of coarse fragments. As the soil developed under forest vegetation, carbonates have been leached from the upper part of the profile, resulting in a light gray, platy A horizon, underlain by a well-developed B horizon enriched in clay.

Plate BP10.

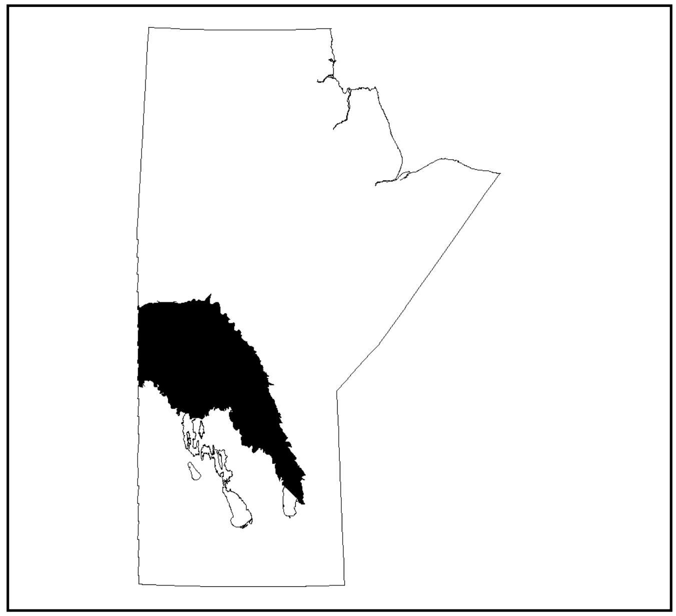
Louisiana-Pacific oriented fibreboard mill with stacks of trembling aspen wood. The establishment of the fibreboard mill in Minitonas creates a market for aspen wood in the Porcupine, Duck Mountain and surrounding areas. Until recently the market for trembling aspen wood was limited. Hardwood was often left standing after the softwood was removed. The increased demand for trembling aspen required new forest management strategies.

Plate BP11.
Mixed forest in the Interlake. The Interlake are supports extensive stands of trembling aspen mixed with white spruce, although forest growth is variable. Trembling aspen on high-lime till soils are often stunted with poor form. Forest growth is much better in areas with clayey and loamy glaciolacustrine surface sediments.

Plate BP12.
Clay loam textured glaciolacustrine sediments near Arborg in the Interlake. The level glaciolacustrine sediments in the southeastern sector are extensively used for arable agriculture. Crops are dominantly cereals, but also include canola and alfalfa.

148. Mid-Boreal Lowland Ecoregion

The Mid-Boreal Lowland Ecoregion occupies the northern section of the low-lying Manitoba Plain from the western shore of Lake Winnipeg to the Cumberland Lowlands in Saskatchewan.



Climate

This ecoregion is part of the Subhumid Mid-Boreal Ecoclimatic Region that forms a continuous belt extending from Lac Seul in northwestern Ontario, across central Manitoba and Saskatchewan to the foothills of the Rocky Mountains in northern Alberta and the southern Yukon Territory. The ecoregion has short, moderately warm summers and long, cold winters. The mean annual air temperature ranges from -0.4°C to 1.2°C. The average growing season ranges from 162 to 172 days, and the number growing degree-days ranges from nearly 1300 to over 1500.

The average annual precipitation ranges from about 450 mm to about 575 mm. Precipitation varies greatly from year to year and is highest during the growing season. Average moisture deficits range from nearly 60 mm to about 125 mm. The region has a moderately cold to cold, subhumid to humid, Cryoboreal soil climate.

Climate data from The Pas Airport and Grand Rapids Hydro is given below.

Selected Climate Data[1] for The Pas Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-21.4	-17.5	-10.0	0.5	8.7	14.8	17.7	16.4	9.9	3.5	-7.7	-18.0	-0.3
Precip. mm	16.6	15.1	21.0	26.2	33.6	63.1	69.1	65.0	58.3	37.5	26.6	19.8	451.9
Growing degree-days	0.0	0.0	0.0	24.0	138.0	294.0	395.0	352.0	155.0	37.0	1.0	0.0	1395.0

Selected Climate Data[1] for Steinbach

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-19.8	-17.7	-9.1	0.5	8.3	14.9	18.8	17.5	11.2	4.0	-6.9	-16.6	0.5
Precip. mm	16.4	12.8	24.8	24.6	38.9	75.2	75.1	67.2	60.7	41.5	26.8	19.4	483.4
Growing degree-days	0.0	0.0	0.0	24.0	127.0	298.0	426.0	388.0	188.0	42.0	1.0	0.0	1494.0

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

Surficial Deposits and Landforms

In Manitoba, this ecoregion is underlain by flat-lying, low relief Palaeozoic limestone rock and is covered almost entirely by glacial deposits of variable thickness. Limestone bedrock is at or near the surface along escarpments, erosion channels and drumlinoid ridges. Lower and smoother than the Saskatchewan Plain to the west, this plain has an elevation ranging from about 350 masl near the Saskatchewan border to 218 masl at Lake Winnipeg. Its surface is generally level with a distinct, north to south trending drumlinoid or ridged topographic pattern with slopes ranging from 1 to 5 percent.

Portions of this lowland plain have been smoothed over by the deposition of clays, silts and sands of glacial Lake Agassiz which have subsequently been covered by organic deposits in the form of poorly drained flat bogs and horizontal fens. More pronounced topography in the form of limestone domes with slopes ranging from 5 to 10 percent occur north of Clearwater Lake. Beaches marking the successively lower water levels of Lake Agassiz wind along the prominent The Pas Moraine and along a bare bedrock escarpment that lies north of Grand Rapids near the northwestern shoreline of Lake Winnipeg.

The most northern part of the ecoregion lies within the discontinuous permafrost zone. Permafrost is patchy but widespread in peatlands. The widespread occurrence of collapse features (thermokarst) indicates that the permafrost is barely in equilibrium with the climate.

Large to very large lakes dominate the ecoregion including the northern basin of Lake Winnipeg, the northern half of Lake Winnipegosis, as well as Cedar, Moose, Cormorant, Clearwater and Athapapuskow lakes. The Saskatchewan and Carrot rivers are the major drainage ways. The ecoregion is part of a number of watersheds including those of the Minago, Hargrave and William rivers, which are all part of the Nelson River drainage system.

Soils

Eutric Brunisols on loamy glacial till, and shallow to deep Organic Mesisols and Fibrisols are co-dominant in the area. Other soils of significance include Gray Luvisolic soils that have developed on well to imperfectly drained, very stony, calcareous, loamy to clayey textured glacial till and on calcareous, stone-free, clayey and silty glaciolacustrine deposits.

Eutric Brunisols are present and are associated with ancient, subdued sandy beaches of former glacial Lake Agassiz. Limestone bedrock outcroppings, covered by rubble, are common throughout the ecoregion.

Vegetation

In Manitoba, this ecoregion is characterized by mixed boreal forest. Medium to tall, closed stands of black spruce, trembling aspen, balsam polar and jack pine are common on well to imperfectly drained clayey and loamy tills and glaciolacustrine deposits. Black spruce is the dominant species in older stands.
After fire, extremely overstocked stands of jack pine often develop on well drained sites, while on better sites, trembling aspen may be the dominant regeneration. Good mixed stands of black spruce, white spruce, balsam fir and trembling aspen may be found on suitable sites along lake shores and on alluvial deposits along rivers. Poorly drained soils support black spruce and shrub vegetation.

Vegetation in bogs consists of black spruce and ericaceous shrubs and mosses. Fens are dominated by sedges, brown mosses and varying amounts of swamp birch and tamarack.

Wildlife

Characteristic wildlife includes moose, black bear, wolf, lynx, red fox and snowshoe hare. This ecoregion also provides habitat for waterfowl including various ducks, geese, white pelican and cormorant. Other birds include various raptors, sandhill crane and ruffed grouse.

Land Use

The largest centres are The Pas and Grand Rapids. There are also a number of First Nation communities.

A significant part of the ecoregion, especially around Cedar Lake, was flooded as a result of the construction of the hydro-electric dam on the Saskatchewan River at Grand Rapids.

Significant pulpwood and local sawlog forestry provides employment in the ecoregion, with most of the pulpwood and timber being processed in the mill at The Pas. Water-oriented recreation, trapping and hunting are also important land uses. Servicing the tourist industry provides seasonal employment during the summer. Arable agriculture is limited to small holdings on clayey glaciolacustrine soils in the lowlands along rivers and streams, where drainage has been improved. Grains for livestock feed, oilseeds, and hay are the common crops.

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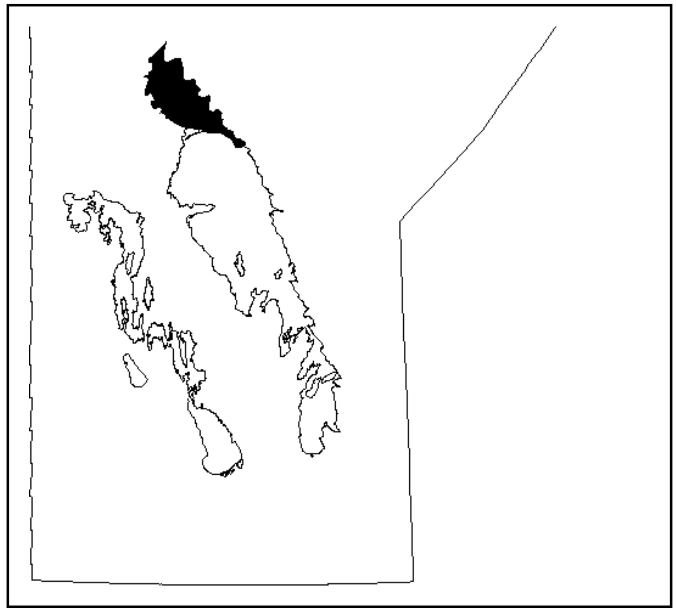
There are fourteen ecodistricts that occur either wholly or in part within the Mid-Boreal Lowlands Ecoregion in Manitoba.

663. Playgreen Lake Ecodistrict (5256 km^2)

The Playgreen Lake Ecodistrict occupies an area in the northeastern corner of the Mid-Boreal Lowland Ecoregion and extends from the north shore of Lake Winnipeg to the northern border of the region.



Climate

This ecodistrict is situated within the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The mean annual temperature is 0.1^{o}C, the average growing season is 162 days with about 1400 growing degree-days.

The mean annual precipitation is approximately 470 mm, of which one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average annual moisture deficit is about 95 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

There are no climate stations in this ecodistrict, but data from Wabowden (363. Sipiwesk Lake Ecodistrict) is relevant.

Physiography and Drainage

The wide-spread, nearly level peatland that makes up a large part of this ecodistrict is an extension of the peatlands found in the Norway House Ecodistrict. This peatland extends northward from the north end of Lake Winnipeg between Playgreen, Kiskittogisu and Kiskitto lakes to the east and Hargrave Lake to the west. The ecodistrict has a mean elevation of about 256 masl, and elevations range from about 300 masl near Hargrave Lake to 213 masl near Playgreen Lake. Regional relief falls at the rate of about 1.1 m per km. Long (more than 150 m), smooth slopes range from level to less than 5 percent. Local relief of 0.5 to 2 m occurs along former Lake Agassiz beaches, while some of the creeks and rivers have carved 5 to 10 m deep channels.

Soils

Deep to shallow, moderately decomposed Mesisolic organic soils are dominant and have some potential for arable agriculture if drainage could be economically implemented.

The ecodistrict lies within the discontinuous permafrost zone. Patches of permafrost occur throughout, but are confined to peatlands. Collapse scars marking the location of former frozen peat plateau and palsa bogs are common features near Limestone Bay.

Gray Luvisols and Gleysols are associated with clayey glaciolacustrine sediments, while Eutric Brunisols are associated with relic beaches.

Lack of natural drainage and poor heat conductance properties of peat soils are the major soil problems.

Vegetation

The vegetation on the peatlands varies with peatland type. Bogs generally support stunted black spruce with ericaceous shrubs and mosses dominated by sphagnum species. Fens are generally dominated by sedges and brown mosses and contain varying quantities of shrubs such as swamp birch and stunted tamarack trees.

Uplands have vegetation that varies with drainage, soil texture and fire history. Black spruce is widespread, but following forest fires, jack pine and, to a lesser extent, trembling aspen, become major forest components. Wet uplands have black spruce and moss vegetation with shrubs such as willow and alder.

Water

The principal sources of water are lakes, streams and creeks. Variable quality groundwater can also be obtained from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and glaciolacustrine deposits. Development of wells is poor from Lower Silurian and Ordovician limestone bedrock formations. Limestone aquifers consist of fractured rock and both water quantity and quality are variable.

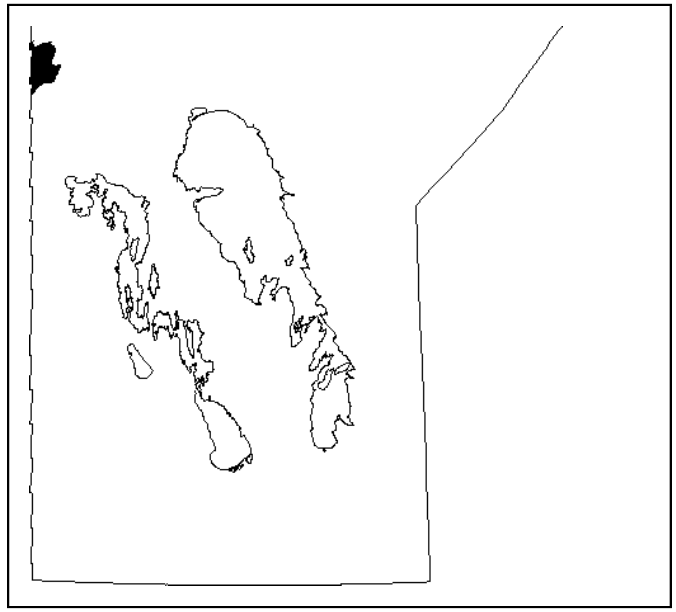
Land Use

There are no communities in this ecodistrict.

Most of the soils are not well suited to, and are not used for, arable agriculture. Most of the land is public land and portions are leased out for pulpwood and sawlog forestry. Hunting, trapping and water-oriented recreation are other important land uses. The habitat is important for wildlife and waterfowl breeding habitat.

664. Namew Lake Ecodistrict (1373 km^2)

The Nanew Lake Ecodistrict straddles the border with Saskatchewan. It is situated in the northwestern corner of the Manitoba portion of the Mid-Boreal Lowland Ecoregion, but only about one-fifth of the ecodistrict lies within Manitoba.



Climate

This ecodistrict occurs in a cooler subdivision of the Mid-Boreal Ecoclimatic Region in west-central Manitoba and is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is -0.4°C, the average growing season is 162 days, and the number of growing degree-days is about 1320.

The mean annual precipitation is approximately 475 mm, of which more than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 85 mm. The district has a humid, cold to moderately cold, Cryoboreal soil climate.

The ecodistrict has a long-term climate station at Wanless, but data is incomplete after 1980.

Selected Climate Data[1] for Wanless

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-1.2	15.4	12.8	16.7	-24
Precip. mm (equiv.)	451.6	189.7	277.2	64.4	17.6
Rain/Snow (mm/cm)	315.5/137.4	189.4/0.3	274.8/2.8	64.4/0.0	0.0T/18.2
Growing degree-days >5°C	1254.0	933.0	1198.0	356.0	0.0

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

Physiography and Drainage

In Manitoba, the Namew Lake Ecodistrict extends from the The Pas Moraine between the Saskatchewan River and Lake Athapapuskow westward to the Saskatchewan border. Relief is terminated abruptly on the southeast by steep morainic deposits that rise 10 to 15 m above the surrounding area. Glacial deposits throughout the area can vary in thickness from less than 10 cm on limestone bedrock outcrops, to more than 30 m. The ecodistrict slopes gently eastward at the rate of about 1.0 m per km. Elevations range from 300 masl at the Saskatchewan border to 261 masl at Rock Lake near its eastern edge. The mean elevation is about 274 masl.

Local relief within this relatively level to undulating shallow glaciolacustrine plain occurs along river banks and lake shores and ranges from 2 to 3 m. Moderately long slopes (50 to 150 m) range from level to less than 5 percent.

Most of the ecodistrict lies within the Saskatchewan River watershed which is part of the Nelson River drainage system. The Goose River and a number of creeks drain several large lakes, including Namew and Athapapuskow lakes.

Soils

The mineral soils are co-dominantly well to imperfectly drained Gray Luvisols on calcareous, clayey glaciolacustrine deposits, and Eluviated Eutric Brunisols and Gray Luvisols associated with well to imperfectly drained till ridges and uplands. The till is extremely to very strongly calcareous, very cobbly to gravelly, loam to clay-loam textured and water-worked. Soil profile development on these materials is very shallow (usually less than 15 cm deep).

Extensive areas of poorly to very poorly drained, shallow to deep, slightly to moderately decomposed (fibric to mesic) organic soils - and sporadic Organic Cryosols where permafrost is present - are found throughout the district.

Poor soil structure, lack of natural drainage, excess amounts of stones and cobbles, and high lime content associated with the till soils are the major limitations to agricultural use of the soils.

Vegetation

The vegetation reflects the drainage, soil materials and the relatively northern location. Black spruce is dominant as a result of predominance of organic and poorly drained clayey soils, and is associated with ericaceous shrubs and mosses. Upland vegetation varies with drainage, texture and fire history. Jack pine is dominant on coarser textured upland burn sites and is associated with ericaceous shrubs, alder, herbs, mosses and lichens. Other sites may support trembling aspen with shrubs and herbs. Favourable sites, especially on mineral soils along creeks and rivers, may have forest stands with black spruce, white spruce, jack pine and trembling aspen.

Water

Approximately 20 percent of the ecodistrict is shallow ponds, lakes, rivers and streams, which are the principal sources of water. Variable quality groundwater may be extracted from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and deposits. Development of wells is poor from dominantly Silurian bedrock formations. Limestone aquifers consist of fractured rock and both water quantity and quality are variable.

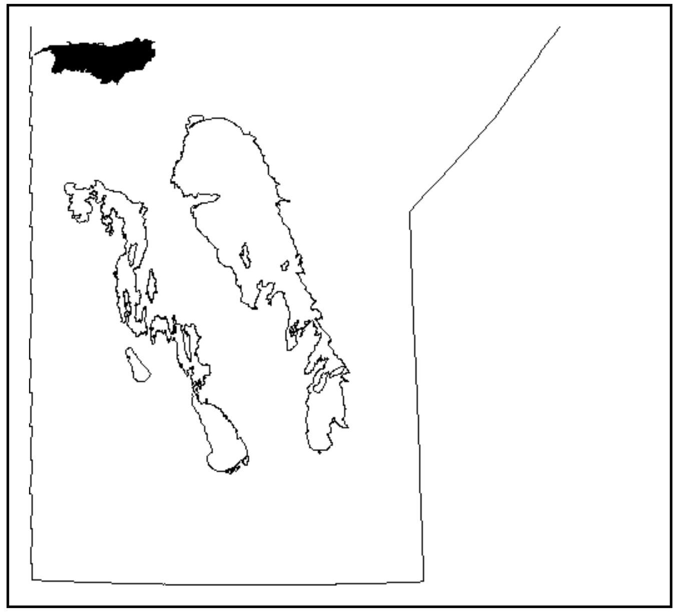
Land Use

There are no communities in the ecodistrict.

The ecodistrict is used for the production of pulpwood and some timber. A limited portion of the clayey soils are cultivated for cereal grains, alfalfa seed and hay crops. Most of the land is public land and some of it is leased as native pasture and hay. The ecodistrict provides important wildlife and waterfowl breeding habitat.

665. Cormorant Lake Ecodistrict (4199 km²)

The Cormorant Lake Ecodistrict is located in the most northern part of the Mid-Boreal Lowland Ecoregion in Manitoba.



Climate

This ecodistrict is in a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. Its climate is marked by short, moderately warm summers and long, very cold winters. The mean annual temperature is -0.4^{o}C, the average growing season is 165 days, and the number of growing degree-days is about 1300.

The mean annual precipitation is approximately 455 mm, of which more than one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average moisture deficit over the year is about 110 mm. The district has a humid, cold to moderately cold, Cryoboreal soil climate.

There are no climate stations in this ecodistrict. Climatic data from Wanless (664. Namew Lake Ecodistrict) and Flin Flon Airport (358. Flin Flon Ecodistrict) has some relevance.

Physiography and Drainage

The Cormorant Lake Ecodistrict borders on the Canadian Shield at Reed Lake on the north and extends south to Clearwater Lake. It is bordered on the west by the The Pas Moraine and the Namew Lake ecodistricts, and on the east by the lowlands of the Playgreen Lake Ecodistrict.

The ecodistrict is a hummocky morainal plain covered by thin, discontinuous glacial till veneers. Most of the glacial deposits vary in thickness from less than 10 cm on limestone bedrock outcrops to more than 30 m. Elevations range from about 300 masl in the western sector to about 263 masl along the shore of Hargrave Lake in the east. The ecodistrict slopes gently eastward at the rate of approximately 0.5 m per km. Moderately long (50 to 150 m), hummocky slopes range from 5 to about 10 percent in subdued upland areas, while long slopes (over 400 m) ranging from level to 0.5 percent occur on organic terrain.

The ecodistrict is drained by a number of creeks and rivers. The most northern and eastern sectors are part of the Grass River-Burntwood River watershed, while the remainder is part of the Saskatchewan River watershed. All are part of the Nelson River drainage system.

Soils

The dominant soils in the Cormorant Lake Ecodistrict are well to imperfectly drained Eluviated Eutric Brunisols that have developed on veneers and blankets of extremely calcareous, very cobbly to gravelly, loamy textured, water-worked glacial till and cobbly to gravelly beach deposits. Soil profile development is very shallow (usually less than 15 cm thick).

Poorly to very poorly drained peaty Gleysolic soils and slightly to moderately decomposed (fibric to mesic) organic soils are widespread and cover extensive areas. Cryosolic soils are associated with widespread patches of permafrost occurring in peatlands. Minor areas of Gray Luvisolic soils that have developed on glaciolacustrine sediments occur near the margins of lakes.

Excessive amounts of stones and cobbles, shallow rooting depth to bedrock and poor natural drainage are the major soil problems.

Vegetation

Vegetation on the uplands varies with fire history. Jack pine is the dominant species after fire, with areas of trembling aspen regenerating on favourable sites. Black spruce becomes dominant with time and is associated with shrubs such as alder and ericaceous shrubs. Ground cover varies from moss to herbs and forbs.

Bog peatlands support stunted black spruce with dwarf birch and ericaceous shrubs and mosses, while fens have sedges, brown mosses and varying amounts of swamp birch, alder, willow and stunted tamarack.

Water

The principal source of water is the variable quality groundwater available from sand and gravel shallow aquifers associated with till, beach and inter-till outwash and glaciolacustrine deposits. Lakes and ponds comprise about 5 percent of the ecodistrict and provide surface sources of water. Development of wells is poor from Silurian bedrock formations. Limestone aquifers consist of fractured rock and both water quantity and quality are variable.

Land Use

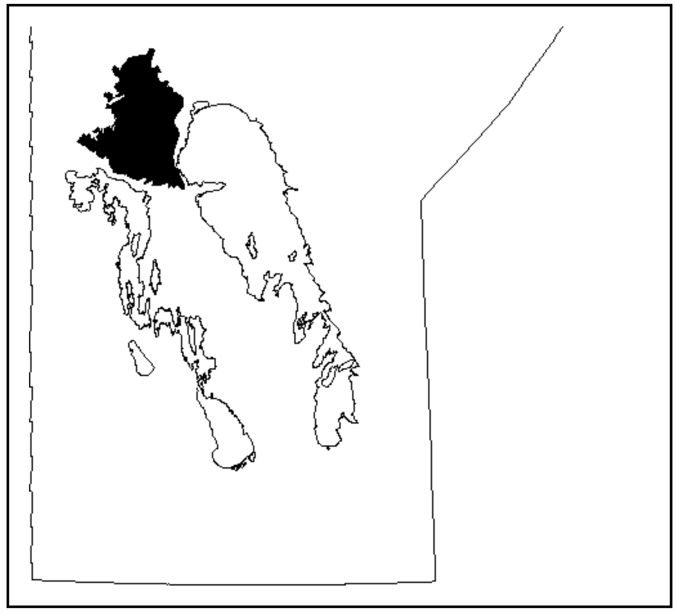
There are no settlements in the ecodistrict.

Most of the soils are not suitable to, and are not used for, arable agriculture. The clayey, Gray Luvisolic soils and organic soils have some potential for arable agriculture. All of the land is public land and significant areas are leased for pulpwood and sawlog forestry. Other uses include hunting, trapping and water-oriented recreation. The habitat is important for wildlife and waterfowl breeding.

Beaver pond and lodge

Beavers occur throughout most of the province, except in the far north. Beavers build dams to create ponds sufficiently deep so that the winter supply of green branches stored on the pond bottom will remain accessible under the ice. Beavers build dens in river banks or they may build lodges, constructed of mud and sticks, with underwater exits. The dams can cause flooding of large areas, especially where the terrain is level. The construction of dams in ditches may cause flooding of nearby roads. As trapping of beavers has decreased in recent years, their numbers have increased in many areas.

666. Cedar Lake Ecodistrict (10 359 km²)



The Cedar Lake Ecodistrict lies immediately north of the The Pas Moraine.

Climate

This ecodistrict is located in a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is from 0.3°C, the average growing season is 163 days, and the number of growing degree-days is about 1400.

The mean annual precipitation is approximately 475 mm, of which one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average yearly moisture deficit is about 80 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

The data from the climate station at Grand Rapids Hydro, which is located in the southeast corner of the ecodistrict, is relevant, but more so for the southern than the northern sector of the ecodistrict.

Selected Climate Data[1] for Grand Rapids Hydro

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	0.5	17.1	14.4	18.8	-19.8
Precip. mm (equiv.)	483.4	217.5	317.1	75.1	16.4
Rain/Snow (mm/cm)	65.8/116.2	217.0/0.5	312.6/4.2	75.1/0.0	16.4/0.0T
Growing degree-days >5°C	1494.0	1111.0	1427.0	426.0	0.0

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

Physiography and Drainage

The Cedar Lake Ecodistrict consists of a nearly level, low relief limestone bedrock plain covered by thin, discontinuous glacial till veneers. Two large lakes, Cedar Lake and Moose Lake, cover approximately 40 percent of the ecodistrict.

Elevations lie generally between 274 to 244 masl, with a mean elevation of about 259 masl. Some localized limestone outcrops have elevations exceeding 284 masl. The ecodistrict slopes very gently at about 0.6 m per km. However, rapid relief changes occur locally along steeply sloping escarpments in the eastern section. Long (>150 m), smooth slopes range from level to less than 5 percent. Small diameter sinkholes with nearly vertical walls are a locally common occurrence on flat limestone bedrock exposures.

Drainage is largely toward the lakes which form part of the Saskatchewan River drainage system. However the most eastern part drains directly into Lake Winnipeg through a number of creeks.

Soils

Limestone bedrock dominates the ecodistrict. Significant areas of well to imperfectly drained Eluviated Eutric Brunisols are present. These soils have developed on very thin veneers of extremely calcareous, very cobbly to gravelly, loamy water-worked glacial till and cobbly to gravelly beach deposits. Most of the glacial deposits vary in thickness from less than 10 cm on limestone bedrock outcrops to about 100 cm. Soil profile development is very shallow (usually less than 15 cm deep).

Small areas of Gray Luvisolic soils that have developed on clayey glaciolacustrine sediments occur near the margins of lakes. Poorly drained, peaty Gleysolic soils and shallow, slightly to moderately decomposed Fibrisolic to Mesisolic Organic soils are local soil inclusions.

Excessive amounts of stones and cobbles, and shallow rooting depth to bedrock are the major soil problems.

Vegetation

Jack pine is widespread due to the droughtiness of many sites and the frequency of forest fires. Older jack pine stands have a layer of ericaceous shrubs, such as blueberry, bearberry and rock cranberry and a ground cover of mosses and lichens with minor grasses and herbs. Clayey glaciolacustrine deposits support black spruce, trembling aspen, alder, willow and herbs and mosses.

In bog peatland the vegetation is stunted black spruce, ericaceous shrubs and mosses, while on fens and peatlands, sedges, brown mosses, swamp birch and stunted tamarack are the dominant vegetative conponents.

Possibly the most northern occurrence of eastern white cedar was around Cedar Lake. However, its distribution may have been affected by flooding.

Water

Approximately 45 percent of this ecodistrict is surface water which provides the principal source of water. Variable-quality groundwater is also available from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and lacustrine deposits. Silurian limestone aquifers consist of fractured rock and both water quantity and quality are variable.

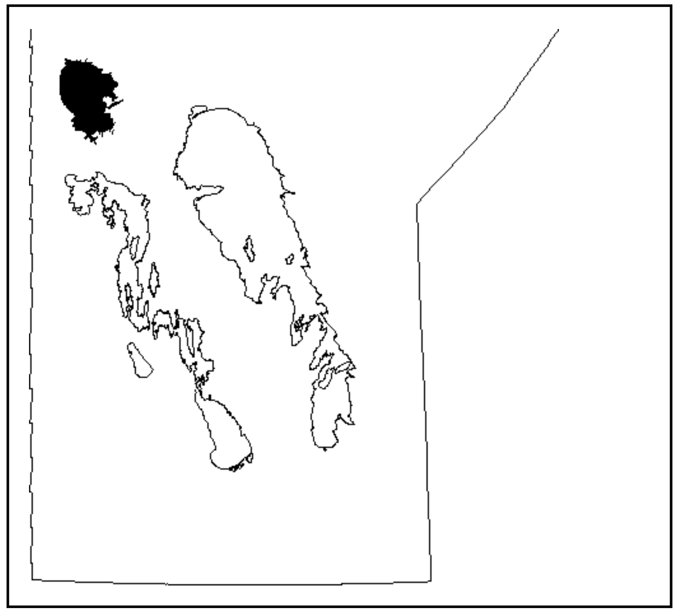
Land Use

The population lives primarily in Grand Rapids, which is the largest settlement in the district, and in the Grand Rapids and Easterville First Nation communities.

The ecodistrict has been strongly affected by the construction of the Manitoba Hydro dam at Grand Rapids, which caused considerable flooding around Cedar and Moose lakes, extending the size of these lakes significantly.

Most of the land is public land and leased for pulpwood and limited sawlog forestry. The large lakes support a limited commercial fishery, while a more extensive fishery is conducted on Lake Winnipeg by fishers from Grand Rapids. Other land uses are hunting, trapping and water-oriented recreation. The ecodistrict provides important moose and waterfowl habitat.

667. Summerberry Ecodistrict (4199 km²)



The Summerberry Ecodistrict is situated between the The Pas moraine to the west and Cedar Lake and Moose Lake to the east.

Climate

This ecodistrict lies within a warmer subdivision of the Mid-Boreal Ecoclimatic Region in west-central Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is -0.3°C, the average growing season is 163 days with about 1300 growing degree-days.

The mean annual precipitation is approximately 450 mm, of which more than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is nearly 95 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate

The climate station at The Pas Airport is located in the east-central sector of the ecodistrict.

Selected Climate Data[1] for The Pas Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-0.3	16.3	13.5	17.7	-21.4
Precip. mm (equiv.)	451.9	197.2	289.1	69.1	16.6
Rain/Snow (mm/cm)	323.3/170.2	196.9/0.3	282.2/7.1	69.1/0.0	0.1/24.0
Growing degree-days >5°C	1395.0	1041.0	1334.0	395.0	0.0

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

Physiography and Drainage

The Summerberry Ecodistrict, situated in the lower Saskatchewan River Delta, is a nearly level lowland of scrolled, recent alluvial deposits and horizontal fens that extends eastward from the The Pas moraine to South Moose and Cedar lakes.

Elevations range from 257 masl to 253 masl. The ecodistrict slopes very gently from west to east at the rate of about 0.1 m per km. Some local relief is provided by till hillocks ranging in height from 0.5 m to 2.0 or 3.0 m above the surrounding delta. Meandering levees are 1.0 to 2.0 m high and about 90 to 360 m wide. Slopes range from level in the lowlands to less than 5 percent on till hillocks. Natural drainage is very slow. The entire ecodistrict is part of the Saskatchewan River drainage system.

Soils

The dominant soils are poorly to very poorly drained, shallow to deep, moderately decomposed Mesisolic Organic soils developed on uniform, moderately decomposed sedge peat. Significant areas of peaty, calcareous, loamy to clayey textured Rego Gleysols and Rego Humic Gleysols occur on recent alluvium. Local areas of Gray Luvisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay-loam textured, water-worked glacial till and thin clayey glaciolacustrine deposits also occur.

Lack of natural drainage is the major soil problem. The excessive amounts of stones and cobbles associated with the till soils is an additional problem.

Vegetation

As a large part of the ecodistrict consists of fens, the vegetation is mostly sedges, brown mosses and stunted and clumped black spruce and tamarack, associated with varying amounts of shrubs such as swamp birch, willow and alder.

On clayey till uplands the vegetation is dominated by black spruce, white spruce, and trembling aspen mixed with small areas of jack pine. Shrub layer and ground cover vegetation changes with tree cover. The coniferous stands have mosses as dominant groundcover, while the groundcover in trembling aspen stands is mostly forbs and herbs. Distribution of the shrub layer is varied, but includes alder and willow, especially on wetter sites.

On floodplains and levees, the vegetation is largely deciduous. Tree cover is dominated by balsam poplar, elm, ash, trembling aspen and white birch, with only minor occurrences of black spruce and white spruce.

Water

The principal source of water is the Saskatchewan River. Water is also available from shallow ponds and lakes that occupy about 20 percent of the delta. Variable-quality groundwater may be obtained from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and deposits. Development of wells is poor from dominantly Silurian bedrock formations. Limestone aquifers consist of fractured rock and both quantity and quality of water are variable.

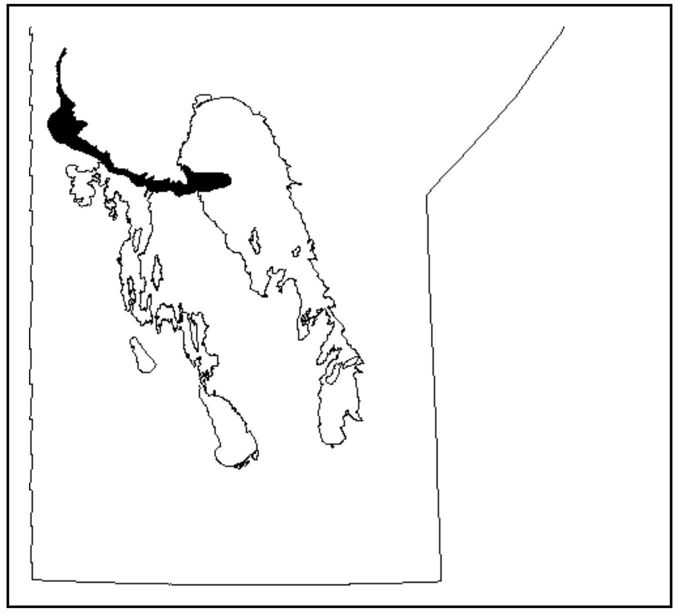
Land Use

Opaskwayak Cree Nation (The Pas) and Mosakahiken Cree Nation are the only communities in the ecodistrict.

A limited extent of the soils in the Rahls Island area of the ecodistrict is cultivated for the production of cereal grains, oil seeds and hay crops. Most of the land is public land and a significant portion is leased for native pasture and hay. The ecodistrict provides important moose and waterfowl breeding habitat.

668. The Pas Moraine Ecodistrict(4253 km2)

The The Pas Moraine Ecodistrict arches in a belt of varying width from the Long Point area on Lake Winnipeg in the east, to the northwestern sector of the Manitoba portion of the Mid-Boreal Lowland Ecoregion.



Climate

This ecodistrict lies within a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, moderately warm summers and long, cold winters. The mean annual temperature is 0.1°C, and the average growing season is 166 days with about 1370 growing degree-days.

The mean annual precipitation is approximately 470 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 90 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

The ecodistrict has no climate stations. The data from Grand Rapids Hydro (See 666. Cedar Lake Ecodistrict) and The Pas Airport (See 667. Summerberry Ecodistrict) is valid for the eastern and western section respectively.

Physiography and Drainage

The The Pas Moraine Ecodistrict consists largely of the The Pas Moraine, which is the most prominent topographical feature within the Mid-Boreal Lowland Ecoregion in Manitoba. The feature is a curvi-linear, drumlinized moraine that extends from Long Point on Lake Winnipeg westward between Lake Winnipegosis and Cedar Lake, terminates at The Pas and Rocky Lake on the northwest.

The ecodistrict crests along its southern and western edges where the elevation drops from 305 masl to about 255 masl. Its mean elevation is about 279 masl. Southwest-northeast oriented drumlin ridges, ranging from about 400 to 800 metres wide, are separated by variable-sized swales or depressions up to about 800 metres wide. After the continental glacier melted about 7000 to 8000 years ago, the surface of this drumlinized end moraine was modified by wave action and by icebergs scouring the ridges as glacial Lake Agassiz retreated.

Wave action has created local textural differentiation on this drumlin-swale landscape. The ridges are more coarse textured and have cobbles and gravels, especially on their apexes. The depressions contain finer textured sediments of glaciolacustrine origin. Iceberg scouring has created clearly visible intersecting micro-grooves or flutes that are usually curvi-linear in form.

Slopes in the ecodistrict range from 50 to 100 m long in the steeper parts and vary from 5 percent to 15 percent in some locations. The organic terrain has long slopes that range from level to 1 percent. The ecodistrict slopes gently northeast at approximately 1.0 m per km. Local relief in the ridge and swale terrain is approximately 0.5 to 3 m, while strongest relief is found along the south face of the moraine where it reaches approximately 25 m.

Most of the ecodistrict is part of the Saskatchewan River watershed, but part drains south into the Lake Winnipegosis drainage system, which is part of the Dauphin River watershed.

Soils

Shallow to deep, moderately decomposed Mesisolic Organic soils are dominant. Organic soils are in part underlain by clayey glaciolacustrine sediment. The soils on well to imperfectly drained ridges are dominantly Gray Luvisols and Eutric Brunisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay textured, water-worked glacial till and beach gravels. The end moraine deposits are generally deep and may extend several tens of metres to bedrock.

Lack of natural drainage, poor thermal conductance properties of the organic soils, excess amounts of stones and cobbles, and an irregular topographic pattern that runs perpendicular to the general regional slope contribute to the soil problems.

Vegetation

The vegetation is dominated by bog and fen vegetation. Although most bogs support stunted black spruce stands, some bog areas support medium growth, closed stands. The understory varies from swamp birch and ericaceous shrubs with sphagnum moss to alder and feather mosses. Fens are generally dominated by sedges and brown mosses and varying quantities of swamp birch and tamarack.

The till areas support a forest of varying quantities of black spruce, white spruce, white birch and trembling aspen. On favourable, usually south-facing slopes with seepage, tree growth can be very good.

One of the most northerly occurrences of eastern white cedar in Manitoba is located along the south side of Long Point.

Water

The principal source of water is variable-quality groundwater from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and glaciolacustrine deposits.

Land Use

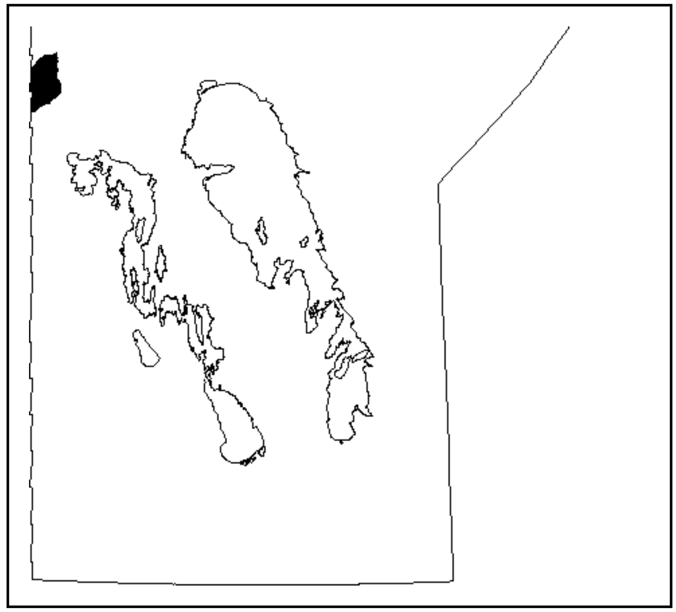
The Chemawawin First Nation community is the only settlement in the ecodistrict.

Most of the land is public land and leased for pulpwood and limited sawlog forestry. Other land uses include hunting and trapping. The area provides important habitat for wildlife including moose, black bear, various members of the weasel family, and woodland caribou.

Long Point

Long Point is the most eastern extension of the The Pas Moraine. The picture is taken from atop the moraine looking southeast towards Lake Winnipeg over the black spruce-covered lowlands bordering the moraine.

669. Saskatchewan Delta Ecodistrict (1537 km^2)



The Saskatchewan Delta Ecodistrict straddles the border with Saskatchewan and occupies the west-central part of the Manitoba portion of the Mid-Boreal Lowland Ecoregion. Only about one-fifth of the ecodistrict lies within Manitoba.

Climate

This ecodistrict is located in a warmer subdivision of the Mid-Boreal Ecoclimatic Region in west-central Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is -0.3^{o}C, the average growing season is 166 days with about 1300 growing degree-days.

The mean annual precipitation is approximately 450 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average yearly moisture deficit is about 125 mm. The ecodistrict has a humid, cold to moderately cold Cryoboreal soil climate.

There are no climate stations in the Manitoba portion of the ecodistrict. However, data from the station at The Pas Airport is valid (See 667. Summerberry Ecodistrict).

Physiography and Drainage

The Saskatchewan Delta Ecodistrict extends westward from the The Pas Moraine, between the Saskatchewan and Pasquia rivers to Delta in Saskatchewan.

Topographically, this depressional ecodistrict is terminated abruptly on the east by the The Pas Moraine which rises 12 to 22 m above the delta. Elevations in the flood plain range from 264 masl at the Saskatchewan border to 259 masl at its eastern edge, falling at the rate of about 0.3 m per km. Its mean elevation is about 261 masl.

The unconsolidated materials are generally deep to very deep and composed of varying deposits. Alluvial sediments often overlie glaciolacustrine sediments, which in turn rest on glacial till, which may rest on limestone bedrock or possibly glaciofluvial gravels. The whole sequence can be over 100 m thick in some locations, or less than a few metres thick where bedrock is close to the surface.

The most significant relief within the western section is provided by drumlin-like till hillocks, which are elongated in a northwest-southeast direction. These hillocks rise from 2 to 20 m above the surrounding plain and have slopes of less than 5 percent.

Meandering levees within the flood plain are significant low-relief features, that are 0.6 to 2.0 m in height and range from 90 to 360 m in width. Levees along the contemporary Carrot and Pasquia rivers range from 1.2 m to 3.0 m high and from 180 m to 700 m wide. Slopes range from level on alluvial sediments to about 2 percent on levees.

Natural drainage of this plain is very slow because of its nearly level to depressed topography and is worsened by the levees which impede drainage into the natural waterways. The construction of ditches has improved drainage in some areas of the Manitoba portion of the ecodistrict.

The ecodistrict is part of the Saskatchewan River drainage system.

Soils

The dominant soils are poorly to very poorly drained, peaty, calcareous, loam to clay textured Rego Gleysols and Rego Humic Gleysols. Areas of poorly to very poorly drained, shallow to deep, slightly to moderately decomposed Fibrisolic and Mesisolic Organic soils become more prevalent in the western section.

Soils on well to imperfectly drained till ridges in the area are dominantly Eluviated Eutric Brunisols and Gray Luvisols. These soils have developed on extremely to very strongly calcareous, very cobbly to gravelly, loam to clay-loam textured, water-worked glacial till. Soil profile development is very shallow - usually less than 15 cm deep.

Lack of natural drainage is the major soil problem. Soil salinity is a problem in some locations. Excessive amounts of stones and cobbles associated with the till soils are also a limitation.

Vegetation

The ecodistrict is dominated by vegetation associated with the poorly to very poorly drained areas. Clumped willows, swamp birch and scattered balsam poplar are found on poorly drained and imperfectly drained sites, and stunted black spruce and tamarack, sedges and rushes in the very poorly drained peat areas.

In the natural state, levees supported balsam poplar, trembling aspen, elm, Manitoba maple, green ash, white birch, white spruce and balsam fir. Fire and logging has removed most of the conifers. Till upland areas have balsam poplar, trembling aspen, white spruce, jack pine and balsam fir.

Water

The principal sources of water are the rivers and streams that border on and flow through the ecodistrict, and from shallow ponds and lakes that occur within the delta. In Manitoba, surface water comprises about 8 percent of the ecodistrict. Variable-quality groundwater is also available from shallow sand and gravel aquifers associated with till, beach and inter-till outwash deposits. Well development is poor from dominantly Silurian bedrock formations as limestone aquifers consist of fractured rock and both water quantity and quality are variable.

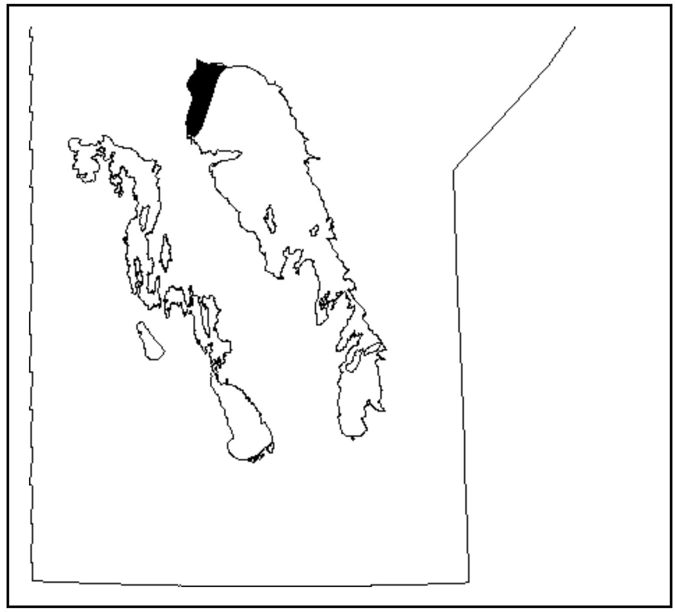
Land Use

The town of The Pas is the largest settlement in the ecodistrict and serves as a trade, service and administrative centre for the ecodistrict and surrounding area. The Opaskwayak Cree Nation is the other community in the ecodistrict.

In Manitoba, only a limited portion of the alluvial soils is cultivated for cereal grains, oilseeds and hay crops. Much of the land in the area is public land and leased out for native pasture and hay. The ecodistrict provides important moose and waterfowl breeding habitat.

670. Grand Rapids Ecodistrict (1760 km²)

The Grand Rapids Ecodistrict borders Lake Winnipeg and extends from just north of the mouth of the Saskatchewan River to Limestone Bay.



Climate

This ecodistrict is located in a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is 0.5°C and the average growing season is 163 days with about 1420 growing degree-days.

The mean annual precipitation is approximately 480 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is slightly over 80 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

There is no climate station in the ecodistrict, but the station at Grand Rapids Hydro (666. Cedar Lake Ecodistrict) is located adjacent to the most southern extension of the ecodistrict; therefore the data is more relevant for the southern than for the northern part.

Physiography and Drainage

The nearly level, peatland-dominated Grand Rapids Ecodistrict is located along the northwestern shoreline of Lake Winnipeg from just north of the mouth of the Saskatchewan River to Limestone Bay at the north end of Lake Winnipeg. The ecodistrict has a mean elevation of about 244 masl. The ecodistrict's western boundary is marked by a prominent 25 m high limestone escarpment which separates it from the adjacent Cedar Lake Ecodistrict.

Local relief (0.5 to 2.0 m, and occasionally higher) occurs along meandering creeks that flow through the ecodistrict and along the shoreline of Lake Winnipeg. Subdued uplands include alluvial soils along creeks, some clayey and loamy glaciolacustrine and till deposits and relic beaches along Lake Winnipeg. Included in the ecodistrict are two islands in Lake Winnipeg. Eagle Island is dominated by bogs and gravelly beaches, while the larger Selkirk Island is a mixture of bogs, deep loamy till and shallow till veneers over limestone bedrock.

Soils

Deep to shallow, moderately decomposed Mesisolic Organic soils developed on sedge peat are the dominant soils. These soils have some potential for arable agriculture. Mesisolic Organic soils on moderately to well decomposed forest peat are significant inclusions. Eutric Brunisols, Gray Luvisols and Gleysols occur throughout and are asscoiated with the minor mineral uplands. Sporadic patches of permafrost occur in the northern section.

Lack of natural drainage and poor heat conductance properties of organic soils are the major soil problems in the area.

Vegetation

The vegetation is dominated by communities associated with peatlands. Bog peatlands have generally stunted black spruce, ericaceous shrubs and moss vegetation. Stands are more closed and somewhat taller than farther north. Fen peatlands usually have sedge, brown mosses and varying quantities of swamp birch and stunted tamarack. Uplands support vegetation dominated by black spruce and jack pine. More favourable sites may also support white spruce and trembling aspen. A shrub layer of willow and alder is often quite widespread.

Water

On the whole, about 65 percent of the surface area of the ecodistrict is water due to the inclusion of a portion of Lake Winnipeg, which accounts for about 50 percent of the area. Lakes and streams and creeks form the principal source of water. Variable-quality groundwater is available from shallow sand and gravel aquifers associated with till, beach and inter-till outwash and lacustrine deposits. Well development is poor from fractured Lower Silurian and Ordovician limestone bedrock.

Land Use

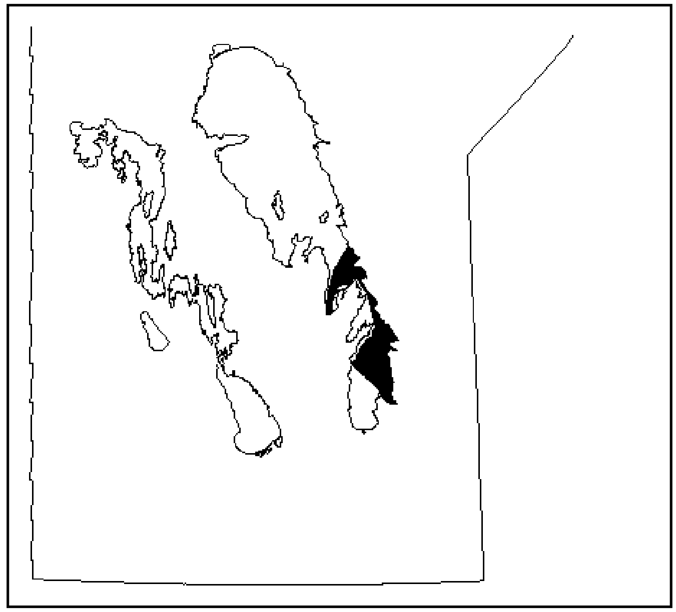
There are no communities in the ecodistrict.

Virtually all of the land is public land and portions are leased for pulpwood and sawlog forestry. Other important uses are hunting, trapping and some water-oriented recreation. The area provides important moose and waterfowl breeding habitat.

Most of the eocdistrict has been included in a recently-created provincial park.

671. Narrows Islands Ecodistrict (3251 km^2)

The Narrow Islands Ecodistrict is mostly water and encompasses a large portion of Lake Winnipeg.



Climate

This ecodistrict is situated in the more humid and cooler subdivision of the Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The climate of the islands, which form the land portion of the district, is affected to a greater degree by the moderating effect of the lake than the surrounding mainland. The figures described below are derived from climate stations based on the mainland, and therefore the data is only moderately relevant. The mean annual temperature is about 1.2^{o}C, and the average growing season is 172 days with about 1500 growing degree-days.

The mean annual precipitation is approximately 560 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is nearly 60 mm. The district has a humid, cold to moderately cold, Cryoboreal soil climate.

Physiography and Drainage

The Narrows Islands Ecodistrict is situated in the Narrows area of Lake Winnipeg, which separates the southern basin of the lake from the much larger northern basin. The land portion is made up of a number of islands, which include the larger Hecla, Black and Deer islands off the eastern shore of the Grindstone Point area. Hecla Island is joined to the mainland by a causeway at Grassy Narrows. Moose, Little Moose, Black Bear, Matheson, Tamarack and Little Tamarack islands and a number of very small islands lie further north within Fisher Bay.

Mean elevations of the islands range from lake level at about 217 masl to about 235 masl. The low-relief topography of the islands is generally level to hummocky, reflecting the nature of the underlying Ordovician limestone bedrock.

The islands in Fisher Bay consist mostly of thin, loamy, water-worked till over limestone bedrock which is partially covered by clayey glaciolacustrine sediments. The more southerly islands are primarily clayey and loamy glaciolacustrine materials, covered in part by peat. However, Black Island is largely water-worked, stony, sandy till. On the extreme eastern shores of Black and Deer islands, surface deposits consist mainly of siliceous sandy deposits originating from quartzose sandstone.

Soils

Clayey Gray Luvisolic soils developed on the well to imperfectly drained hummocky till ridges which are covered with a variable layer of glaciolacustrine clay are dominant on the islands in Fisher Bay. Significant areas of poorly drained, shallow Mesisolic and Fibrisolic Organic soils and peaty Gleysolic clayey soils occur on Hecla Island and in level depressions on most of the other islands. Sandy Gray Luvisolic and Dystric Brunisolic soils are dominant on Black Island and on the east end of Deer Island.

Excessive amounts of stones and cobbles, irregular topography and lack of natural drainage, particularly on Hecla Island, contribute to the soil problems.

Vegetation

Vegetation is varied. On imperfectly and moderately well drained sites, stands of black and white spruce, often mixed with trembling aspen, balsam fir and white birch are dominant. Common understory species are hazel, mountain-maple and snowberry. On poorly drained and organic soils, black spruce is dominant.

Feather mosses are the dominant groundcover on wet mineral soils, while sphagnum mosses are dominant on organic soils. Very poorly drained fens have sedge, brown moss, sedge and tamarack vegetation. On drier till ridges and former beaches, jack pine often forms pure stands, due in part to site conditions and in part to fire history.

Red pine stands on Black Island are the most northerly in Manitoba.

Water

The principal source of water is Lake Winnipeg. Variable-quality groundwater is also available from shallow sand and gravel aquifers associated with glacial till, beach and inter-till outwash deposits, and from the Winnipeg formation of sandstone on Black and Deer islands. Well development from underlying Ordovician limestone bedrock aquifers are variable both in water quantity and quality.

Land Use

There are no permanent communities in the ecodistrict.

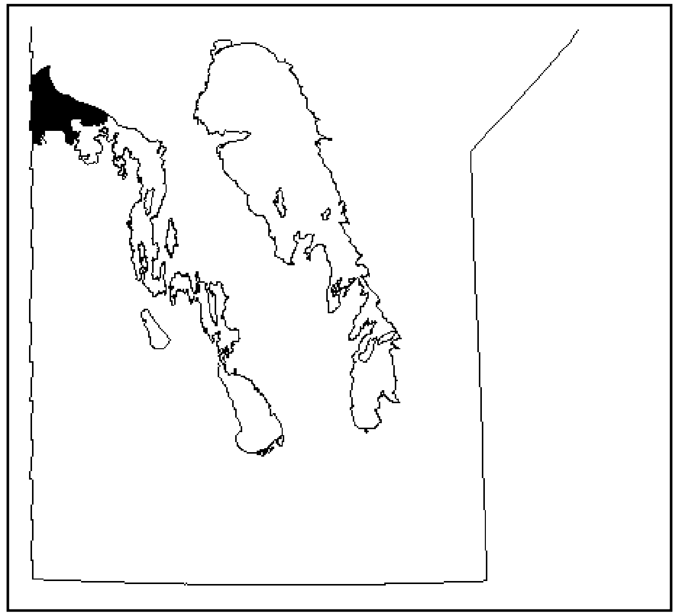
Both the mineral and organic soils have some potential for arable agriculture. Most of the ecodistrict is public land where water-oriented recreation, hunting and trapping are dominant uses. Hecla Island is a provincial park and provides significant habitat for moose, deer, black bear, small mammals, songbirds, raptors and many species of waterfowl. Black Island is a source of silica sand.

Marsh

Marshes are wetlands with shallow water that usually fluctuates daily, seasonally or annually due to tides, evaporation, groundwater recharge, or seepage losses. Parts of a marsh may fall dry at times. Marshes are important habitat for breeding and staging waterfowl, and as nurseries for a wide variety of aquatic life from insects to fish. Marshes occur throughout Manitoba. The two largest marshes in southern Manitoba are Netley Marsh on the southern end of Lake Winnipeg, and Delta Marsh at the southern end of Lake Manitoba. Oak Hammock Marsh, north of Winnipeg, is the largest restored marsh in Manitoba.

672. Overflowing River Ecodistrict (2904 km^2)

The Overflowing River Ecodistrict straddles the border with Saskatchewan. About half of the ecodistrict lies within Manitoba.



Climate

This ecodistrict lies within a cooler subdivision of the Mid-Boreal Ecoclimatic Region in west-central Manitoba. The climate is characterized by short, moderately warm summers and long, very cold winters. The mean annual temperature is -0.2°C, the average growing season is 167 days and the number of growing degree-days is slightly over 1300.

The mean annual precipitation is approximately 450 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the growing season is about 125 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The nearest is the station at The Pas Airport (668. The Pas Moraine Ecodistrict), which is relevant.

Physiography and Drainage

The Overflowing River Ecodistrict is a smooth, level area bounded by the Pasquia Hills on the northwest and the Porcupine Hills on the south. These uplands rise 400 to 500 m above this lowland plain while the The Pas Moraine to the northeast extends to an approximate maximum of 38 m above the plain.

Elevations range from 305 masl at the Saskatchewan border to about 266 masl along the Overflowing River near Dawson Bay, which forms the eastern edge of the ecodistrict. The land surface slopes gently to the east at the rate of about 1.0 metre per km. Relief along river banks and lake shores ranges from 2.0 to 3.0 m. Long slopes, largely over 150 m long, have inclines that range from almost level to less than 2 percent.

Surficial deposits are dominantly shallow and deep organic materials. The peat materials are derived from sedges, brown mosses and sphagnum mosses and are underlain by calcareous, loamy to clayey glaciolacustrine and till deposits. Most of the peatlands are in the form of flat bogs, which have generally a thick, slightly decomposed sphagnum peat surface layer. An extensive area of horizontal and patterned fens occurs between Overflow Bay and the The Pas Moraine. This is an area of shallow and deep, moderately decomposed fen peat.

Moderately well to poorly drained subdued uplands of glaciolacustrine and till deposits occur throughout the ecodistrict.

Drainage in the ecodistrict is generally slow. Most of the drainage is provided by the Overflowing River, and a number of small creeks. Most of the ecodistrict is part of the Lake Winnipegosis watershed, while the northern sector is part of the Saskatchewan River watershed, which are both part of the Nelson River drainage system.

Soils

The dominant soils are poorly to very poorly drained, shallow to deep, slightly decomposed Fibrisols and moderately decomposed Mesisols. On well to imperfectly drained till ridges in the area, soils are dominantly Eluviated Eutric Brunisols and Gray Luvisols that have developed on extremely to very strongly calcareous, slightly cobbly to very cobbly to gravelly, loamy to clay-loam water-worked glacial till. Soil profile development is very shallow (usually less than 15 cm thick). Gray Luvisols and Dark Gray Chernozems are associated also with clayey glaciolacustrine and till sediments.

Lack of natural drainage and poor thermal conductance properties limit the usefulness of organic soils. Excessive amounts of stones and cobbles associated with the till soils are a major problem, but the limited areas of clayey glaciolacustrine and clayey, less stony till deposits have potential for arable agriculture.

Vegetation

The vegetation in the ecodistrict is dominated by peatland vegetation. Black spruce is widespread and is associated with bog peatlands. Black spruce growth varies from closed, medium-tall stands to open, stunted stands, depending on drainage and depth of sphagnum peat. Generally, bog peatlands that are somewhat raised and contain moderately well decomposed forest peat in the surface layers support the better stands. However, large areas are dominated by black spruce, sphagnum moss and ericaceous shrub vegetation.

The fens are dominated by sedges, brown mosses and varying amounts of shrubs such as swamp birch and willow. Tamarack occurs in varying quantities as well.

The uplands are dominated by stands of black spruce mixed with varying quantities of balsam fir, white birch, trembling aspen and jack pine, with a varying understory of shrubs such as alder, willow and hazel, ericaceous shrubs and a ground cover varying from feather mosses to herbs and forbs.

Water

The principal source of water is the Overflowing River, as well as water from the shallow bays of Lake Winnipegosis. Very limited quantities of variable-quality groundwater are available from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash and deposits. Well development is poor from dominantly Silurian bedrock formations. Limestone aquifers consist of fractured rock and yield water of variable quantity and quality.

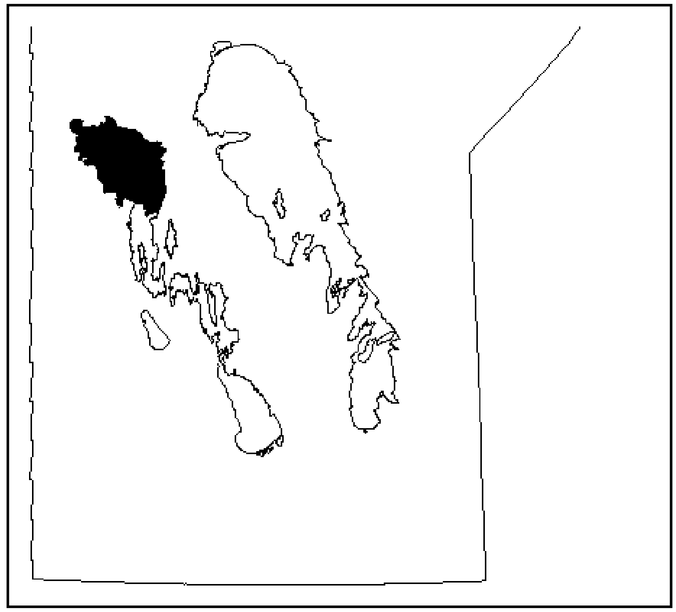
Land Use

There are no communities in the ecodistrict.

Limited pulpwood forestry is conducted in the ecodistrict. Most of the land in the area is public land. The ecodistrict is important as moose habitat, and as habitat for waterfowl breeding.

674. Pelican Lake Ecodistrict (5458 km^2)

The Pelican Lake Ecodistrict is situated in the south-central part of the Mid-Boreal Ecoregion.



Climate

This ecodistrict is located in a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in west-central Manitoba. The climate is characterized by short, moderately warm summers and long, cold winters. The mean annual temperature is 0.7^{o}C, and the average growing season is 171 days with about 1400 growing degree-days.

The mean annual precipitation is approximately 490 mm of which less than one-third falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is nearly 100 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

The climate, especially on the two peninsulas, is to some extent influenced by the expanse of Lake Winnipegosis bordering it.

There are no climate stations in the ecodistrict. The nearest stations are at Swan River (717. Swan Lake Ecodistrict), The Pas Airport (668. The Pas Moraine Ecodistrict), and at Grand Rapids Hydro (666. Cedar Lake Ecodistrict). Data from these stations is only moderately relevant to this ecodistrict.

Physiography and Drainage

The Pelican Lake Ecodistrict encompasses the northern part of Lake Winnipegosis. The land area of the ecodistrict includes Birch Island and two wide peninsulas bordered by Lake Winnipegosis. The ecodistrict is basically a nearly level plain with a mean elevation of about 229 masl.

The land surface has a prominent north-south trending drumlinoid or ridge and swale topographic pattern. The fluted ridges, ranging from about 400 to 800 m wide, are separated by variable-sized swales or depressions up to 800 m wide. Glacial deposits can vary in thickness from less than 10 cm, where limestone bedrock outcrops, to more than 30 m. Level peatlands are prominent.

Following the retreat of the continental glacier, the surface of this ridged till plain was covered by glacial Lake Agassiz and subsequently modified by wave action and by icebergs scouring the ridges. The scouring by icebergs resulted in the formation of strongly intersecting micro-grooves or flutes that are usually curvi-linear in form. Wave action has resulted in local textural differentiation. The drumlinized ridges tend to have a coarser texture and are cobbly and gravelly, while the depressions generally have a finer texture.

The ecodistrict slopes very gently northeastward at approximately 0.6 m per km. Local relief is subdued with ridge to swale relief generally in the range of 0.5 to 3.0 m.Slopes range from level to less than 5 percent.

Drainage is generally in a northeasterly direction reflecting surface configuration. Most drainage is by creeks flowing into bays of Lake Winnipegosis. The ecodistrict is part of the Lake Winnipegosis watershed, which is part of the Nelson River drainage system.

Soils

On well to imperfectly drained ridges, soils are dominantly Eluviated Eutric Brunisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay-loam water-worked glacial till. Soil profile development is very shallow and is usually less than 15 cm deep. Significant areas of poorly drained peaty Gleysolic soils occur in the swales. Shallow, slightly to moderately decomposed (fibric to mesic) organic soils are significant soil inclusions.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

The vegetation on the uplands and ridges is a mixture of black and white spruce, trembling aspen, balsam fir and white birch. Wetter areas have increasing amounts of black spruce and balsam poplar. Jack pine is present on drier sites. The understory consists of shrubs such as alder and hazel. Groundcover varies from feather mosses to herbs and forbs, with the former more prevalent under coniferous stands and the latter more often associated with deciduous stands.

Low-lying areas are dominated by sedges with varying amounts of herbs and forbs and some shrub. Peatlands vary from bogs with black spruce and sphagnum mosses to fens with sedge, tamarack and swamp birch.

Water

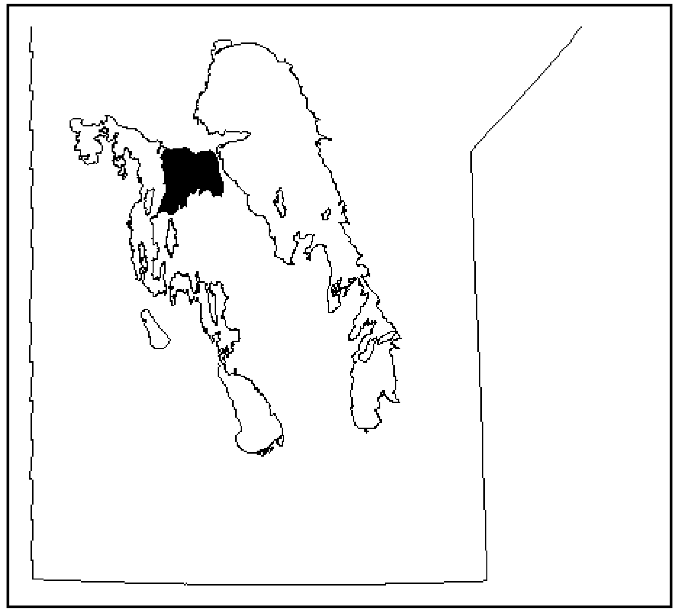
The principal sources of water are Pelican Lake and the bays of Lake Winnipegosis. Approximately 45 percent of the ecodistrict is covered by water, when all lakes, including parts of Lake Winnipegosis, ponds, rivers and creeks are included. Variable-quality groundwater is also available from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash and glaciolacustrine deposits. Well development from underlying Silurian bedrock aquifers varies greatly both in terms of water quantity and quality.

Land Use

The Sapotaweyak First Nation (Shoal Lake) community is the only settlement in the ecodistrict.

Most of the land is public land and a significant portion is leased out for native pasture and hay. The ecodistrict provides important moose and waterfowl breeding habitat.

675. Chitek Lake Ecodistrict (2886 km^2)



The Chitek Lake Ecodistrict is situated in the south-central part of the Mid-Boreal Lowland Ecoregion. It is bordered on the west by Lake Winnipegosis, on the north by the The Pas Moraine, and extends east almost to Lake Winnipeg.

Climate

This ecodistrict lies within a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, moderately warm summers and long, cold winters. The mean annual temperature is 0.5°C, the average growing season is 166 days, and the number of growing degree-days is about 1420.

The mean annual precipitation is approximately 480 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 60 mm. The district has a humid, cold to moderately cold, Cryoboreal soil climate.

There are no climate stations in the ecodistrict. The nearest is Grand Rapids Hydro (666. Cedar Lake Ecodistrict). Data from this station is only moderately relevant.

Physiography and Drainage

The Chitek Lake Ecodistrict is generally a plain with a mean elevation of about 259 masl. The ecodistrict has a subdued north-south trending drumlinoid or ridge and swale topographic pattern. The fluted ridges, ranging from about 400 to 800 m wide, are separated by variable-sized swales or depressions up to 800 m wide. Glacial deposits can vary in thickness from less than 10 cm, where limestone bedrock outcrops, to more than 30 m. Slopes range from level to less than 5 percent. Regional relief is approximately 0.6 m per km, while local relief from ridge to swale is approximately 0.5 to 3 m. Level peatlands are prominent.

Drainage is slow due to the flatness of the terrain and the impediment caused by the ridge and swale topography perpendicular to the overall slope of the land. The drainage system is poorly developed and the creeks tend to drain in a north to northeasterly direction.

The western part of the ecodistrict lies in the Lake Winnipegosis watershed, while the eastern part lies in the Long Point watershed. Both are part of the Nelson River drainage system.

Soils

The dominant mineral soils are Gray Luvisols that have developed on well to imperfectly drained clayey till ridges, and Eutric Brunisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy textured water-worked glacial till. A significant area of Mesisols, developed on woody forest peat, occurs in the centre of the ecodistrict. Local areas of poorly drained, peaty Gleysolic soils and shallow, slightly to moderately decomposed (fibric to mesic) organic soils are soil inclusions in the swales.

Excessive amounts of stones and cobbles, irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

Forest stands on uplands and ridges are generally a mixture of black spruce, jack pine and trembling aspen. The species composition varies with drainage and fire history. Well drained sites with coarse textured soils, and sites recovering from fire, usually have stands with, or dominated by, jack pine. Favourable sites, especially those along waterways and lakes, may have a significant component of white spruce.

The shrub understory varies with drainage and soil texture as well. The more moist sites have willow and red-osier dogwood dominant in the shrub layer, while drier sites have alder and hazel shrub. Ericaceous shrubs are often associated with stands dominated by conifers. Feather mosses are widespread in coniferous stands, while forbs and herbs are more associated with deciduous stands.

The peatlands are dominantly level and consist of complexes of peat plateau bogs and horizontal and water track fens. The bogs have black spruce, sphagnum moss and ericaceous shrub vegetation, while the fens have sedge, tamarack and swamp birch vegetation.

Water

The principal source of water is variable-quality groundwater from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash and glaciolacustrine deposits. Numerous lakes and ponds also provide surface sources of water. Well development from Silurian limestone bedrock aquifers are variable both in terms of quantity and quality.

Land Use

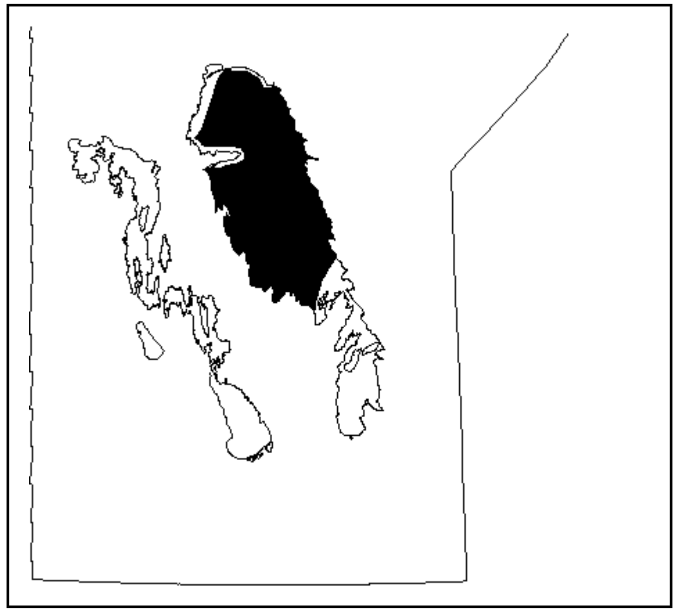
There are no settlements in the ecodistrict.

The clayey textured, Gray Luvisolic till soils and some organic soils have some potential for arable agriculture. Most of the land is public land and leased out for limited pulpwood and sawlog forestry. Other land uses are hunting and trapping. Limited water-oriented recreation takes also place. The ecodistrict provides extensive habitat for moose, deer, black bear, small mammals, songbirds and waterfowl.

White Pelicans

White pelicans nest on some low islands in Kaweenakunik (Kawinaw) Lake. The left photo shows a pelican nursery, consisting of a group of young pelicans of approximately the same age. The right photo shows adult pelicans and gulls wheeling around. The latter feed on dead pelican chicks and spoiled eggs.

676. Sturgeon Bay Ecodistrict (21 213 km²)



The Sturgeon Bay Ecodistrict consists of a land area that extends along the west side of Lake Winnipeg from Wicked Point in the north to Fisher Bay in the south, and an extensive area consisting of most of the North Basin of Lake Winnipeg, including Reindeer, Berens and Commissioner islands and some smaller islands.

Climate

This ecodistrict lies within a warmer subdivision of the Subhumid Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, moderately warm summers and long, cold winters. The mean annual temperature is 0.3°C, the average growing season is 166 days, and the number of growing degree-days is about 1430.

The mean annual precipitation is approximately 510 mm, of which slightly more than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is around 70 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

The proximity of Lake Winnipeg has a moderating effect on the climate, especially along the shore and on the islands and peninsulas. There are no climate stations in the ecodistrict.

Physiography and Drainage

The Sturgeon Bay Ecodistrict has a mean elevation of about 259 masl. The eastern half has a prominent north-south trending drumlinoid or ridge and swale topographic pattern. The fluted or grooved ridges, ranging from about 400 to 800 m wide, are separated by variable-sized swales or depressions up to 800 m wide. Following the retreat of the continental glacier, the ecodistrict was covered by glacial Lake Agassiz and consequently, the surface of this level to ridged till plain was modified by wave action and by icebergs scouring the ridges. Wave action has resulted in local textural differentiation. The drumlinized ridges tend to have a coarser texture and are more cobbly and gravelly, while the depressions have finer textured sediments. Iceberg scouring has produced strongly intersecting micro-grooves or flutes that are usually curvi-linear in surface form.

The area slopes gently northeastward to Lake Winnipeg at approximately 0.6 m per km. Local relief (ridge to swale) is approximately 0.5 to 3.0 m. Slopes are generally gentle and range from level to less than 5 percent. Level peatlands dominate the west half of the ecodistrict.

Drainage is slow due to the surface topography. As a result, a large portion of the ecodistrict is covered by shallow to deep fibric and mesic peat. Most peatlands are flat bogs and peat plateau bogs, but a considerable area consists of horizontal fen and water track fen. The ecodistrict is drained by a number of creeks and rivers which generally drain in a northeasterly direction. The ecodistrict lies in the Lake Winnipeg South watershed division, which is part of the Nelson River drainage system

Soils

Very poorly drained shallow to deep, moderately decomposed (Mesisols) organic soils are dominant. Significant areas of very poorly drained sphagnum Fibrisols occur between Sturgeon Bay and Kinwow Bay. Local soils that occur on well to imperfectly drained ridges in the area are dominantly Eluviated Eutric Brunisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay textured water-worked glacial till.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

Due to the extensive amounts of shallow and deep peatlands and poorly drained mineral soils with a peaty surface, black spruce is the dominant tree. The black spruce is associated with bogs and transitional bogs and poorly drained mineral soils. Growth on the bogs is generally less vigorous than on the mineral soils, but good growth can be encountered on peatlands consisting of mesic forest peat. The associated vegetation varies from sphagnum and feather mosses, ericaceous shrubs such as Labrador tea, leatherleaf and bog rosemary, swamp birch on bogs, to sedges, mosses, tamarack and willow on transitional bogs. Fens have vegetation dominated by tamarack, sedges, brown mosses, willow and swamp birch shrub, and occasionally some black spruce.

The uplands have a varied vegetation reflecting differences in drainage, soil texture and fire history. Stands are generally mixed with varying quantities of black spruce, jack pine, trembling aspen and white spruce. Shrubs include willow and red-osier dogwood on wetter sites and ericaceous shrubs on dry sites. Feather mosses are common as groundcover in coniferous stands. Herbs and forbs are the dominant ground cover in deciduous stands, which generally have a hazel shrub layer.

Water

The principal source of water is variable-quality groundwater from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash and glaciolacustrine deposits. Numerous lakes and ponds provide sources of surface water in the eastern half of the ecodistrict. Surface water, which includes most of the north basin of Lake Winnipeg, comprises over 80 percent of the ecodistrict. Silurian limestone bedrock aquifers are variable both in water quantity and quality.

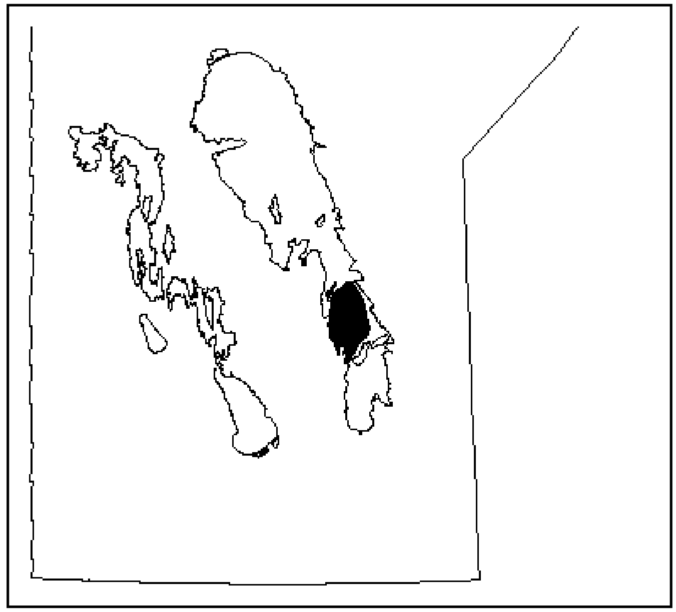
Land Use

The Dauphin River and Jackhead First Nations are the only communities in the ecodistrict.

The till and organic soils have some potential for arable agriculture. All of the land is public land and leased for pulpwood and sawlog forestry. Other uses are hunting and trapping. Water-oriented recreation is not well developed due to the lack of settlements. The ecodistrict provides extensive habitat for moose, deer, black bear, small mammals, songbirds and waterfowl.

677. Grindstone Ecodistrict (2382 km^2)

The Grindstone Ecodistrict consists of a land area along the west shore of Lake Winnipeg and part of the Lake Winnipeg Narrows area.



Climate

This ecodistrict lies within the more humid and cooler subdivision of the Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 0.9°C, the average growing season is 171 days, and the number of growing degree-days is around 1470.

The mean annual precipitation is approximately 580 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is around 50 mm. The ecodistrict has humid, cold to moderately cold, Cryoboreal soil climate.

Climate is moderated by the proximity of Lake Winnipeg. As the Pine Dock climate station is located near Lake Winnipeg, the data is probably somewhat less representative of the inland area to the west.

Selected Climate Data[1] for Pine Dock

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.0	17.3	14.5	18.9	-20.0
Precip. mm (equiv.)	610.0	248.4	369.8	71.4	32.0
Rain/Snow (mm/cm)	428.7/181.6	248.4/0.0	365.0/4.7	71.4/0.0	0.0T/32.0
Growing degree-days >5°C	N	1128.9	1484.9	431.9	N

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

Physiography and Drainage

The Grindstone Ecodistrict is a plain with a mean elevation of about 229 masl. On the mainland portion, and to some extent in the remainder of the ecodistrict, the surface has a moderate north-south trending, drumlinoid or ridge and swale topographic pattern. The ridges, ranging from about 400 to 800 metres wide, are separated by variable sized swales or depressions up to 800 m wide. Glacial deposits in the area can vary in thickness from less than 10 cm, where limestone bedrock outcrops, to well over 10 metres.

Following the retreat of the continental glacier, the ecodistrict was covered by glacial Lake Agassiz. During this time, the surface of the plain was modified by wave action and by icebergs scouring the ridges. Iceberg scouring has produced strongly intersecting micro-grooves or flutes that are usually curvi-linear in surface form. Wave action has caused the ridges to have coarse textures with very cobbly and gravelly surfaces. The depressional areas have finer textured sediments, as the lower portions of the till plain and depressions are covered by clayey sediments deposited by glacial Lake Agassiz.

Slopes are generally gentle and range from level to less than 5 percent. Regional relief over the ecodistrict changes approximately 0.6 m per km. Local relief (ridge to swale) is approximately 0.5 to 3.0 m.

Due to its topographic characteristics, most of the ecodistrict is poorly drained. As a result, the ecodistrict is extensively covered by peatlands. For example, the area around Moose Lake is dominated by extensive level peatland. The peatlands consist of flat bogs, some raised bogs and horizontal fens.

Drainage is provided by a number of creeks draining into Lake Winnipeg. The ecodistrict lies within the Lake Winnipeg watershed division, which is part of the Nelson River drainage system.

Soils

Typic (deep) Fibrisols developed on sphagnum moss peat dominate in the ecodistrict. Significant other organic soils include Typic (deep) Mesisols developed on sedge and brown moss peat. Extensive areas of Terric (shallow) Fibrisols and Mesisols developed on a variety of peat materials also occur as significant inclusions.

Upland soils are well drained Eluviated Eutric Brunisols on very strongly to extremely calcareous loamy till, imperfectly drained Gray Luvisols, and Dark Gray Chernozems on strongly calcareous, clayey, glaciolacustrine sediments which frequently overlie till at shallow depth. Significant areas of poorly drained, clayey, peaty Gleysolic soils occur in the swales and along the edges of peatlands.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

The vegetation is dominated by that associated with the peatlands. Stunted black spruce, ericaceous shrubs and sphagnum moss is the dominant vegetation on the bogs in the Moose Lake area. Sedge, tamarack and swamp birch are the dominant vegetation associated with shallow and deep fens. On clayey soils, trembling aspen with white spruce, and understorys of alder, hazel and red-osier dogwood are common. Trembling aspen, jack pine and white spruce, with a variety of shrubs, grasses and herbs are found on well drained till areas.

Water

The principal source of water is variable-quality groundwater from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash and deposits. Good quality water can be obtained from Lake Winnipeg. Well development from Silurian limestone bedrock aquifers is variable both in water quantity and quality.

Land Use

There are only a couple of hamlets along the shore of Lake Winnipeg.

The mineral and organic soils have some potential for arable agriculture. Much of the land is public land and leased for pulpwood and sawlog forestry. Other land uses include hunting and trapping. The Grindstone Point area of the ecodistrict is part of provincial recreational park, and has significant cottage development which is tied to water-oriented recreation. The ecodistrict provides habitat for moose, deer, black bear, small mammals, songbirds and waterfowl.

149. Boreal Transition Ecoregion

In Manitoba, the Boreal Transition Ecoregion consists of a narrow belt of wooded upland bordering Riding Mountain, Duck Mountain and part of the gap between Duck Mountain and Porcupine Hills. It forms a portion of the extensive deciduous forest belt that extends from southeastern Manitoba to the Peace River in north-central Alberta. The ecoregion presents a mosaic of farmland and forest, and marks the southern limit of closed boreal forest and the northern advance of commercial arable agriculture in the prairie provinces.

Climate

In Manitoba, this ecoregion is part of the Subhumid Low Boreal Ecoclimatic Region which is characterized by short, warm summers and long, cold winters. The mean annual air temperature is around 0.6 ^{o}C, the mean growing season varies with elevation but averages 171 days, and the number of growing degree-days is around 1400.

The average annual precipitation is about 480 mm. Precipitation varies greatly from year to year and is highest during the growing season. The average yearly moisture deficit is about 150 mm. The ecoregion has a subhumid, moderately cold, Cryoboreal to subhumid, cool, Boreal soil climate.

The only climate station in the ecoregion was at Roblin.

Selected Climate Data[1] for Roblin

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-21.7	-17	-10.2	1.9	10.2	14.8	17.5	16.1	10.0	4.0	-6.9	-16.4	0.2
Precip. mm	26.6	16.6	23.9	20.7	48.0	79.4	65.8	52.0	66.8	31.5	24.6	20.8	476.7
Growing degree-days	0.0	0.0	0.4	31.4	171.8	296.1	387.4	345.8	161.5	48.6	1.3	0.0	1444.3

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

Surficial Materials and Landforms

In Manitoba, this upland is comprised of Cretaceous shale, which is covered almost entirely by thick, kettle to hummocky, calcareous glacial till and fluvioglacial deposits. In Manitoba, this region encircles the prominent uplands comprising the Mid-Boreal Uplands Ecoregion and ranges in elevation from 350 masl in the gap between Duck Mountain and Porcupine Hills to 640 masl along the boundary with Riding Mountain. Associated with the rough topography of the morainic deposits are a large number of small lakes, ponds and sloughs occupying shallow depressions. These are especially common in the area south of Riding Mountain.

Soils

Well drained Dark Gray Chernozemic soils are predominant and associated with all types of deposits. Local areas of Gray Luvisols also occur in these uplands and are generally associated with clayey till and glaciolacustrine sediments, especially those found at the higher elevations. Other soils are peaty Gleysols and Organic Mesisols found in low-lying areas.

Vegetation

A closed cover of tall trembling aspen with secondary quantities of balsam poplar and an understory of mixed herbs and tall shrubs is the predominant vegetation. White spruce and balsam fir are the climax species but are not well represented because of forest fires and logging. Water-filled depressions and poorly drained sites are usually covered with sedges, willow, some black spruce and tamarack.

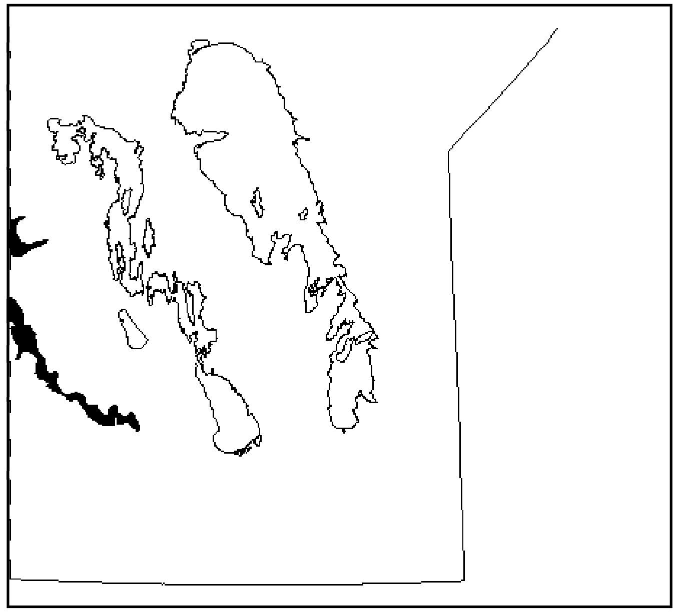
Land Use

In Manitoba, this ecoregion remains for the most part in its native state. Limited production of spring wheat, other cereals, oilseeds and hay crops are characteristic in other portions of the region. Native hay and pasture are more prevalent on the steeper slopes. The ecoregion provides habitat for white-tailed deer, black bear, moose, ruffed grouse, beaver, coyote, rabbit and waterfowl.

There is only one ecodistrict within the Boreal Transition Ecoregion in Manitoba.

709. Swan River Ecodistrict (3015 km²)

In Manitoba, the Swan River Ecodistrict coincides with the same area as the Boreal Transition Ecoregion and consists of a belt bordering Riding Mountain and Duck Mountain and part of the erosional gap between Duck Mountain and Porcupine Hills. The ecodistrict extends well into Saskatchewan and slightly less than half of the total area is in Manitoba.



Climate

This ecodistrict lies within a cooler subdivision of the Low Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, warm summers and cold winters. The mean annual air temperature is 0.6°C, the mean growing season is 171 days, and the average number of growing degree-days is around 1400.

The mean annual precipitation is approximately 480 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and peaks in early summer. The average yearly moisture deficit is about 150 mm. The district has a subhumid, moderately cold, Cryoboreal soil climate.

The only climate station in the ecodistrict was at Roblin, which is now closed. Climate data from the station at Swan River is also valid for the district, especially for the area between the Duck Mountain and Porcupine Hills (See 717. Swan Lake Ecodistrict).

Selected Climate Data[1] for Roblin

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	0.2	16.1	3.7	17.5	-21.7
Precip. mm (equiv.)	476.7	197.2	312.0	65.8	26.6
Rain/Snow (mm/cm)	351.1/124.0	197.2/0.0	306.2/5.5	65.8/0.0	0.0/25.7
Growing degree-days >5°C	1444.0	1029.0	1363.0	387.0	0.0

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

Physiography and Drainage

The Swan River Ecodistrict is a narrow wooded upland belt bordering Riding Mountain, Duck Mountain and Porcupine Hills, and extends westward into Saskatchewan. Within Manitoba, elevations of this hummocky morainal upland range from about 580 to 610 masl along the boundary with Riding and Duck mountains to about 350 m in the gap between Duck Mountain and Porcupine Hills. Slopes within the upland are moderately steep, ranging from 5 to about 15 percent, and range in length from 50 to 100 m. Local relief in the upland exceeds 30 m in some places.

Parts of the ecodistrict are dissected with deep channels and gullies. Some are tributary to the Swan River in the erosional gap between Duck Mountain and Porcupine Hills. The Shellmouth, Assiniboine, Birdtail and Minnedosa (Little Saskatchewan) rivers and Boggy Creek, course south and southeasterly from Duck Mountain and Riding Mountain. Portions of these rivers are deeply incised and relief along these portions exceeds 60 m.

Drainage is provided by the rivers listed, which belong primarily to two drainage divisions. The northern sector is part of the Dauphin River division, while the area south of Riding Mountain lies in the Assiniboine division. Both divisions are part of the Nelson River drainage system.

Soils

Well drained Chernozemic Dark Gray soils that have developed on calcareous, loamy to clayey textured glacial till predominate. Chernozemic Dark Gray soils also occur on fluvioglacial deposits and on sandy relic beaches. Local areas of well drained Gray Luvisols, generally associated with clayey till and pockets of glaciolacustrine sediments, occur at higher elevations. Poorly drained peaty Gleysolic soils and shallow (Terric), moderately decomposed organic soils occur in depressions which are widespread in some parts of the ecodistrict.

Vegetation

A closed cover of tall trembling aspen with secondary quantities of balsam poplar and an understory of mixed herbs and tall shrubs is the predominant vegetation. White spruce and balsam fir are the climax species but are not well represented because of logging and wildfires. Water-filled depressions and poorly drained sites are usually covered with sedges, willow, some black spruce and tamarack.

Water

The principal sources of water are variable quality groundwater and surface water from the numerous rivers and creeks emanating from the uplands. The groundwater occurs primarily in shallow, stratified, sandy and gravelly surface deposits and sandy and gravelly aquifers associated with till and inter-till deposits. Because of the variable concentrations of salt, well development is variable from the Swan River bedrock formation, which underlies the glacial deposits. In this formation, salt concentrations in water from sources 30 to 60 m below the surface may exceed 4000 mg/l.

Land Use

Kenville, Durham and Benito are small agriculture-based communities in the northern sector. In the southern sector there are several settlements of which the towns of Roblin and Erickson are the largest.

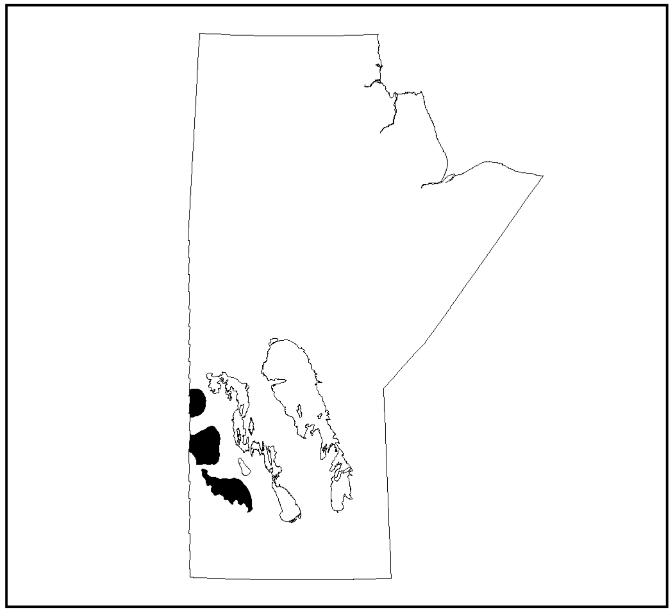
Gently sloping land is used for the production of spring wheat, other cereal grains, oil seeds and hay crops. More steeply sloping farmland is used for livestock pasture and native hay. Forest resources are used for wood pulp and local sawlog forestry. Wetlands are important breeding habitat for waterfowl. Wooded valleys provide habitat for deer, wapiti, black bear, many small mammals and songbirds.

Shell River Valley

The Shell River Valley is a large glaciofluvial meltwater channel originating in the Duck Mountain Upland (Ecodistrict 715). The west facing valley wall is a patchwork of vegetation communities. Shrubs and hardwoods occur in the gullies and on the lower slopes, and grass and herb vegetation occur on the exposed, drier ridges and upper slopes.

152, 153, 154. Mid-Boreal Uplands Ecoregion

The Manitoba portion of the Mid-Boreal Uplands Ecoregion occurs as three separate elevated uplands along the Manitoba Escarpment known as the Porcupine Hills, Duck Mountain and Riding Mountain.



Climate

These three uplands are part of the extensive Subhumid Mid-Boreal Ecoclimatic Region that extends from Lac Seul in northwestern Ontario, across central Manitoba and Saskatchewan to the foothills of the Rocky Mountains in northern Alberta and southern Yukon Territory. The climate is marked by short, warm summers and long, cold winters. The mean annual air temperature ranges from 0.4 to 1.2^{o}C. The average growing season is about 173 days, while the number of growing degree-days ranges from about 1400 to 1500.

The average annual precipitation is around 500 mm. It varies greatly from year to year and also varies greatly across the uplands. Precipitation is highest during the growing season. Average yearly moisture deficits range from less than 100 mm to over 130 mm. The regions have a moderately cold to cold, subhumid to humid Cryoboreal soil climate.

The only continuous long-term climate station in Manitoba is located at Wasagaming on the Riding Mountain Upland. Data from this station is relevant for that area, but not for the uplands farther north. The station at Birch River is located a short distance outside the Porcupine Hills and at a lower elevation, but is probably still moderately relevant for this most northern component of the ecoregion.

Selected Climate Data[1] for Wasagaming

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-20.0	-16.0	-9.2	1.3	8.9	13.8	16.5	14.9	9.2	3.0	-7.2	-16	0.0
Precip. mm	18.6	18.4	2.2	33.4	45.8	82.4	70.9	72.9	58.7	36.7	23.2	21.8	508.0
Growing degree-days	N	0.0	0.1	N	N	263.0	356.0	310.0	N	29.3	N	N	N

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

Selected Climate Data[1] for Birch River

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-21.2	-16.3	-10.2	1.9	9.9	14.7	17.5	15.9	10.2	4.9	-6.4	-16.1	0.4
Precip. mm	19.3	23.6	35.3	32.3	33.0	77.2	58.4	57.5	45.5	26.6	35.5	30.3	474.5
Growing degree-days	0.0	0.0	0.2	36.2	165.1	293.5	386.7	338.9	162.0	56.9	2.2	0.0	1441.7

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

Surficial Materials and Landforms

In Manitoba, this ecoregion occupies the higher parts of the Riding Mountain (405 to 720 masl), Duck Mountain (the highest upland at 540 to 830 masl) and Porcupine Hills (400 to 780 masl). These Cretaceous shale outliers occur along the dip slope of the Manitoba Escarpment and are covered entirely by kettled and dissected, deep, loamy to clayey textured glacial deposits. Overlying some of these glacial deposits are clayey glaciolacustrine sediments and coarse textured and gravelly glaciofluvial deposits. Depressional areas may contain shallow to deep, largely moderately decomposed peat materials. Slopes range from about 10 to over 30 percent. Associated with the topographically rougher, morainal deposits are a large number of small lakes, ponds and sloughs occupying deep to shallow depressions.

Drainage for these upland areas is multi-directional via creeks draining into larger rivers skirting the uplands. Although these uplands are part of many smaller watersheds, at a broader level, the south half of Riding Mountain upland is part of the Assiniboine River watershed, and the northern half is part of the Dauphin River watershed. Both the Duck Mountain and Porcupine Hills uplands are part of the Dauphin River watershed. Both watersheds are part of the Nelson River drainage system.

Soils

Well drained Gray Luvisolic soils are dominant in the ecoregion and are associated with moderately calcareous, fine loamy to clayey till and the more limited calcareous clayey glaciolacustrine sediments. Significant inclusions are peaty phase Humic Gleysols, and shallow to deep Organic Mesisols in poorly drained depressions. Eutric Brunisols and Dark Gray Chernozems are associated with coarse textured to gravelly glaciolacustrine deposits.

Vegetation

This mixed forest ecoregion is characterized by medium to tall closed stands of trembling aspen and balsam poplar and extensive white spruce, balsam fir and black spruce stands occurring throughout, but especially as stands in later successional stages. Jack pine occurs throughout, but generally is more prevalent on drier sites while white birch is locally significant. Deciduous species tend to be more abundant in the more southerly Duck and Riding mountains sections. Deciduous and mixed stands generally have diverse understories of shrubs and herbs, while coniferous stands tend to promote feather moss-dominated groundcover. Cold and poorly drained fens and bogs respectively support tamarack and black spruce stands of varying densities.

Wildlife

The uplands comprising the ecoregion provide extensive and good quality habitat for many species of wildlife. Wapiti, moose, black bear, wolf, lynx, snowshoe hare and beaver are common throughout. Several species of raptors, including bald eagle, and many species of songbirds are present. Wetlands provide habitat for ducks and geese.

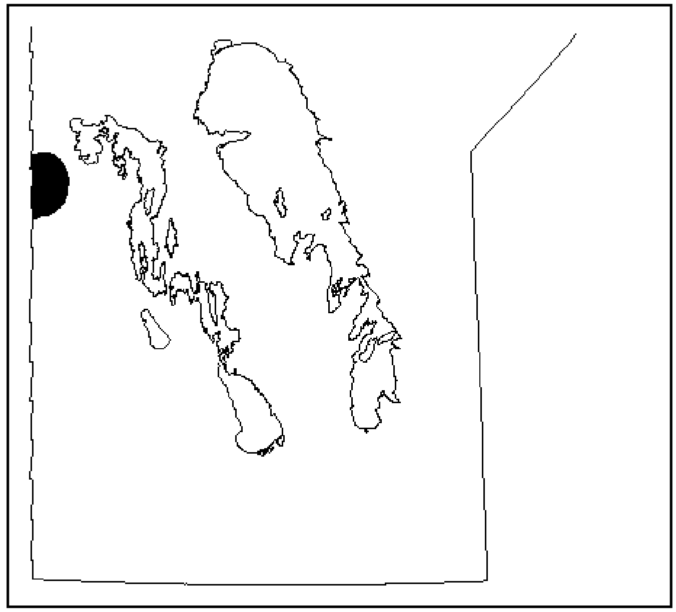
Land Use

Most of these uplands are held as national park land (Riding Mountain), and as provincial park and forest reserve land (Duck Mountain and Porcupine Hills). Sawlog forestry has a long history in the Duck Mountain and Porcupine Mountain areas. The use of trembling aspen for the manufacture of oriented strandboard is a recent additional use of the forest resource use. Recreation in the form of cottaging is generally concentrated around the lakes, and is associated with water recreation such as boating, fishing and water skiing. Recreational, and to some extent, subsistence hunting, are additional land uses. These areas are generally not used for agriculture.

There are three ecodistricts within the Mid-Boreal Uplands Ecoregion in Manitoba.

714. Porcupine Hills Ecodistrict (2045 km^2)

The Porcupine Hills Ecodistrict straddles the border with Saskatchewan. Only about one-fifth of the ecodistrict is located within Manitoba.



Climate

This ecodistrict is located in a cooler, more humid subdivision of the Mid-Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, warm summers and long, cold winters. Because of the topography of the district, precipitation, temperature and growing season length vary considerably from area to area. The higher elevations tend to be cooler and wetter than the lower slopes. The mean annual air temperature is about 0.4^{o}C, the mean growing season is 169 days, and the number of growing degree-days is about 1320.

The mean annual precipitation is around 480 mm, of which less than one-third falls as snow. Precipitation varies greatly from year to year, but peaks in early summer. The average yearly moisture deficit is about 130 mm. The ecodistrict has a humid, cold, Cryoboreal soil climate.

The ecodistrict has no climate station. Therefore the above data, extrapolated from a station at a lower elevation, may underestimate total precipitation and overestimate the growing season length and number of growing degree-days.

Physiography and Drainage

The Porcupine Hills Ecodistrict is the northernmost of the three upland outliers that comprise the Mid-Boreal Uplands Ecoregion within Manitoba. It occurs along the dip slope of the Manitoba Escarpment and extends westward into Saskatchewan. The elevations of this hummocky moraine-covered upland range from about 400 masl along its boundary with the Manitoba Plain to about 760 masl at its highest point.

The Porcupine Hills Ecodistrict is characterized by steep southeast, east and northeast faces that rise about 300 m from their base at 400 masl to an elevation of 700 masl within a span of about 4 to 6 km. The upland dips westward at the rate of about 3.9 m per km. Local slopes within the ecodistrict range from 15 to over 30 percent, and are from 50 to more than 100 m in length. Local relief within the hummocky till areas exceeds 30 m in some places. The slopes along the edge of the upland, especially the steep faces on the eastern side, are dissected with many deep channels and gullies. Local relief along portions of these valleys exceeds 60 m.

Drainage is multi-directional. Many creeks and small rivers drain the ecodistrict into rivers flowing in the surrounding area. The Whitefish River in the southwest and the Steeprock River in northeast are some of the larger drainage ways. The ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Well drained Gray Luvisolic soils developed on calcareous, loamy to clayey textured glacial till are dominant. Gleyed Gray Luvisols are widespread on lower slopes and in depressions and grade into local areas of poorly drained Luvic Gleysols and some peaty Gleysols. Mesic and Fibric organic soils occur locally in depressions as well. Well drained Dark Gray Chernozemic soils also occur, but are limited to dry sites.

Vegetation

The vegetation of this ecodistrict is characterized by a mixture in varying proportions of deciduous and coniferous species. As the ecodistrict is the most northern of the three districts in Manitoba, the coniferous component is somewhat stronger than in the other two districts.

Before logging and recent major fires affected the forest cover over significant areas, old stands of tall, well-grown white spruce and balsam fir were widespread throughout the ecodistrict. As a result of these disturbances, trembling aspen and some balsam poplar, and jack pine on drier sites, are now much more widespread and dominate the forest cover over significant acreages. White birch is dominant locally, especially on slopes along the east face. Black spruce is confined largely to wet, poorly drained localities and bog peatlands. Understory vegetation and ground cover vegetation varies with stand mixture and site quality.

Water

The principal source of water is surface water from the many lakes and ponds throughout the district. Significant supplies of variable quality groundwater are available from small sandy and gravelly aquifers in the glacial till, intertill and glacial outwash deposits. The shale bedrock underlying the till yields very little water.

Land Use

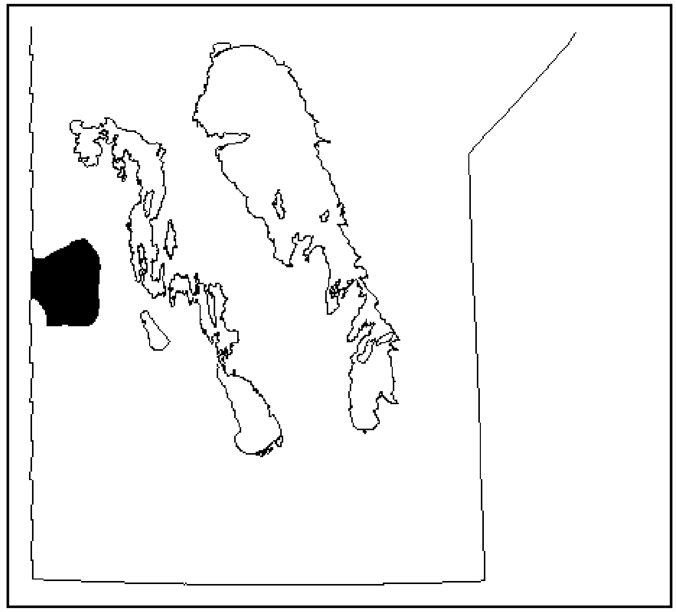
There are no settlements in the ecodistrict.

Most of the Porcupine Hills Ecodistrict is not well suited to arable agriculture. This public land has been retained for forestry, hunting and water oriented recreation. Limited areas around the southern periphery of the area are used for the production of cereal grains, oil seeds and hay crops. Portions of the steeply sloping valleys and benchlands are used for livestock pasture and native hay. The ecodistrict provides extensive habitat for wildlife such as moose, elk and black bear. Other wildlife includes wolf, marten and snowshoe hare. Wetlands are important breeding habitat for waterfowl.

Porcupine Hills

The Porcupine Hills are extensively covered with a mixture of hardwoods and softwoods. Some of the best white spruce stands in the province were found on this upland, before logging and wildfire diminished their distribution.

715. Duck Mountain Ecodistrict (4866 km²)



The Duck Mountain Ecodistrict straddles the border with Saskatchewan, with only a small portion lying outside Manitoba.

Climate

This ecodistrict is located in a cooler, more humid subdivision of the Mid-Boreal Ecoclimatic Region belt in Manitoba. The climate is characterized by short, moderately warm summers and long, cold winters. Because of the topography of the district, temperature, precipitation and frost free period vary significantly from area to area. The higher elevations tend to be cooler and wetter than the lower slopes. The mean annual air temperature is about -0.3°C, the mean growing season is 174 days, and the number of growing degree-days is about 1500.

The mean annual precipitation is approximately 500 mm, of which nearly one-quarter falls as snow. Precipitation varies greatly from year to year and peaks in early summer. The average yearly moisture deficit is about 135 mm. The ecodistrict has a humid, cold, Cryoboreal soil climate.

Since there is no climate station in the ecodistrict, the above climate data is an estimate derived from stations in the surrounding area and is adjusted accordingly. Precipitation may be underestimated while the number of growing degree-days may be overestimated.

Physiography and Drainage

Situated on the Manitoba Escarpment, the Duck Mountain Ecodistrict reaches the highest elevation of the three upland outliers forming the Mid-Boreal Upland Ecoregion in Manitoba.

Elevations of this hummocky, moraine-covered upland range from about 450 masl along its eastern base to 831 masl at Baldy Mountain, the highest point on this upland and the highest point in Manitoba. The area dips westward from Baldy Mountain at the rate of about 3.1 m per km. Slopes range from 10 to about 15 percent, but are locally much steeper. Slope lengths range from 50 to more than 100 m. Local relief in areas with stronger hummocky topography exceeds 30 m.

This upland has steep faces along its eastern and northern boundaries that overlook the Manitoba Plain some 550 to 300 m below. Elevations rise 150 to 250 m over 4 to 6 kms along broken slopes. These areas are also dissected with many deep channels and gullies and local relief along portions of these valleys exceeds 60 m.

The most widespread surficial deposits are loamy to clayey till materials. Other clayey sediments include glaciolacustrine materials which can be found in depressions and also covering some upland till materials. Gravelly and sandy glaciofluvial materials are limited in extent. Alluvial deposits are found along the many rivers and creeks. Peatlands are largely small basin bogs, but shore fens are also present.

Drainage from this ecodistrict is multi-directional through the many creeks and rivers which drain into rivers flowing through the lowlands around the ecodistrict. The Shell River in the southwest and the Favel River in northern sector are two of the larger drainage ways. The western sector of the ecodistrict is part of the Assiniboine River drainage division and the remainder is part of the Dauphin River division. Both are part of the Nelson River drainage system.

Soils

Well to imperfectly drained Gray Luvisolic soils developed on calcareous, loamy to clayey textured glacial till dominate the ecodistrict. Gray Luvisols are also associated with calcareous, clayey glaciolacustrine sediments. Local areas of well drained Dark Gray Chernozems are found on sandy areas, especially in the southwestern sector, while poorly drained Luvic Gleysolic soils occur in and around depressions.

Shallow (Terric) and deep (Typic), moderately well decomposed Mesisols are found on peat deposits formed in poorly drained, small and medium sized basins, that are generally underlain by clayey glaciolacustrine sediments. Calcareous, sandy and gravelly glaciofluvial deposits support Eutric Brunisols on the higher upland, but support Chernozemic Dark Gray soils in the western sector.

Vegetation

The vegetation is characterized by a mixture of deciduous and coniferous species in varying proportions. This ecodistrict has a higher component of trembling aspen, balsam poplar and white birch than the Porcupine Hills to the north.

Before logging and recent major fires affected the forest cover significantly, old stands composed of tall, well grown white spruce and balsam fir were widespread. As a result of these disturbances, trembling aspen and some balsam poplar, and jack pine on drier sites, mixed with younger white spruce, now form the dominant forest cover over extensive areas.

Some of the forest stands in the Duck Mountain Ecodistrict are the fastest growing forest stands in the province. White spruce and trembling aspen can attain diameters of 90 cm or more and heights of 30 m on favourable sites.

White birch is locally widespread, especially in areas along the east face. Black spruce is confined largely to wet, poorly drained localities and to the few bog peatlands, but it is also found in mixtures with white spruce and trembling aspen on moist sites. Understory vegetation and ground cover vegetation vary with stand mixture and site quality and aspect. North facing slopes on fine textured soils have more moss under coniferous stands, while south and west facing slopes have hazel shrub and herbs under mixed forest stands.

Water

The principal source of water is the numerous lakes and ponds found throughout the ecodistrict. Significant supplies of variable quality groundwater are found in small sandy and gravelly aquifers in the glacial till, inter-till and glacial outwash deposits as well. The shale bedrock underlying the till yields very little water.

Land Use

The only settlements in the ecodistrict are the hamlets of Boggy Creek and San Clara on the west side.

Most of the land is not well suited to arable agriculture due to climate and steepness of slopes. Therefore, most of the ecodistrict has been retained as the Duck Mountain Provincial Forest Reserve and Duck Mountain Provincial Park.

Sawlog forestry is carried out throughout the ecodistrict. The importance of trembling aspen as a forest resource has increased significantly since the establishment of an oriented strandboard factory in the Swan River area.

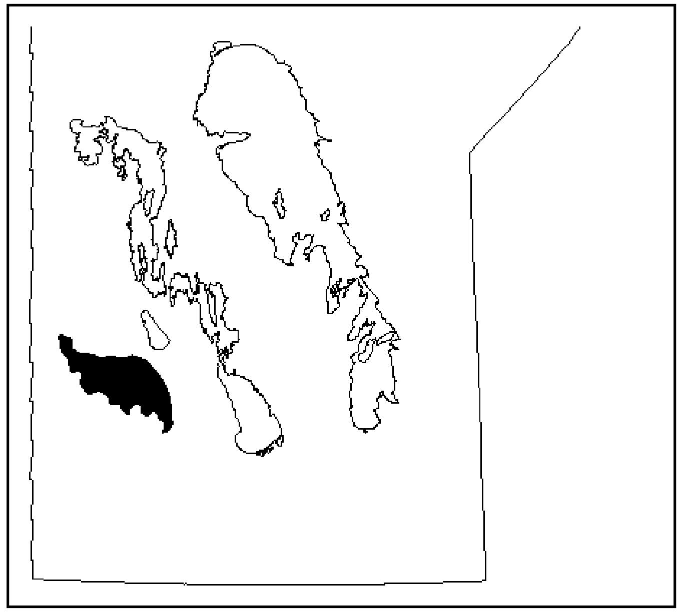
Cottage development, associated with water-oriented recreation such as boating and fishing, is extensive around some lakes and is expanding. Other recreational activities in the district include camping and hunting.

Limited sections along the periphery of the ecodistrict are used for the production of cereal grains, oil seeds and hay crops. The steeply sloping valley walls, benchlands and poorly drained alluvial soils are used for livestock pasture and native hay.

The ecodistrict provides extensive and varied habitat for many species of wildlife. Elk (wapiti), moose, white-tailed deer and black bear are common species in the district. Other wildlife includes members of the marten family, beaver, snowshoe hare, various raptors, jays and many species of songbirds. The wetlands are important breeding habitat for waterfowl.

716. Riding Mountain Ecodistrict (4700 km^2)

The Riding Mountain Ecodistrict is the most southerly of the three uplands comprising the Mid-Boreal Uplands Ecoregion in Manitoba. This ecodistrict is totally confined to Manitoba.



Climate

This ecodistrict is situated within a more humid and cooler outlier or subdivision of the Mid-Boreal Ecoclimatic Region within Manitoba. The climate is characterized by short, warm summers and long, cold winters. The precipitation, temperature and length of growing season vary significantly from area to area because of the topography. The mean annual air temperature is 1.2^{o}C, the mean growing season is 173 days, and the number of growing degree-days is about 1400.

The mean annual precipitation is about 500 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and peaks in early summer. The average yearly moisture deficit is nearly 100 mm. The ecodistrict has a humid, cold, Cryoboreal soil climate.

The only long-term climate station is located at Wasagaming in the southern part of the ecodistrict.

Selected Climate Data[1] for Wasagaming

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	0.0	15.1	12.7	16.5	-19.7
Precip. mm (equiv.)	508.0	226.2	330.7	70.9	18.6
Rain/Snow (mm/cm)	376.9/134.9	226.2/0.0T	327.3/3.5	70.9/0.0	19.6/0.0T
Growing degree-days >5^{0}C	N	928.8	N	356.0	N

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

Physiography and Drainage

Located on the dip slope of the Manitoba Escarpment, the Riding Mountain is the southernmost of the three wooded uplands that comprise the Mid-Boreal Uplands Ecoregion in Manitoba.

Elevations of this hummocky moraine-covered upland range from about 450 masl to 716 masl at its highest point. Slopes within the upland are moderately steep, ranging from 5 to about 15 percent and range in length from 50 to 100 m. Local relief may exceed 30 m. The ecodistrict is dissected by many deep channels and gullies, particularly along its steeply sloping eastern and northern faces that overlook the Manitoba Plain some 300 to 400 m below. Local relief along portions of these valleys exceeds 60 m.

Drainage is multi-directional through many small rivers and creeks. The Ochre River in the northeast, Vermillion River in the north-central and Birdtail Creek in the southwest are some of the larger drainage ways. The northern part lies in the Dauphin River drainage division while the remainder is part of the Assiniboine River drainage division. Both divisions are part of the Nelson River drainage system.

Soils

Well drained Gray Luvisolic soils developed on calcareous, loamy to clayey textured glacial till are dominant in the ecodistrict. Local areas of well drained Chernozemic Dark Gray, poorly drained peaty Gleysolic soils and shallow (Terric), moderately decomposed (Mesisols) organic soils also occur.

Vegetation

The vegetation is characterized by a mixture of deciduous and coniferous trees in varying proportions. Before most of the ecodistrict was turned into a national park, logging removed many of the stands of tall, well grown, white spruce and balsam fir. As result of this disturbance, trembling aspen and some balsam poplar, and jack pine on drier sites, mixed with younger white spruce, now form the dominant forest cover over extensive areas. Some of the forest stands in the Riding Mountain are the fastest growing forest stands in the province. White spruce and trembling aspen can attain diameters of 90 cm or more and heights of 30 m on favourable sites. Black spruce, although only widespread in wet, poorly drained localities and in the few bog peatlands, is also found in mixtures with white spruce and trembling aspen on moist sites.

Understory vegetation and ground cover vegetation varies with stand mixture, site quality and aspect. North facing slopes on fine textured soils have more moss ground cover under coniferous stands, while south and west facing slopes have hazel shrub and herbs under mixed forest stands. In the western sector, drier conditions produce a vegetative cover consisting of forest groves or small stands of trembling aspen and white spruce intermixed with grassland on the driest parts.

Water

The principal source of water is the numerous small lakes and ponds in the ecodistrict. Significant supplies of variable quality groundwater are found in small sandy and gravelly aquifers in the glacial till, inter-till and outwash deposits. The shale bedrock underlying the till yields very little water.

Land Use

Most of this hummocky upland is occupied by the internationally renowned Riding Mountain National Park. The park provides many opportunities for land and water based recreation during the summer and is also a popular destination for winter camping, cross-country skiing and downhill skiing. Cottage development outside the park around small lakes is expanding.

Settlements are generally small. Wasagaming, located within the park, has a small permanent population, but grows considerably in the summer with cottagers and tourists. Onanole is another community in the ecodistrict. There is also one First Nation community in the ecodistrict - Keeseekoowenin.

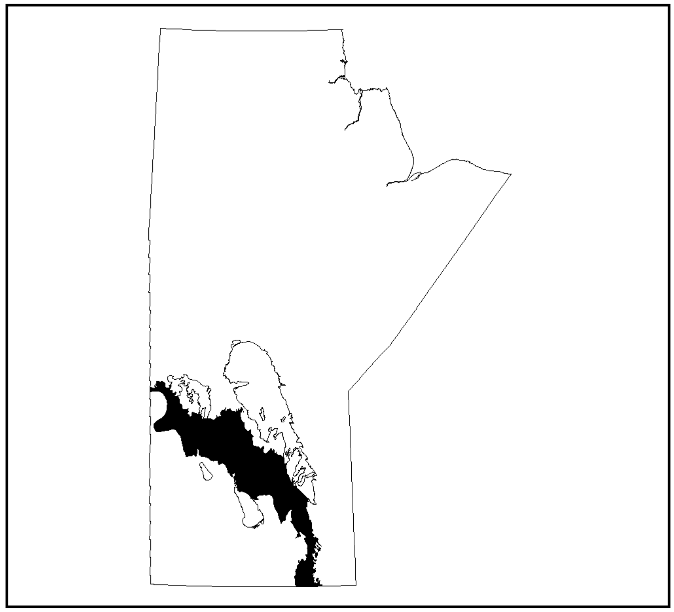
Soils are not well suited to, and are not used for, arable agriculture because of climate and steepness of slopes.

The park and surrounding area also provide extensive and varied habitat for many species of wildlife. Elk (wapiti), moose, white-tailed deer and black bear are common. Wolf is also present, as are several species belonging to the marten family, beaver, snowshoe hare, coyote and red fox. Several species of raptors may be found in the ecodistrict, as well as spruce grouse, Canada jay and many songbird species. Wetlands are important breeding habitat for waterfowl.

Wapiti or elk

Elk are found in large numbers in the Riding and Duck Mountain areas. They occur in small numbers in areas such as Spruce Woods Provincial Park (Shilo Ecodistrict 757).

155. Interlake Plain Ecoregion



The Interlake Plain Ecoregion extends in a broad arc from the USA-Canada border at the southeastern edge of the Manitoba Plain, northwestward across the southern Interlake/Westlake region to the Saskatchewan border at Red Deer Lake. It is a mosaic of farmland and forest marking the southern limit of closed, mixed boreal forest and northern and eastern extent of commercial agriculture.

Climate

This ecoregion forms a portion of the extensive Subhumid Low Boreal Ecoclimatic Region that extends from southeastern Manitoba to the Peace River in north-central Alberta. The climate is marked by short, warm summers and fairly long, cold winters. In Manitoba, the mean annual air temperature ranges from 1.1 to 2.4°C, the average growing season varies from 173 to 184 days, and the number of growing degree-days ranges from about 1400 to 1700.

The average annual precipitation ranges from slightly less than 500 to near 525 mm, and varies greatly from year to year. Precipitation is highest during the growing season. Average yearly moisture deficits range from 85 to nearly 175 mm. The ecoregion is characterized by a subhumid, moderately cold to cold, Cryoboreal soil climate.

Climatic data for three stations are presented. The Steinbach station represents the southern part of the ecoregion, the Gypsumville station represents the central and northeastern portion, and the Swan River station represents the northwestern part. The data from the Gypsumville station only covers the period 1966 to 1980.

Selected Climate Data[1] for Gypsumville

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-20.7	-16.8	-8.7	1.9	10.1	15.1	18.0	16.3	11.1	4.3	-5.8	-16.1	0.7
Precip. mm	22.1	13.8	18.9	17.3	34.0	58.8	63.6	63.6	51.3	25.1	25.9	24.0	418.4
Growing degree-days	0.0	0.0	0.5	35.3	167.1	299.1	405.6	358.0	179.2	59.3	3.4	0.0	1507.5

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

Selected Climate Data[1] for Steinbach

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.0	-14.7	-6.7	3.9	11.5	16.7	19.5	18.1	12.1	5.8	-4.4	-14.3	2.4
Precip. mm	23.4	13.3	20.8	31.8	63.2	86.1	75.0	65.6	56.0	34.5	19.9	20.0	509.7
Growing degree-days	0.0	0.0	1.8	57.1	208.5	347.3	454.1	403.0	218.0	76.5	4.3	0.0	1771.0

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

Surficial Deposits and Landforms

Lying within the Manitoba Plain, this ecoregion is underlain by low relief, flat-lying Palaeozoic limestone rock and is lower and smoother than the Saskatchewan Plain to the west. The surface of the plain has an elevation ranging from about 410 masl near the Manitoba Escarpment at its northwestern extreme to 218 masl at Lake Winnipeg. Its general surface form is that of a level to ridged lake terrace complex.

Selected Climate Data[1] for Swan River

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.8	-15.1	-7.9	2.5	10.6	16.0	18.5	17.1	10.9	4.7	-6.0	-15.5	1.4
Precip. mm	24.3	17.8	29.7	29.6	46.2	71.9	79.7	63.9	55.3	30.4	24.5	25.5	498.9
Growing degree-days	0.0	0.0	0.6	41.1	186.6	331.1	419.7	374.6	179.9	54.6	2.0	0.0	1590.0

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

Much of the Interlake/Westlake section has a distinct, low relief, north to south trending drumlinoid or ridge and swale topographic pattern with slopes that range from 1 to 3 percent. Surface deposits are comprised of extremely calcareous, very stony, water-worked loamy glacial till.The till materials are deep (>30 m) to very shallow (<20 m) over limestone bedrock.

East and southeast of this lowland region, the water-worked till has been smoothed over by thin, discontinuous veneers and blankets of sandy to clayey glaciolacustrine sediments as well as sandy to gravelly beach materials and bouldery near-shore deposits. Till-covered, thick, coarse textured fluvioglacial deposits also occur in places from Birds Hill south to the USA border. Limestone bedrock is at or near the surface of erosional remnants, scarps and drumlinoid ridges.

The ecoregion contains a number of large to very large lakes including lakes Winnipeg, Winnipegosis and Manitoba, as well as all of Waterhen, St. Martin and Red Deer lakes. Beaches marking successively lower water levels of glacial Lake Agassiz wind along the lower slopes of Duck Mountain and Porcupine Hills. The Red River flows through the area from the south into Lake Winnipeg, and the Swan and Red Deer rivers enter this plain from the escarpment in the northwest section of the region.

Soils

Well to imperfectly drained Chernozemic Dark Gray soils are predominant in the ecoregion. Significant inclusions are well to imperfectly drained Chernozemic Black soils, especially in the southern and northwestern parts of the ecoregion. These soils are associated with both the very to extremely calcareous, clayey glaciolacustrine overlays. Eutric Brunisols, shallow Gray Luvisols on till and some glaciolacustrine deposits, Organic Mesisols on the peatlands and peaty phase Humic Gleysols in transitional areas occupy significant portions of the central and northern sections. The central portion is also characterized by locally widespread, very shallow Eutric Brunisols over limestone bedrock.

Vegetation

A closed cover of trembling aspen of varying quality with secondary quantities of balsam poplar and an understory of mixed herbs and tall shrubs is predominant. In the Interlake, trembling aspen stands are often of poor growth with poorly formed trees, likely due to the extreme calcareousness of the soils. White spruce and balsam fir are the climax species but are not widely represented because of fires. However, they do exhibit moderate to good growth through most of the ecoregion except on very dry sites or sites with very shallow soils. Open stands of medium to tall jack pine occur on dry, sandy sites. Water filled depressions and poorly drained sites are usually covered with sedges, willow, some black spruce and tamarack.

Wildlife

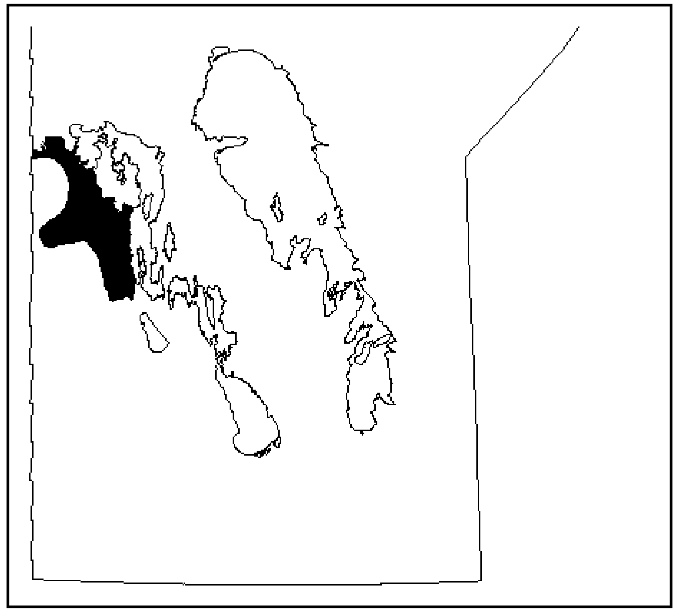
The ecoregion contains extensive habitat for white-tailed deer, black bear, moose, ruffed grouse, beaver, coyote, snowshoe hare and waterfowl. White-tailed deer populations have benefited from the development of arable agriculture which provides a varied habitat for this species.

Land Use

Production of spring wheat, other cereal grains, oilseeds and hay crops dominate the agriculture of the ecoregion on the more suitable glaciolacustrine soils. Native hay and pasture are more prevalent on the stony, glacial till soils of the Interlake and Westlake sections of the plain.

There are six ecodistricts within the Interlake Plain Ecoregion.

717. Swan Lake Ecodistrict (7314 km^2)



The Swan Lake Ecodistrict is located west of Lake Winnipegosis in the northwestern corner of the Interlake Plain Ecoregion and extends a short distance into Saskatchewan.

Climate

This ecodistrict lies within the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region in Manitoba. Summers are short and warm, while winters are cold. The mean annual temperature is 1.1^{o}C, the average growing season is 174 days, and the number of growing degree-days is 1430.

The mean annual precipitation is approximately 500 mm, of which nearly one-third falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 120 mm. The district has a humid, cold to moderately cold, Cryoboreal soil climate.

Data from the climate station at Swan River is valid for the area around Swan River and to the south, but is likely less representative of the most northern sector.

Selected Climate Data[1] for Swan River

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	1.4	17.2	14.6	18.5	-18.8
Precip. mm (equiv.)	498.9	215.5	317.0	79.7	24.3
Rain/Snow (mm/cm)	358.9/139.2	215.5/0.0	311.2/5.7	79.7/0.0	24.2
Growing degree-days >5^{0}C	1590.0	1125.4	1491.9	419.7	0.0

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

Physiography and Drainage

The Swan Lake Ecodistrict is situated east of (below) the Manitoba Escarpment (Kenville Escarpment). The mean elevation along the western boundary of the ecodistrict is about 290 masl and declines to about 255 masl along the shore of Lake Winnipegosis.

The ecodistrict is dominantly a smooth, level to very gently sloping alluvial and glaciolacustrine plain with slopes ranging from level to 2 percent. The slopes are gentle to the northeast at approximately 2.0 to 3.0 m per km. Local relief of approximately 3 to 5 m occurs along the Woody and Swan rivers. Along the numerous meandering streams and creeks emanating from the Duck Mountain and Porcupine Hills, river bank erosion has resulted in local relief of 5 to 10 m. The ecodistrict is subject to flooding in spring and after heavy summer storms which causes further erosion of channels and roadside ditches that carry runoff from the escarpment.

The whole ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Nearly all of the soils in the Swan Lake Ecodistrict are imperfectly drained, Gleyed Rego Black and Gleyed Dark Gray Chernozems that have developed on shallow, very strongly calcareous, sandy loam to clayey textured glaciolacustrine sediments and glacial till. Significant local areas of poorly drained peaty Gleysolic soils and shallow organic soils are found in depressional areas, while areas of imperfectly drained, Gleyed Regosols are found on alluvial sediments.

Vegetation

The dominant forest cover is trembling aspen and balsam poplar growing on well to imperfectly drained sites on glaciolacustrine and till deposits. These areas are also very suitable for agriculture, and consequently, the extent of forest cover has been severely reduced. Sandy areas support jack pine forests, while maple and green ash grow along rivers and on alluvial flats. White spruce is also present, but is more widespread on somewhat higher elevations and is often mixed with trembling aspen. Peaty areas generally have a vegetation of willow and sedges, but black spruce and tamarack are found on deeper and better developed peatlands.

Water

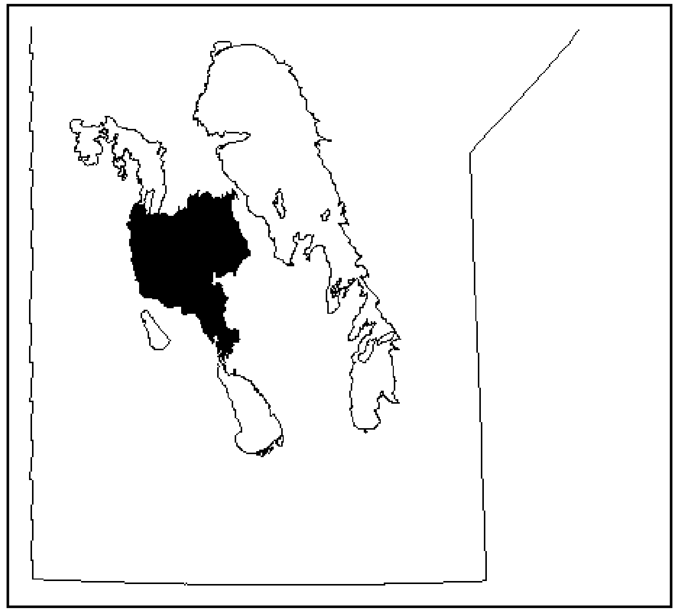
The principal sources of water are variable quality groundwater and surface water from Swan Lake, the Woody and Swan rivers and the numerous creeks and streams emanating from the escarpment. The groundwater is available from shallow, stratified, sandy and gravelly surface deposits and sandy and gravelly aquifers associated with till and inter-till deposits. Well development is variable from the Swan River bedrock formation because of variable concentrations of salt in these waters. This formation lies below the glacial deposits and at 30 to 60 m below the surface, and salt concentrations of water in this formation can exceed 4000 mg/l.

Land Use

There are several settlements in the ecodistrict. The town of Swan River is the largest and is the service centre for the ecodistrict and surrounding area. The settlement of Minitonas is expanding as a result of the recent establishment of an oriented strand board plant, which uses large quantities of trembling aspen from Duck Mountain and surrounding areas including the ecodistrict itself. Wuskwisipihk and Pine Creek are two First Nation communities in the ecodistrict.

Most of the soils in the Swan Lake Ecodistrict are cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Areas where drainage has not been improved are used for native pasture and hay. The wooded areas provide habitat for white-tailed deer, moose, black bear, ruffed grouse and songbirds.

718. Waterhen Ecodistrict (11 423 km²)



The Waterhen Ecodistrict occupies the northeastern part of the Interlake Plain Ecoregion and encompasses the southern half of Lake Winnipegosis, the northern basin of Lake Manitoba and all of Waterhen Lake.

Climate

This ecodistrict lies in the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic region, which is characterized by short, warm summers and cold winters. The mean annual temperature is 1.1^{o}C, the average growing season is 173 days, and the number of growing degree-days is 1500.

The mean annual precipitation is approximately 510 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from spring to early summer. The average moisture deficit over the year is nearly 90 mm. The ecodistrict has a humid, cold to moderately cold Cryoboreal soil climate.

The data from the now-closed station at Gypsumville (720. Gypsumville Ecodistrict) is relevant to the ecodistrict.

Physiography and Drainage

The ecodistrict extends from Lake Winnipegosis and Lake Manitoba on the west to near Lake Winnipeg on the east. It has a mean elevation of about 267 masl. The ecodistrict has a north-south trending drumlinoid or ridge and swale topographic pattern. The fluted ridges, ranging from about 400 to 800 m wide, are separated by variable sized swales or depressions up to 800 m wide.

Following the retreat of the continental glacier, glacial Lake Agassiz covered the ecodistrict and the surface of this gently undulating till plain was modified by waves and icebergs. Wave action resulted in local differentiation in the texture of surface materials with the ridges being more coarse textured and cobbly and gravelly, while the depressions are finer textured. Iceberg scouring created strongly intersecting micro-grooves or flutes that are usually curvi-linear in surface form. Slopes range from level to less than 5 percent.

The ecodistrict is a slight topographic high that slopes very gently eastward toward Lake Winnipeg and westward toward Lake Winnipegosis at a rate of approximately 0.6 m per km. Local relief from ridge to swale is approximately 0.5 to 3.0 m.

Natural drainage over most of the area is very poorly developed. The western section is part of the Dauphin River division, while the eastern section is part of the Lake Winnipeg South division. Both divisions are part of the Nelson River drainage system.

Soils

The soils on well to imperfectly drained ridges in the Waterhen Ecodistrict are dominantly Dark Gray Chernozems and Eutric Brunisols that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay loam water-worked glacial till. Soil profile development is very shallow (usually less than 15 cm thick). Significant areas of poorly drained peaty Gleysolic soils and shallow, slightly to moderately decomposed (fibric to mesic) organic soils occur in the swales. Glacial deposits can vary in thickness from less than 10 cm where limestone bedrock outcrops to more than 30 m.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

Vegetation varies from closed trembling aspen and balsam polar stands interspersed with white spruce on well to imperfectly drained till and glaciolacustrine sediments, to pure jack pine stands on dry sites. Forest stands dominated by white spruce and balsam fir may be found on favourable sites, including lake shores. The occurrence of conifers in the mixed stands increases with latitude.

Depressional areas have sedge and willow vegetation. Peatlands have tamarack and sedge vegetation on fens and black spruce and tamarack and mosses on bog and transitional bog peatlands..

Water

The principal source of water is the variable quality groundwater available from shallow sand and gravel aquifers associated with till, beach and inter-till outwash deposits. Well development is poor from Silurian bedrock formations. Bedrock aquifers made up of fractured limestone are variable both in water quantity and quality.

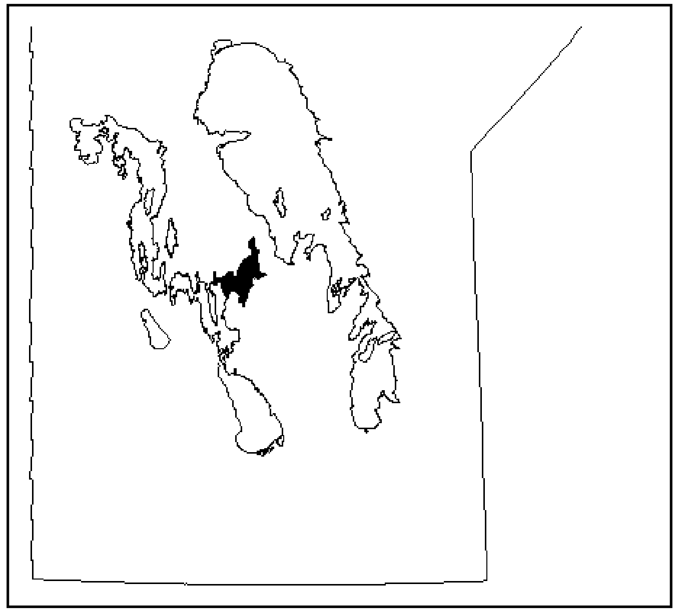
Land Use

There are several small communities in the ecodistrict including Waterhen and O-Chi-Chak-Ko-Sipi First Nations and Skownan and Crane River.

Only small portions of the soils are cultivated for spring wheat, other cereal grains, oil seeds and hay crops. Much of the land is public land and leased for native pasture and hay. The ecodistrict provides important wildlife habitat and breeding habitat for waterfowl.

720. Gypsumville Ecodistrict (1291 km²)

The Gypsumville Ecodistrict occupies a small area in the north-central part of the Interlake Plain Ecoregion and encompasses Lake St. Martin.



Climate

This ecodistrict lies in the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region, and is characterized by short, warm summers and cold winters. The mean annual temperature is around 1.3°C, the average growing season is 173 days, and the number of growing degree days is about 1500.

The mean annual precipitation is approximately 520 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 85 mm. The ecodistrict has a humid, cold to moderately cold, Cryoboreal soil climate.

Data from the now-closed station at Gypsumville is presented below.

Selected Climate Data[1] for Gypsumville

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	0.7	16.5	14.1	18.0	-20.7
Precip. mm (equiv.)	418.4	186.0	271.3	63.6	22.1
Rain/Snow (mm/cm)	301.3/102.1	185.9/0.1	270.1/1.7	63.6/0.0	0.2/20.0
Growing degree-days >5°C	1507.5	1062.7	1409.0	405.6	0.0

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

Physiography and Drainage

The Gypsumville Ecodistrict occupies a small area surrounding Lake St. Martin between Lake Winnipeg and Lake Manitoba. Its mean elevation is about 251 masl.

The ecodistrict is a level to ridged till plain partly covered with a thin, discontinuous veneer of glaciolacustrine clay. Slopes range from level to 2 percent and are frequently less than 50 m long, although some slopes are as long as 150 m. The ecodistrict slopes gently northeastward at approximately 0.7 m per km from Lake St. Martin. The ecodistrict lies in the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Nearly all of the soils are imperfectly drained, Gleyed Dark Gray Chernozems that have developed on extremely to very strongly calcareous, loamy to clayey textured glacial till. Significant local areas of poorly drained peaty Gleysolic soils and areas of imperfectly drained, Gleyed Rego Chernozemic Black soils are found on very shallow, discontinuous, loamy to clayey glaciolacustrine veneers.

Stoniness and irregular patterns of imperfectly and poorly drained conditions contribute to soil problems.

Vegetation

The forest stands in the ecodistrict are a mixture of trembling aspen, balsam poplar and white spruce in varying quantities. Jack pine is prevalent on drier sites.

Water

The principal sources of water are variable quality groundwater and good quality surface water from Lake St. Martin. The groundwater is available from shallow, stratified, sandy and gravelly aquifers associated with till and inter-till deposits. Well development in the underlying Ordovician and Silurian limestone bedrock is poor because of variable concentrations of soluble salts in these aquifers.

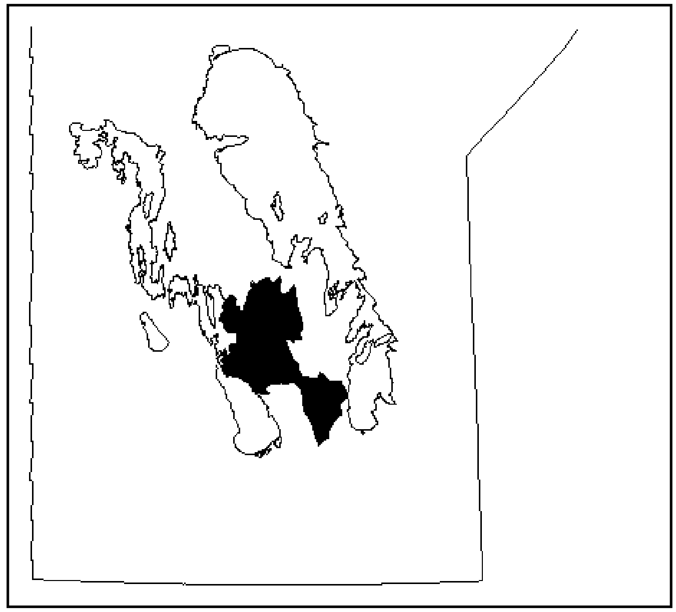
Land Use

Little Saskatchewan, Fairford and Lake St. Martin are the First Nations communities in the ecodistrict. The settlement of Gypsumville serves as a service centre for the ecodistrict and adjacent areas.

Most of the soils are not cultivated, and those that are produce spring wheat, other cereal grains, oil seeds and hay crops. Limited areas where drainage has not been improved or where the soils are too cobbly and stony to cultivate are used for native pasture and hay. There is a limited forest industry.

The wooded areas provide wildlife habitat for white-tailed deer, black bear and ruffed grouse. Lake St. Martin is an important habitat for waterfowl breeding and migratory staging area.

723. Ashern Ecodistrict (9121 km²)



The Ashern Ecodistrict occupies a major portion of the area generally referred to as the "Interlake".

Climate

This ecodistrict lies in the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region, which is characterized by short, warm summers and cold winters. The mean annual temperature is 1.2°C, the average growing season is 175 days, and growing degree-days number about 1500.

The mean annual precipitation is approximately 510 mm, of which nearly one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from spring through early summer. The average moisture deficit over the year is about 100 mm. The ecodistrict has a humid, cold to moderately cold Cryoboreal soil climate.

The data from the climate station at Ashern is relevant for most of the ecodistrict.

Selected Climate Data[1] for Ashern

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.1	16.9	14.5	18.3	-19.5
Precip. mm (equiv.)	483.2	215.1	319.2	65.3	18.9
Rain/Snow (mm/cm)	374.3/109.3	215.1/0.0T	314.7/4.7	65.3/0.0	0.1/18.8
Growing degree-days >5°C	1563.0	1092.8	1468.8	410.8	0.0

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

Physiography and Drainage

The Ashern Ecodistrict is situated between Lake Manitoba to the west and Lake Winnipeg to the east and has a mean elevation of about 274 masl. The ecodistrict has a northwest-southeast trending, drumlinoid or ridge and swale topographic pattern. The fluted or grooved ridges range from about 400 to 800 m wide and have slopes that are usually less than 5 percent and range in length from 50 to over 200 m.

Following the retreat of the continental glacier, the surface of this gently undulating till plain was modified by wave action and by icebergs scouring the ridges as glacial Lake Agassiz retreated. Wave action has resulted in local differentiation in soil textures. The ridges are more coarse textured, cobbly and gravelly, and the depressions are finer textured. Iceberg scouring formed strongly intersecting micro-grooves or flutes that are usually curvi-linear in surface form.

The ecodistrict is a slight topographic high, sloping very gently eastward toward Lake Winnipeg and westward toward Lake Manitoba at approximately 0.6 m per km. Local relief (ridge to swale) is approximately 0.5 to 3.0 m. Natural drainage is very poorly developed over most of the ecodistrict.

The western portion is part of the Dauphin River drainage division, while the eastern portion is part of the Lake Winnipeg South division. Both divisions are part of the Nelson River drainage system.

Soils

Soils situated on well to imperfectly drained ridges are dominantly Dark Gray Chernozems that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay loam water-worked glacial till. Soil profile development is very shallow (usually less than 15 cm). Glacial deposits in the area can vary in thickness from less than 10 cm where limestone bedrock outcrops, to more than 30 m. Significant areas of poorly drained peaty Gleysolic soils and shallow, slightly to moderately decomposed (fibric to mesic) organic soils occur in the swales.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems.

Vegetation

The forest stands in the ecodistrict are dominated by trembling aspen. Associated species are balsam poplar and white spruce. White spruce occurs largely interspersed in the trembling aspen stands, but also forms small pure stands. The white spruce distribution is much affected by forest fires. Poorly drained areas have willow, sedge and meadow grass vegetation. Much land has been cleared for agriculture, but some has reverted to shrub vegetation.

Tree quality is very much influenced by soil texture, soil depth and carbonate level. Generally, white spruce has better growth than trembling aspen on the same site. Trembling aspen often shows poor growth and form, unless growing on good quality sites. Black spruce and to lesser extent, tamarack, form the vegetative cover in the bogs in association with swamp birch, ericaceous shrubs and sphagnum and other mosses. Willows and sedges, and to some extent tamarack, brown mosses and various herbs and forbs are dominant in fen peatlands.

Water

The principal source of water is variable quality groundwater available from shallow sand and gravel aquifers associated with till, beach and inter-till outwash deposits. Well development is poor from Silurian bedrock formations. Limestone aquifers are made up of fractured rock and both water quantity and quality are variable.

Land Use

Ashern and Eriksdale are the main service centres and Lake Manitoba is the First Nation community in the ecodistrict.

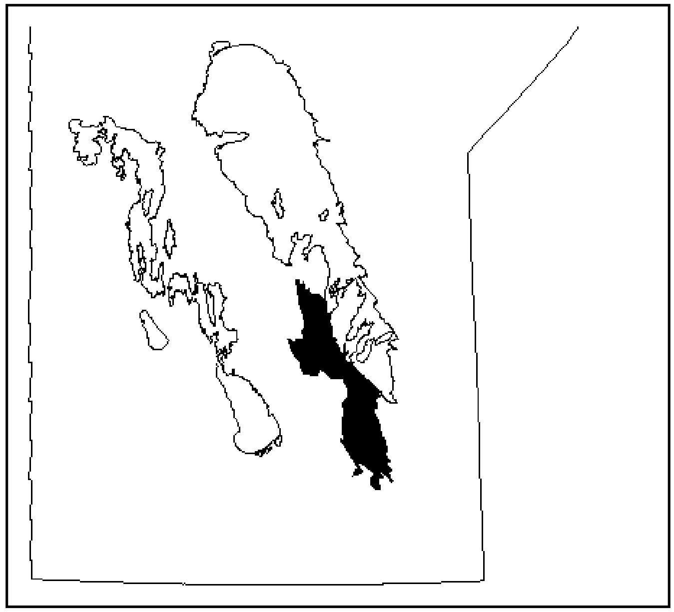
Only a limited, but significant, portion of the ecodistrict is cultivated for spring wheat, other cereal grains, oil seeds and hay crops. Much of the land is public land and leased out for native pasture and hay. The ecodistrict supports limited forestry, and provides important wildlife and waterfowl breeding habitat and migratory bird staging areas.

Ridge and swale topography

The ridges are well drained and have a vegetation cover of trembling aspen and various shrubs, while the poorly drained swales have sedge and reed vegetation.

724. Gimli Ecodistrict (6978 km²)

The Gimli Ecodistrict is a generally north-south elongated area extending from north of Fisher Bay to southeast of Birds Hill.



Climate

This ecodistrict lies within the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region, which is characterized by short, warm summers and cold winters. the mean annual temperature is 1.4°C, the average growing season is 176 days, and the number of growing-degree days is about 1540.

The mean annual precipitation is about 520 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average annual moisture deficit is nearly 100 mm. The ecodistrict has a humid, moderately cold, Cryoboreal to subhumid, cool, Boreal soil climate.

The ecodistrict contains a number of climate stations. The station at Arborg represents the northern sector, the station at Beausejour represents the southern sector and the now-closed Gimli station represents the area along Lake Winnipeg.

Selected Climate Data[1] for Arborg

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	0.9	16.9	14.3	18.4	20.2
Precip. mm (equiv.)	491.1	215.0	314.0	65.8	20.4
Rain/Snow (mm/cm)	380.8/110.1	215.0/0.0T	311.7/2.3	65.8/0.0	20.4/0.0T
Growing degree-days >5°C	1543.0	1099.1	1453.6	414.3	0.0

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

Selected Climate Data[1] for Beausejour 2

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.6	17.8	15.3	19.1	-19.6
Precip. mm (equiv.)	539.2	228.5	342.9	69.2	25.9
Rain/Snow (mm/cm)	412.7/126.4	228.5/0.0	341.3/1.6	69.2/0.0	25.6/0.3
Growing degree-days >5°C	N	1173.5	1589	435.7	0.0

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

Selected Climate Data[1] for Gimli Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.6	17.6	14.8	19.0	-19.7
Precip. mm (equiv.)	545.3	231.1	336.4	75.0	25.1
Rain/Snow (mm/cm)	397.1/164.7	231.1/0.0	332.4/4.2	75.0/0.0	0.4/27.8
Growing degree-days >5°C	N	N	N	N	N

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

Physiography and Drainage

The Gimli Ecodistrict lies along the southwestern shore of the south basin of Lake Winnipeg. It extends from Birds Hill in the south to the Fisher River Lowland near Dallas in the north. Its mean elevation is about 244 masl.

The ecodistrict is a level to depressional glaciolacustrine lowland and a gently undulating lake terrace, characterized by fluvioglacial, shallow glaciolacustrine deposits and water-worked glacial till. Slopes range from long and nearly level in the lowlands to short and less than 2 percent in the lake terrace areas.

West of Lake Winnipeg, slopes are very gentle at approximately 0.5 m per km eastward. The area south of Lake Winnipeg slopes very gently northward to Lake Winnipeg at a rate of less than 0.5 m per km. Netley Marsh on the south shore of Lake Winnipeg is a delta formed by the Red River. It has little relief, many channels and small water bodies enclosed by levees. A significant change of relief of occurs at Birds Hill, a prominent, interlobate glaciofluvial and moraine complex which rises about 30 m above the surrounding area. Local relief in the order of 5 to 10 m occurs along portions of the Red, Icelandic and Fisher rivers as a result of river bank erosion.

The northern portion of the ecodistrict is part of the Lake Winnipeg South drainage division, while the portion south of Lake Winnipeg is part of the Red River drainage division. Both are part of the Nelson River drainage system.

Soils

Most of the lowland soils are poorly drained Peaty Gleysols and shallow organic soils. Soils in the lake terrace areas are dominantly well to imperfectly drained, Dark Gray Chernozems that have developed on extremely to very strongly calcareous, loamy to clayey textured, water-worked glacial till and shallow loamy, glaciolacustrine veneers. Gray Luvisols, which developed under forest vegetation, are found on loamy, sandy to gravelly materials on the Birds Hill upland. Marsh soils are dominant in the extensive marsh area just south of Lake Winnipeg.

Vegetation

Forest is dominated by stands and coppices of trembling aspen. White spruce is interspersed with some of the trembling aspen stands in the more northern sections of the ecodistrict. Manitoba maple, green ash, elm and cottonwood dominate along the rivers, particular along the Red River. Depressional areas support sedges, meadow grasses and willows, while marsh areas are characterized by reed, cat tail and sedges.

The vegetation on Birds Hill reflects the somewhat higher elevation. Although deciduous trees are still prevalent, there is more white spruce, and there are also peatlands with black spruce, tamarack and eastern white cedar.

Water

The principal sources of water are variable quality groundwater from shallow, stratified sand and gravel aquifers associated with till and inter-till deposits, and surface water from Lake Winnipeg and the Red, Icelandic, and Fisher rivers. Well development in the underlying Ordovician limestone bedrock is poor because of variable concentrations of soluble salts in these aquifers.

Land Use

The major service centres are the city of Selkirk and the towns of Beausejour and Gimli. Besides a number of villages and hamlets, there are three First Nation communities - Fisher River, Peguis and Brokenhead Ojibway.

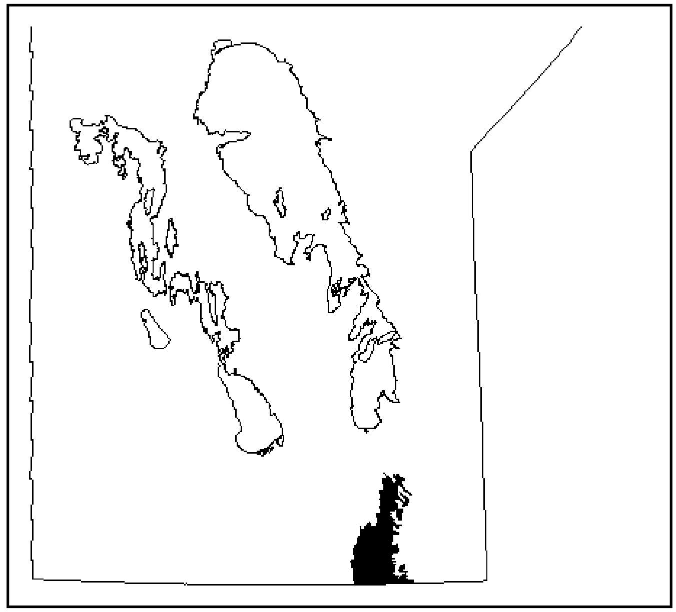
Except for Birds Hill, most of the soils in the southern lake terrace area are cultivated, while only those soils in the lowlands that have improved drainage are cultivated. Crops include spring wheat, other cereal grains, oil seeds and hay crops.

Areas where drainage has not been improved or where the soils are too cobbly and stony to cultivate are used for native pasture and hay. The wooded areas provide wildlife habitat for white-tailed deer, black bear, ruffed grouse, raptors and songbirds. Wetlands in the area are important for waterfowl breeding and migratory bird staging.

The ecodistrict provides many opportunites for recreation.The west shore of Lake Winnipeg has a large number of cottages. Most recreation is associated with beach and water sport activities. The Birds Hill area is a locally popular provincial park, providing camping, horseback riding, hiking and cycling in the summer and cross-country and downhill skiing in winter.

726. Steinbach Ecodistrict (3583 km²)

The Steinbach Ecodistrict is a north-south elongated area extending from the USA border to east of Winnipeg.



Climate

This ecodistrict lies within the more humid and cooler subdivision of the Subhumid Low Boreal Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and cold winters. The mean annual temperature is 2.4°C, the average growing season is 184 days, with about 1700 growing degree-days.

The mean annual precipitation is approximately 510 mm, of which about one-fifth falls as snow. Precipitation varies greatly from year to year and is highest from spring to early summer. Average soil moisture deficit over the growing season is about 200 to 250 mm. The ecodistrict has a humid, moderately cold Cryoboreal to subhumid, cool Boreal soil climate.

The climate station at Steinbach is situated on the western border of the ecodistrict, but is relevant to the area.

Selected Climate Data[1] for Steinbach

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.4	18.1	15.6	19.5	-18.0
Precip. mm (equiv.)	509.7	226.7	345.9	83.3	23.4
Rain/Snow (mm/cm)	410.5/99.3	226.7/0.0	344.6/1.1	83.3	0.2/23.3
Growing degree-days >5°C	1847.0	1204.4	1630.9	454.1	0.0

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

Physiography and Drainage

The Steinbach Ecodistrict is located within the southeastern lake terrace section of the Manitoba Plain. Its mean elevation is about 297 masl. The landform ranges from a smooth, level glaciolacustrine plain to a gently undulating, water-worked glacial till and glaciofluvial, terraced plain. Extensive areas consist of sandy glaciolacustrine veneers overlying extremely calcareous, cobbly and gravelly loamy till.

Slopes range from level to less than 5 percent and range in length from about 50 m to more than 150 m. The ecodistrict slopes gently at about 1.0 m per km northwestward from its eastern edge toward the Red River in the central lowland area. Some change of relief, approximately 1.0 to 3.0 m, occurs along the leading edge of a series of sandy and gravelly ridged terraces throughout the area. Peatlands are common, especially along its eastern border, and consist mostly of fens and transitional bogs.

Major drainage ways are the Roseau River and some creeks draining towards the Red River. The ecodistrict is part of the Red River drainage division, which is part of the Nelson River drainage system.

Soils

Well to imperfectly drained soils are dominantly Dark Gray Chernozems that have developed on thin, variably calcareous, discontinuous, sandy to loamy glaciolacustrine veneers overlying extremely calcareous, loamy to clayey textured, water-worked glacial till. In the southwest, Black Chernozems are found on similar materials. In the eastern sector, imperfectly and well drained Luvisols are found on sandy deposits and till ridges respectively. Some Eutric Brunisols have also developed on sandy materials in the eastern sector. Most soils in the depressional lowland areas are poorly drained peaty Gleysols and shallow to moderately deep, moderately decomposed organic Mesisols.

Vegetation

Vegetation is dominated by trembling aspen with some balsam poplar. Understorys are normally willow and red-osier dogwood with a ground cover of grasses and herbs. Poorly drained areas have dominantly willow and sedge vegetation, while well drained sandy areas in the eastern sector have a jack pine cover.

The peatlands have generally fen vegetation dominated by sedges and reed grasses, and also varying willow shrub. Transitional bogs have generally clumped tamarack and black spruce, increasing moss ground cover interspersed with fen vegetation components.

Water

The principal source of water is variable quality groundwater available from small, sand and gravel aquifers associated with the glacial till, inter-till, beach and fluvioglacial deposits. Limited supplies of variable quality groundwater under artesian pressure are available from Ordovician and/or Silurian limestone bedrock.

Land Use

There are many settlements in the ecodistrict, of which the towns of Steinbach and Ste. Anne are the major service centres. A significant percentage of the soils are cultivated as a result of improved drainage in lowland areas. Crops include spring wheat, other cereal grains, oil seeds and hay crops. Areas where drainage has not been improved or where the soils are too cobbly and stony to cultivate are used for native pasture and hay.

Wooded areas provide habitat for white-tailed deer, moose, black bear and ruffed grouse and a variety of other birds. Wetlands in the area are important habitat for waterfowl breeding and migratory bird staging areas.

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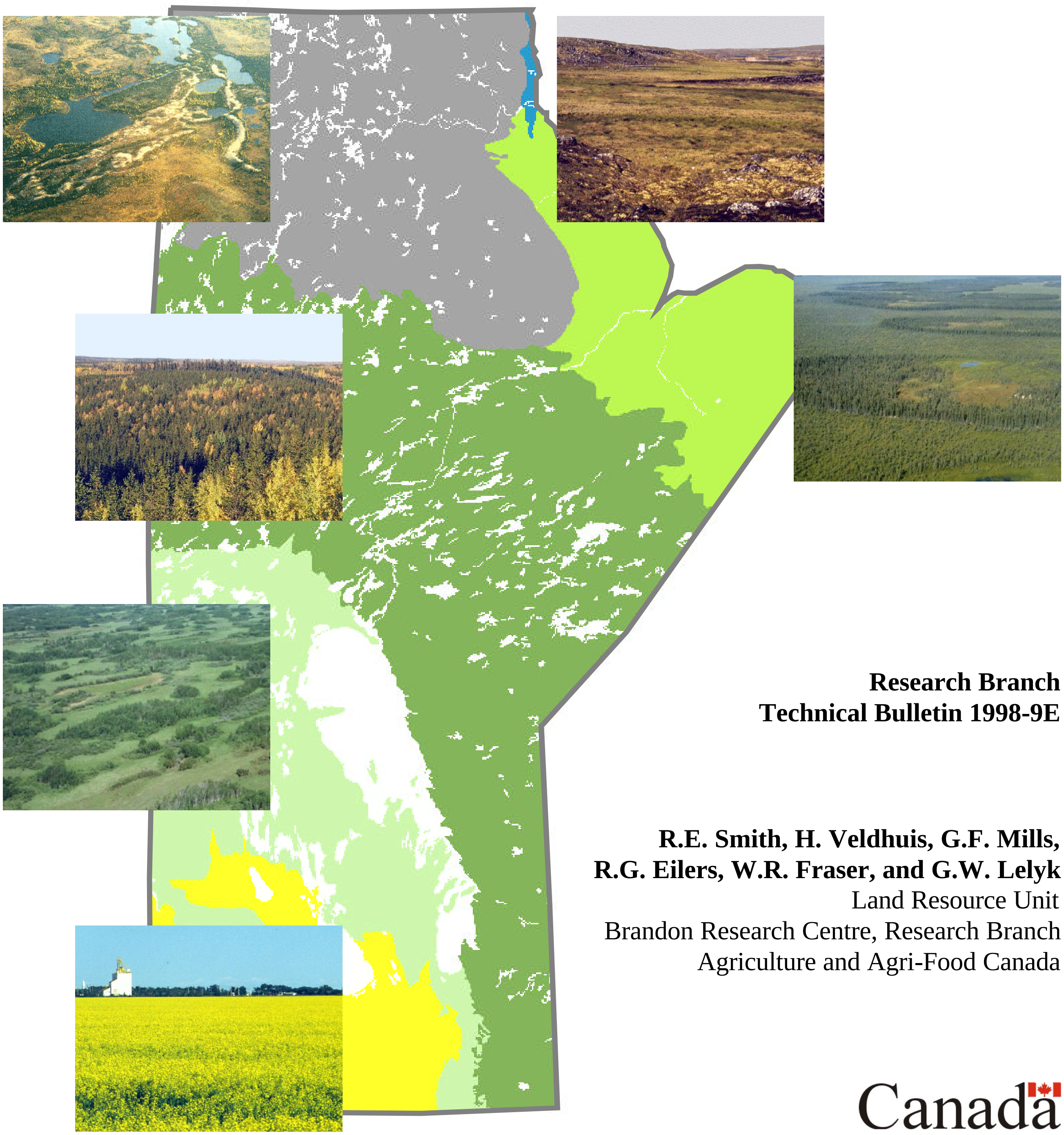
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



Research Branch
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Prairies Ecozone

The Prairies Ecozone extends north from the Canada-United States border and arcs from the western edge of Alberta to eastern Manitoba. This zone comprises the northern extension of the former open grasslands of the Great Plains of North America. Topographic relief is generally subdued, and besides the large expanses of undulating and hummocky terrain, large river valleys are the most striking landscape features.

Climate

The climate of the Prairies Ecozone is determined by its location in the heart of the North American continent and by the Rocky Mountains to the west which impede access of moisture-bearing winds from the Pacific. The result is a continental climate, subhumid to semiarid, with short, warm summers and long, cold winters, low levels of precipitation and high evaporation. Winds are frequent and often strong in this ecozone, and precipitation in summertime is often in the form of localized, heavy storms.

Mean annual temperatures range from 1.5ºC to 3.5ºC. Mean winter temperatures range from -12.5ºC to -8.0ºC and mean summer temperatures from 14ºC to 16ºC.

The mean annual precipitation is extremely variable. It ranges from 250 mm in the arid regions in southwest Saskatchewan and southeast Alberta, to about 550 mm in the Lake Manitoba Plain Ecoregion. On average, about one-quarter of the precipitation falls as snow. The data from the climate stations at Altona, Dauphin Airport, Virden and Winnipeg International Airport illustrate the climate for the Manitoba portion of the ecozone.

Selected Climate Data[1] (Annual Means) for the Manitoba Portion of the Prairies Ecozone

Station	Temperature (ºC)	Precipitation			Degree Days (>5ºC)	Frost Free Period[2] (days)
		Rain (mm)	Snow (cm)	Total (mm)		
Altona	3.1	392.9	118.6	511.9	1908.0	123.0
Dauphin A	1.7	366.3	137.9	491.9	1631.0	106.0
Virden	2.5	349.2	110.6	460.5	1745.0	120.0
Winnipeg A	2.4	404.4	114.8	504.4	1802.0	121.0

[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

The ecozone is underlain for the most part by Cretaceous shales and by flat-lying Paleozoic limestone in the most easterly section in Manitoba. Surficial deposits are primarily level to rolling plains of hummocky glacial moraine and level to gently undulating sandy to clayey glaciolacustrine deposits. Because of the hummocky nature of the till plains with their many undrained depressions, numerous wetlands such as sloughs, ponds and marshes were once an integral landscape component of this ecozone, especially in the eastern half. However, many sloughs have fallen victim to mechanized farming over the years and are no longer valuable as wildlife habitat.

The major rivers traversing the area are the North Saskatchewan, South Saskatchewan, Assiniboine and the Red. Many smaller rivers and creeks drain the area in a generally easterly or northeasterly direction through the Nelson River drainage system which empties into Hudson Bay. Most major waterways have been modified or developed to some extent for hydro power, irrigation, flood protection or water management.

Soils

The dominant soils are Chernozems characterized by a generally thick surface horizon rich in organic material. Due to cultivation, the organic matter content and/or the thickness of the organic-rich surface layer has been reduced in most soils. In some instances, current organic content is estimated to be in the order of 50 percent of its natural state. However, these soils continue to have relatively high natural fertility and good moisture-holding capacity because of their organic matter content and the favourable physical and chemical properties of the surface and subsurface soil material. Therefore, they are still highly productive for agriculture.

The most productive soils are the Black, Dark Gray and Dark Brown Chernozems of the Aspen Parkland and the Lake Manitoba Plain and the Dark Brown Chernozems of the Moist Mixed Grassland ecoregions.

Vegetation

Most of the native vegetation in this ecozone has been supplanted by agricultural crops, except in the driest parts where it has been transformed into rangeland.

Originally, a large part of this ecozone in Manitoba consisted of tall-grass prairie. Almost all of this region has been converted to cropland or has been strongly modified by drainage, grazing and haying. The same is true for most of the mixed-grass prairie and Aspen Parkland, where about three-quarters has been converted to cropland or has been seeded to non-native forage species. The short-grass prairie section, which occupies the driest southerly arc of this ecozone, has been strongly modified by human activity.

The northern and eastern areas of this ecozone are associated with groves of trembling aspen and balsam poplar. In the most eastern sector, bur oak groves become part of the mix. This vegetation mix characterizes the Aspen Parkland Ecoregion, which forms the transition between the Boreal Forest and the grasslands. This transitional zone has expanded southward into the grasslands over the years since settlement, possibly due to the suppression of natural prairie fires which in the past, likely kept the expansion of the wooded areas in check.

The natural grassland vegetation was dominated by spear grass, wheat grass and blue gamma grass. Saline areas have vegetation dominated by alkali grass, wild foxtail barley, red samphire and sea blite.

Wildlife

Because of the size of the ecozone, characteristic mammals of the zone may not be present throughout. In Manitoba, characteristic mammals include elk (wapiti), coyote, badger, white-tailed jack rabbit, Richardson's ground squirrel and northern pocket gopher. While farther west, pronghorn antelope and mule deer are present. The white-tailed deer is a recent addition to the fauna and is especially well established in Manitoba, where it thrives in the mixture of cultivated fields, pastures and aspen-oak bluffs.

Bird species characteristic of all or parts of the ecozone include ferruginous hawk, sage grouse, American avocet and burrowing owl, but their numbers are often severely reduced through habitat loss. Great blue heron, black-billed magpie, Baltimore oriole, veery and brown thrasher are other representative birds. This ecozone continues to provide major breeding, staging and nesting habitat for ducks, geese, other waterfowl and shore birds, even though a significant reduction in acreage and numbers of wetlands has occurred.

The red-sided and western plains garter snakes are common and widespread. Other reptiles and amphibians present in the Manitoba section of the ecozone include the blue-tailed skink found in the Spruce Woods, the western painted turtle, gray salamander and various toads and frogs.

Land use

Agriculture is the dominant land use. Over 60 percent of Canada's cropland and 80 percent of its pasture and rangeland are located in this ecozone. Other major economic activities include mining and oil and gas production. Despite the dominance of agriculture on the landscape, approximately 80 percent of the population of 3.8 million are found in urban communities. The cities of Calgary, Edmonton, Regina, Saskatoon and Winnipeg are the largest population centres in the ecozone.

There are three ecoregions within the Manitoba portion the Prairie Ecozone.

Plate PR1.
The gently undulating landscape of the Grandview Ecodistrict. This ecodistrict occurs between the Riding Mountain and Duck Mountain ecodistricts. The soils are predominantly well drained Black Chernozems developed on medium textured lacustrine sediments and sandy deltaic deposits that lie over strongly calcareous till at depth. Topography is gently undulating to nearly level, except where stream channels dissect the plain.

Plate PR2.
The level lacustrine landscape southeast of Dauphin. This portion of the Lake Manitoba Plain Ecoregion, just below the Manitoba Escarpment, consists of level to very gently sloping, clayey lacustrine sediments and loamy to clayey alluvial deposits overlying calcareous till. Drainage ranges from well to poor, with saline soils in some areas. Gleyed Black Chernozems are dominant on the lacustrine sediments, while the alluvial soils are dominantly well and imperfectly drained Regosols.

Plate PR3.
View from Riding Mountain east over the West-Lake Plain. The view from Mountain Road east shows the lower east slope of the Riding Mountain upland in the foreground, which consists of loamy till of largely shale origin. The West-Lake Plain, visible in the background, consist dominantly of loamy to clayey alluvial and lacustrine deltaic deposits. Farther east the plain becomes dominated by extremely calcareous glacial till with very shallow soil development.

Plate PR4.
The Manitoba Escarpment near Miami. The Manitoba Escarpment marks the eastern edge of the Aspen Parkland Ecoregion in the Miami area, approximately 110 km southwest of Winnipeg. Sandy, ancient beaches parallel to the escarpment indicate former shorelines of Glacial Lake Agassiz. To the east are the deep, heavy clay sediments that settled in the deep waters of Glacial lake Agassiz that covered the Red River Valley. The Escarpment consists of till and Cretaceous shale bedrock and is marked by many, deeply eroded gullies.

Plate PR5.
Pasture land in Interlake. In the area east of Lake Manitoba some of the land is better suited to pasture than arable agriculture. The surface material is dominantly loamy, extremely calcareous, stony glacial till. The soils are typically imperfectly drained shallow Gleyed Black Chernozems.

Plate PR6.
Gleyed Rego Black Chernozemic soil on heavy clay glaciolacustrine sediments. The Red River Valley is characterized by extensive deep, clayey glaciolacustrine sediments of Glacial Lake Agassiz. These deposits are generally very high in clay content, and are varved below the depth of soil development. The soils are dominantly imperfectly drained Red River soils and poorly drained Osborne clay soils, characterized by black surface horizons with a high organic matter content. An extensive network of surface drains has significantly improved soil drainage in the Valley. Nearly all of these soils are now cultivated and are some of the most productive soils found in Western Canada.

Plate PR7.
Spring seeding on clayey soil in the Red River Valley. The Red River soils are widespread in the Winnipeg Ecodistrict. These soils are very productive , but are not without their problems. The heavy clay tends to remain wet for some time in spring, which may cause delays in seeding. They also require significant horse power for tillage. Significant rainfall in spring and early summer may cause water logged conditions in lower areas of fields. On the other hand these soils are able to provide sufficient moisture for crops during droughty periods.

Plate PR8.
The level glaciolacustrine plain of the Red River Valley. The combination of a level topography and heavy texture causes most soils to be saturated in spring. Most of the area was Tall Grass Prairie, of which little remains.

Plate PR9.
Flowering canola on clayey soil. Traditionally spring seeded cereals are the dominant crops grown on the Red River soils, but the area seeded to canola has increased significantly in recent years.

Plate PR10.
Alluvial plain within Assiniboine River valley. Alluvial sediments, lighter in texture than the Glacial Lake Agassiz deposits, are found along rivers. They are generally very productive soils and somewhat easier to cultivate than the heavy clay soils. Some areas are prone to spring flooding. They are suitable for a large variety of crops, including vegetables.

Plate PR11.
Upper Assiniboine Delta landscape. The Upper Assiniboine Delta consists largely of sandy, glaciofluvial deposits. Large portions of the Shilo Ecodistrict have been modified by wind erosion. The dunes in the picture were formed a long time ago and have since been stabilized by vegetation, allowing the development of Chernozemic soils. However, these soils remain sensitive to wind erosion and good land cover management is required.

Plate PR12.
Active dune. Part of the Upper Assiniboine Delta still contains active dunes. This area is part of the Spruce Woods Provincial Park and is a protected area. As the dunes move over the landscape they cover areas that are vegetated, burying the vegetation including the trees. These active eolian landforms lack soil development, which can only start after vegetation stabilizes the soil surface. In many areas buried soil profiles can be encountered at depth indicating that the newly deposited eolian materials have covered previous surfaces.

Plate PR13.
Irrigated potatoes on a sandy soil in the Upper Assiniboine Delta. Level sandy areas of the Assiniboine Delta in the Carberry Ecodistrict are very suited to the production of potatoes. However, as moisture supply from the sandy soils is limiting, irrigation is required to optimize production. Manitoba has recently become the second largest producer of potatoes in Canada.

Plate PR14.
Stabilized dune landscape in the Assiniboine Delta. The stabilized dune landscape has grassland vegetation on the upper slopes of the dunes, and trees and shrub vegetation in the depressions. The depressions offer a more sheltered environment and more available moisture, due to the accumulation of runoff and snow, a higher water table, protection from drying winds, and reduced solar radiation.

Plate PR15.
Undulating Upper Assiniboine Delta landscape. The undulating loamy fine sandy areas of the Delta are suitable for cereals, canola, and alfalfa production.

Plate PR16.
Sunflowers. Sunflowers used to be a more extensive crop than is presently the case.

Plate PR17.
Orthic Black Chernozemic soil on loamy fine sandy, lacustrine sediments. Sandy soils that have developed under grassland vegetation have developed thick, organic rich surface Ah horizons. The enrichment in organic matter reduces the risk of wind erosion, allows the soil to retain more moisture, and is a source of nitrogen for plant growth. Soil management aimed to sustain the organic rich surface horizon is strongly recommended on these light soils.

Plate PR18.
Strongly undulating till plain. The till plains of the Aspen Parkland Ecoregion in south-western Manitoba vary in relief. The stronger undulating or hummocky plains are characterized by a large number of wet depressions called " Prairie potholes" or sloughs. The water in these depressions comes from local runoff, mainly from snowmelt in the spring, and from the watertable. The amount of water in these wetlands varies from year to year and diminishes during the summer season. Most soils on the higher ground are Black Chernozems, while in the depression they consist of various Gleysolic types.

Plate PR19.
Gently undulating till plain. These till plains have relatively low relief. Wetter areas are less basin-like than the ones in the areas with stronger topography. Some wet areas are cultivated, although this may not be possible in all years.

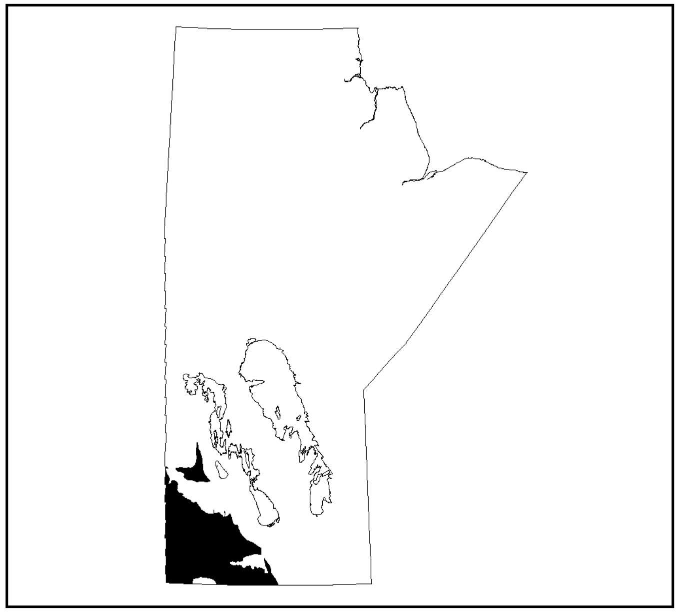
Plate PR20.
Orthic Black Chernozemic soil on loamy till. The glacial till parent material in the Aspen Parkland Ecoregion is moderately to strongly calcareous, loamy in texture, and contains moderate quantities of coarse fragments. The dominant soils are Orthic Black Chernozems, characterized by a deep organic rich A horizon, underlain by a brownish B horizon. These soils are very productive if rainfall is sufficient and well distributed throughout the growing season.

Plate PR21.
Prairie pothole or slough. Prairie potholes and sloughs are classified as basin marshes. The centre is open water, which is surrounded by an area of sedges and/or reed grasses. This is bordered by a fringe of willows, which in turn are bordered up-slope by trembling aspen and/or balsam poplar. These wetlands store runoff water in the spring, and form very important habitat for waterfowl, black birds, raptors, white-tailed deer, and predators such as striped skunks and red foxes. Large numbers of potholes have been lost over the years to agriculture.

Plate PR22.
Prairie summer storm. The summer weather on the Prairies is characterized by severe thunder storms, which often bring large amounts of precipitation in a short period. Thunder storms are often marked by intense lightning, large hail, high winds, and occasionally tornadoes. Locally, damage to standing crops may be severe as a result of such storms.

Plate PR23.
The Pembina Valley and the Pembina River. The Pembina Valley and most of the other river valleys in this ecozone were formed by large amounts of glacial meltwater. The present-day rivers are considered “underfit” as their flow is only a fraction of the glacial meltwater that originally created the valley. Over the years these rivers have modified the valley bottom through erosion and deposition. Some of the most productive soils are found in these valley bottoms, but they are prone to flooding in years of high snowfall.

156, 161. Aspen Parkland Ecoregion



In Manitoba, the Aspen Parkland Ecoregion occupies the southwestern corner of the province and a small area nestled between the Riding and Duck mountains. It forms part of the extensive parkland belt between the closed boreal forest cover to the north and northeast and the treeless grasslands to the west. A mosaic of trembling aspen and oak groves and rough fescue grasslands extends in a broad arc from southwestern Manitoba northward through Saskatchewan to its northern apex in north-central Alberta.

Climate

This ecoregion lies in the Transitional Grassland Ecoclimatic Region, which is characterized by a continental climate marked by short, warm summers and long, cold winters. In Manitoba, the mean annual air temperature ranges from 1.2ºC to 2.8ºC. The average growing season ranges from 173 days in the northern section to 183 days in the southwest. The number of growing degree-days ranges from 1470 to almost 1700 depending on location.

The average annual precipitation ranges from about 440 to 530 mm and varies greatly from year to year. Precipitation is highest during the growing season. Average yearly moisture deficits in Manitoba range from less than 140 mm in north to about 300 mm in the southwestern corner of the province. Poorly drained soils may remain saturated for prolonged periods after snowmelt, but during the growing season they are usually only saturated for short periods after heavy rains.

This ecoregion has a subhumid, cool to moderately cool Boreal soil climate.

The data from the three stations shown below illustrates the range of climatic conditions found in the ecoregion.

Selected Climate Data[1] for Gilbert Plains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.7	-15.8	-8.6	2.1	10.4	15.8	18.2	16.8	10.8	4.5	-6.0	-15.7	1.2
Precip. mm	18.9	17.0	30.4	33.8	48.4	71.9	70.8	67.2	60.0	29.8	23.2	25.5	497.0
Growing degree-days	0.0	0.0	0.8	41.2	185.0	325.0	409.7	366.6	181.4	56.3	2.5	0.0	1569.0

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

Selected Climate Data[1] for Brandon CDA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.0	-15.0	-7.1	-3.7	11.4	17.7	19.2	18.0	11.8	5.4	-5.1	-15.0	2.2
Precip. mm	20.6	19.2	22.9	37.5	48.6	70.4	71.6	70.9	50.5	23.6	16.2	20.7	473.0
Growing degree-days	0.0	0.0	2.1	52.1	207.0	351.0	442.0	400.0	209.0	68.4	2.8	0.0	1733.0

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

Selected Climate Data[1] for Morden CDA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-16.0	-12.8	-5.5	4.5	12.3	17.6	20.4	19.1	13.2	6.8	-3.5	-12.7	3.6
Precip. mm	20.1	18.4	28.1	41.8	65.7	78.4	70.3	67.7	51.6	33.5	22.2	22.6	520.3
Growing degree-days	0.0	0.0	2.7	64.3	233.6	377.3	477.8	437.9	249.0	97.1	8.2	0.0	1948.0

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

Surficial Deposits and Landforms

In Manitoba, the eastern boundary of this ecoregion is marked by the Manitoba Escarpment that forms the dip slope of the Saskatchewan Plain. Lower and smoother than the Alberta Plain to the west, it is composed of Upper Cretaceous shaly sediments and is covered almost entirely by glacial deposits. Elevations range from 320 masl near the Manitoba Escarpment to about 600 masl in the hilly uplands to the west. Its surface deposits range from kettled to gently undulating loamy glacial till, to level to gently undulating sandy glaciofluvial and glaciolacustrine deposits. Areas with eolian dunes contain some of the roughest topography of the region with slopes that range to 30 percent and occasionally steeper. Associated with the rougher morainal deposits are a large number of small lakes, ponds and sloughs occupying shallow depressions. The larger flat basins are the bottoms of former glacial lakes.

The ecoregion slopes gently eastward and is drained by the Souris, Assiniboine, Qu'Appelle and Pembina rivers. These are undersized streams flowing in deeply incised broad valleys carved by glacial meltwaters.

Soils

Well drained Chernozemic Black soils developed on relatively stone-free to moderately and very strongly calcareous glacial till are dominant in the region. Significant associated soils include excessively drained sandy Regosols and poorly drained humic Gleysols.

Vegetation

In Manitoba, trembling aspen and shrubs occur on moist sites, bur oak and grassland communities occupy increasingly drier sites. Dominant grasses include fescues, wheat grasses, June grass and Kentucky bluegrass. A great variety of deciduous shrubs and herbs is also characteristic. Poorly drained sites support slough grasses, marsh reed grass, sedges, cattails and shrubby willows.

Wildlife

The wildlife has been affected by agricultural development. Grassland and wetland habitat loss has affected both the distribution of species and populations. In the Manitoba portion of the ecoregion, wapiti is largely confined to the Spruce Woods area, while pronghorn antelope is sighted only very rarely. On the other hand, white-tailed deer are widespread, especially in areas which provide both grazing and cover habitat. Coyote and red fox are widespread throughout the area, as are ground squirrel, cottontail rabbit, hare, striped skunk, redback vole and deer mice.

Many bird species are still found throughout this ecoregion. Various raptors, such ferriguous hawk , sparrow hawk and red-tailed hawk are still fairly common. Other birds include mourning dove, black-billed magpie, red-winged blackbird, killdeer and meadowlark. Various species of ducks are found in wetlands. Red-sided and western plains garter snakes and various frogs are also common.

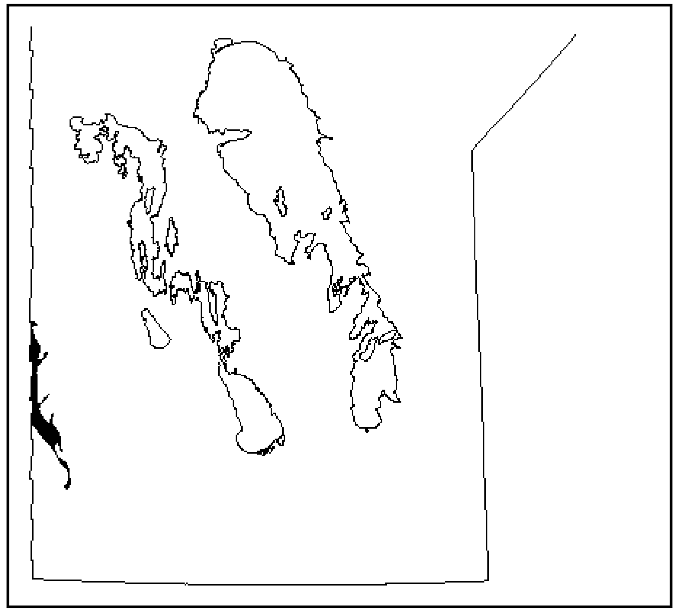
Land Use

Production of spring wheat and other cereal grains by continuous cropping and dryland methods dominate the agriculture of the region. Oilseeds and hay are also grown. Potato production has increased dramatically in Manitoba, especially on sandy soils were irrigation is feasible.

There are twelve ecodistricts within the Aspen Parkland Ecoregion in Manitoba.

751. St. Lazare Ecodistrict (1399 km^2)

The St. Lazare Ecodistrict straddles the border with Saskatchewan. Most of the ecodistrict is in Manitoba.



Climate

This ecodistrict is located within a subdivision of the Grassland Transition Ecoclimatic Region that lies between the driest subdivision to the southwest and the most humid subdivision to the east in the Manitoba Plain. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 1.7^{o}C, the average growing season is 177 days and the number of growing degree-days is about 1540.

The mean annual precipitation is approximately 440 mm, of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from spring to early summer. The average moisture deficit over the year is about 240 mm.

The ecodistrict has a subhumid to humid, moderately cold, Cryoboreal soil climate.

The climate station at Virden is located in the most southern portion of the ecodistrict. Data from the station at Russell (753. Hamiota Ecodistrict) is relevant for the northern sector.

Selected Climate Data[1] for Virden

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.5	18.1	15.5	19.5	-17.3
Precip. mm (equiv.)	460.5	196.7	298.2	65.5	21.8
Rain/Snow (mm/cm)	349.2/110.6	196.7/0.0	285.7/2.3	65.5/0.0	0.0T/21.8
Growing degree-days >5^{0}C	1745.0	1202.8	1621.3	448.5	0.0

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

Physiography and Drainage

The ecodistrict consists of a subdued undulating to hummocky till plain dissected by broad river valleys in which the undersized Assiniboine and Qu'Appelle rivers flow to the south. These valleys form the most impressive physiographic elements in the ecodistrict and were formed about 10 000 years ago when large quantities of glacial meltwater flowed through the area. While the areas outside of the valleys are level to gently sloping, the valley walls are steep, ranging from 15 to 60 percent slope, with lengths ranging from 50 to 150 m. Maximum relief from valley wall crest to valley floor ranges from 30 m to 60 m. Tributary to the rivers are numerous channels and streams with similar slope conditions. The mean elevation of this ecodistrict is about 457 masl.

The ecodistrict lies largely in the Foxwarren division of the Assiniboine River watershed, which is part of the Nelson River drainage system.

Soils

Well drained Black Chernozems developed on strongly calcareous, water-worked, glacial till derived from limestone, granitic rock and local bedrock shale, and Black Chernozemic soils developed on calcareous, glaciofluvial deposits are predominant in this ecodistrict. Valley floors are characterized by imperfectly drained Regosolic soils on river alluvium. Local areas of imperfectly drained, carbonated and variably saline Gleyed Rego Black Chernozems ring poorly drained Gleysolic soils found in depressions.

Vegetation

The natural vegetation consisted of grassland vegetation interspersed with trembling aspen groves, but most of the natural vegetation has disappeared due to cultivation. Valley walls are characterized by a mosaic of grass, tree and shrub vegetation on east and north facing slopes, while grassland vegetation is characteristic of south and west facing slopes.

Water

Surface waters are stored in Lake of the Prairies behind the major Shellmouth Dam near Russell, Manitoba. Significant supplies of variable quality groundwater for domestic and livestock use are found in fluvioglacial deposits and alluvial fans at the junction of tributaries emptying into the Assiniboine River, in valley fills and in small buried aquifers in glacial till. The dominant shale bedrock underlying the till yields very little water.

Land Use

The town of Virden is an important service centre for this ecodistrict and adjacent ones. Birdtail Sioux is the only First Nation Community in the ecodistrict.

Cultivated soils are used for the production of spring wheat, other cereal grains, oil seeds and hay crops. The steeper valley slopes and drier outwash soils are used for pasture and hay crops. The Shellmouth Dam is a major flood control structure on the Assiniboine River and the associated Lake of the Prairies is the focus for water-oriented recreation.

752. Melville Ecodistrict (1855 km²)

The Melville Ecodistrict extends a considerable distance into Saskatchewan. Approximately one-fifth of the district lies within Manitoba.

Climate

This ecodistrict is located in a subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast in the Manitoba Plain. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.2°C, the average growing season is around 178 days, and the number of growing degree days is about 1545.

The mean annual precipitation is approximately 460 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average soil moisture deficit over the growing season is about 250 to 300 mm.

This ecodistrict has a moderately cold, subhumid Cryoboreal to a cool, subhumid, Boreal soil climate.

There are no climate stations in this ecodistrict. The climate station at Virden (751. St. Lazare Ecodistrict) is relevant.

Physiography and Drainage

The Melville Ecodistrict is an undulating to hummocky and kettled glacial till plain with local relief of less than 30 m. It lies between the Pipestone Creek to the south and the Assiniboine River to the north. Its mean elevation is about 488 masl. Slopes in this hummocky terrain are relatively short, ranging from 50 to 150 m, with usually less than 5 percent inclination. Slopes toward the Pipestone Creek and the Assiniboine River tend to be more than 150 m long, and are also steeper with inclinations between 5 and 10 percent.

The Manitoba portion of the ecodistrict is part of several watersheds. The northern and central sectors lie in the Foxwarren and Hamiota divisions of the Assiniboine River watershed, while the southern sector is part of the Hartney division of the Souris River watershed. Both watersheds are part of the Nelson River drainage system.

Soils

Well drained Black Chernozems developed on very strongly calcareous glacial till derived from shale, limestone and granitic bedrock are dominant in the area. A significant area of salinized and poorly structured Solonetzic soils occurs to the northeast of Elkhorn in the Two Creeks-Willen area. Local areas of imperfectly drained, variably saline, carbonated Gleyed Rego Black Chernozems ring poorly drained Gleysolic soils found in depressions.

Most of the cultivated soils on well drained knolls have been variably affected by moderate to severe wind and water erosion. Current management practices of continuous cropping, virtual elimination of summerfallow, retention of crop residues as surface cover and tree shelterbelts have greatly reduced the risk of soil erosion.

Vegetation

The natural vegetation of the Melville Ecodistrict was once park-like because of the presence of trees in and around depressions and grassland vegetation on the slopes and knolls. However, much of this vegetation has disappeared due to cultivation.

Under natural conditions, depressions are marked by aquatic vegetation. The lower portions of these basins contain water throughout the year, and the open water portion is ringed by slough grass, sedges and rushes. Surrounding this vegetation is a belt of willows which, in turn, is encircled by trembling aspen. Next is a border of shrubs comprised of prairie rose, silverberry, snowberry and others. This vegetation gives way, if not cultivated, to a grassland of pasture sage, grama grass, June grass, anemone, chickweed, etc. on the drier knolls, while intermediate slopes have little bluestem, spear grass, ragwort and other grasses and forbs.

Water

Variable annual rainfall is the principal source of water. Much of it is retained in the numerous sloughs and potholes characteristic of this hummocky terrain. Surface water stored in dugouts and behind small retention dams along the creeks which dissect this plain are important additional sources. Significant supplies of variable quality groundwater for domestic use and livestock are found in sandy and gravelly aquifers in glacial till and inter-till deposits. The dominant shale bedrock underlying the till yields very little water.

Land Use

There are several small communities in the ecodistrict of which Elkhorn is the largest.

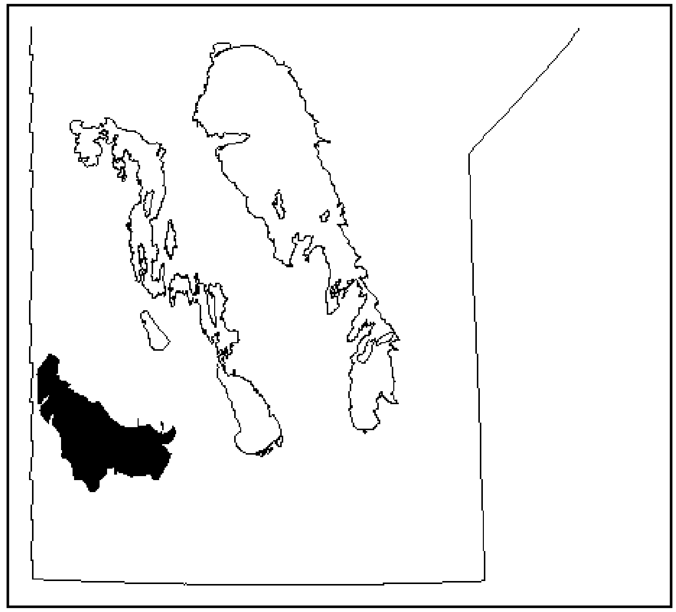
Most of the land in the Melville Ecodistrict is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. The saline and Solonetzic soil areas are generally limited to pasture and hay production. The numerous wetlands are important as breeding habitat for various ducks and as staging areas for waterfowl.

Mallards

Mallards are a common duck on the prairies where the habitat provided by potholes and sloughs is still extensive. Over the years, this type of habitat has diminished significantly in many areas due to agricultural practices. However, in recent years habitat protection and restoration has increased both habitat quality and extent.

753. Hamiota Ecodistrict (8316 km^2)

The Hamiota Ecodistrict is bordered on the north by the slopes leading to Riding Mountain, and it extends nearly to the Assiniboine River on the south. The district lies wholly within Manitoba.



Climate

This ecodistrict is located in a subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast. The climate is characterized by short, warm summers and long, cold winters. Due to its size and location, climatic conditions vary throughout. The mean annual temperature is 1.4^{o}C, and the average growing season is 175 days with about 1480 growing degree-days.

The mean annual precipitation is about 460 mm; about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average annual moisture deficit is about 180 mm.

The ecodistrict has a moderately cold, subhumid, Cryoboreal soil climate.

Data from the long-term climate stations at Minnedosa, in the eastern sector, and Russell, in the northwest corner, and from the short-term station at Oakner in the south is presented below.

Selected Climate Data[1] for Minnedosa

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	0.8	16.3	13.8	17.5	-18.6
Precip. mm (equiv.)	466.9	215.1	312.0	75.6	21.3
Rain/Snow (mm/cm)	366.9/99.9	215.1/0.0T	311.6/0.3	75.6/0.0	0.0T/21.3
Growing degree-days >5^{0}C	1442	1049.7	1371.8	389.1	0

Selected Climate Data[1] for Russell

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	1.1	16.8	14.3	18.1	-18.9
Precip. mm (equiv.)	484.4	207.8	309.1	69.9	26.4
Rain/Snow (mm/cm)	343.7/139.0	207.8/0.0	302.1/5.0	69.9/0.0	0.1/26.2
Growing degree-days >5^{0}C	1542.0	1086.6	1446.4	407.3	0.0

Selected Climate Data[1] for Oakner

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	1.9	17.2	14.8	18.5	-18
Precip. mm (equiv.)	84.4	207.8	309.1	69.9	26.4
Rain/Snow (mm/cm)	343.7/139.0	207.8/0.0	302.1/5.0	69.9/0.0	0.1/26.2
Growing degree-days >5^{0}C	1542.0	1086.6	1446.4	407.3	0.0

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

Physiography and Drainage

The Hamiota Ecodistrict is located along the southern, lower slopes of Riding Mountain. The mean elevation is about 518 masl.

The area is an undulating to hummocky and kettled glacial till plain. Included within its boundaries are the undersized Birdtail and Minnedosa (Little Saskatchewan) rivers flowing in broad valleys, coursing southward through the area to the Assiniboine River. Apart from these valleys, the area ranges from nearly level to areas of moderate local relief of less than 30 m. Slopes are generally less than 5 percent, of medium length and usually between 50 to 150 m long. However, the slopes of the deeply incised valleys are steep, ranging from 15 to 60 percent, and hummocky with slope lengths ranging from 50 to 150 m. Maximum relief from valley rim to valley floor ranges from 30 to 60 m. Tributary to the rivers are numerous channels, streams and gullies. The slopes near rivers and streams tend to be longer and smoother than the slopes usually encountered in the rest of the ecodistrict.

This ecodistrict is part of a large number of drainage divisions. The northwest corner is part of the Foxwarren division, while the central portion is a part of the Hamiota and Minnedosa River division. The southeast corner lies within the Brandon drainage division. These divisions are all part of the Assiniboine River watershed. Only the northeast corner of the district lies in the Lake Manitoba southwest division, which is part of the Dauphin River watershed. Both the Assiniboine and Dauphin River watersheds are part of the Nelson River drainage system.

Soils

Well drained Black Chernozems developed on strongly calcareous glacial till derived from local bedrock shale, limestone and granitoid rock are predominant in the area. Local areas of imperfectly drained, variably saline and carbonated Gleyed Rego Black Chernozems ring poorly drained Gleysolic soils in depressions.

Vegetation

The natural vegetation of the Hamiota Ecodistrict is parklike due to the presence of trees surrounding depressions and grasslands on the slopes and knolls. Much of this vegetation has disappeared due to cultivation. However, under natural conditions, depressions which contain water throughout the year have aquatic vegetation which is ringed by slough grass, sedges and rushes. Surrounding this vegetation is a belt of willows encircled by a strip of trembling aspen. This area is bordered by shrubs comprised of prairie rose, silverberry, snowberry and others. This vegetation gives way, if not cultivated, to a grassland of pasture sage, grama grass, June grass, anemone, chickweed etc. on the drier knolls, while the intermediate slopes have little bluestem, spear grass, ragwort and other grasses and forbs.

In the northern part of the ecodistrict, the amount of tree cover increases when approaching the boundary with the Boreal Transition Ecoregion. Trees are found on moist sites and around depressions, and also on lower slopes. River valleys are marked with more extensive tree cover on north and east facing slopes. A variety of deciduous tree species may be found on stream embankments and floodplains.

Water

Variable annual rainfall is a principal source of water where limited amounts are retained in numerous small ponds and sloughs of this glacial till area. Additional surface waters are stored in dugouts and small headwater retention ponds. Significant supplies of variable quality groundwater for domestic and livestock use are found in small aquifers in the glacial till as well. The dominant shale bedrock underlying the till yields very little water.

Land Use

There are many communities of which Minnedosa, Hamiota, Birtle and Russell are the largest. There are four First Nation communities: Waywayseecappo, Rolling River, Gamblers and Sioux Valley.

Most of the land is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. The more saline soil areas are used for pasture and hay production. Most of the cultivated soils on well drained knolls have been slightly to moderately affected by wind and water erosion. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of erosion damage. Undrained wetlands in the area are important breeding habitat for various ducks, and also provide habitat for migrating waterfowl.

757. Shilo Ecodistrict (2659 km^2)

The Shilo Ecodistrict is bordered by the Assiniboine River on the south and the Manitoba Escarpment on the east.

Climate

This ecodistrict is situated in a subdivision of the Grassland Transition Ecoclimatic Region that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.4^{o}C, the average growing season is 181 days, and growing degree-days number about 1650.

The mean annual precipitation is approximately 480 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and it is highest from late spring through summer. The average moisture deficit for the year is about 210 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.

The only climate station in the ecodistrict is the short-term station located at Neepawa in the northern sector. Data from the Cypress River station (758. Stockton Ecodistrict) is also relevant, especially for the southern sector.

Selected Climate Data[1] for Neepawa Water

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.4	17.9	15.4	19.2	-16.8
Precip. mm (equiv.)	487.4	221.6	331.4	76.6	18.0
Rain/Snow (mm/cm)	382.4/105.2	221.6/0.0	330.5/0.8	76.6/0.0	0.0T/18.0
Growing degree-days >5^{0}C	1723.0	1190.3	1608.4	440.3	0.0

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

Physiography and drainage

This level to hummocky ecodistrict forms a major part of the Assiniboine Delta, a feature that extends eastward from its apex just east of Brandon to the Manitoba Escarpment. Its mean elevation is about 366 masl.

The Shilo Ecodistrict consists, for a large part, of fine to coarse sand deposited by glacial meltwaters. Large tracts of the fine to medium sands on the surface of the delta have been blown into hummocky dunes characterized by gentle to strong slopes, less than 50 m long, with gradients varying from 6 to 30 percent. Most of the duned areas are no longer active and only an area of about 10 km^2, called the Spirit Sands, are still considered active sands.

The landscape along the eastern edge is characterized by deeply incised gullies having short to medium length (50-150 m), with moderate to very strong slopes often exceeding 30 percent.

This ecodistrict is part of two drainage divisions. The northern sector is part of the Lake Manitoba southwest division of the Dauphin River watershed, while the southern sector is part of the Brandon division of the Assiniboine River watershed. Both watersheds are part of the Nelson River drainage system.

Soils

In areas of shifting sands and in areas that have only recently become stabilized, soil development is nonexistent or very minimal. Soil development is slightly more advanced in areas that have been stabilized for a longer time, although it is still very weak, and humus-enriched surface horizons are still very shallow. Therefore excessively to well drained Regosolic soils predominate on duned sand areas.

On coarse sand areas that have been less prone to wind shifting, shallow Black Chernozemic soils are present. Also, significant areas of well drained, Black Chernozemic soils occur on strongly calcareous, coarse loamy sediments near Brandon and on the dissected, steeply sloping, silty sediments in the eastern section. Minor areas of poorly to very poorly drained organic Terric (shallow) Mesisol soils are found in depressions. These are largely composed of sedge material mixed with alder and willow shrub detritus. Most of the cultivated soils have been affected to some degree by wind erosion.

Vegetation

The natural vegetation varies. Most of the loamy areas have vegetation characteristic of the aspen parkland region with trembling aspen groves in more moist locations and various types of grassland on drier landscapes. Maple and ash occur on alluvial materials along the larger waterways.

This ecodistrict also includes a unique area of sparse white spruce associated with a ground cover of mostly mixed prairie grasses, but also including creeping and common juniper and bearberry.

The vegetation varies with soil texture, aspect, slope, drainage and the length of time since the soil has become stabilized. The vegetation on rapidly drained and well drained sites is generally grassland with hazel, common and creeping juniper, white spruce, trembling aspen and sometimes scrub bur oak. North facing slopes generally have the heavier forest cover with less grass and no juniper. Imperfectly drained sites commonly have trembling aspen and balsam poplar, and dense alder and red-osier dogwood. Poorly drained sites have willow, alder and red-osier dogwood with a grass or sedge groundcover.

Water

The principal source of water in the Shilo Ecodistrict is good quality groundwater extracted from deep stratified sands and gravel and from bottom-set beds of clay, silts and sands. This deep aquifer provides sufficient water for irrigation of commercially grown corn and potatoes in adjacent areas of higher quality soils.

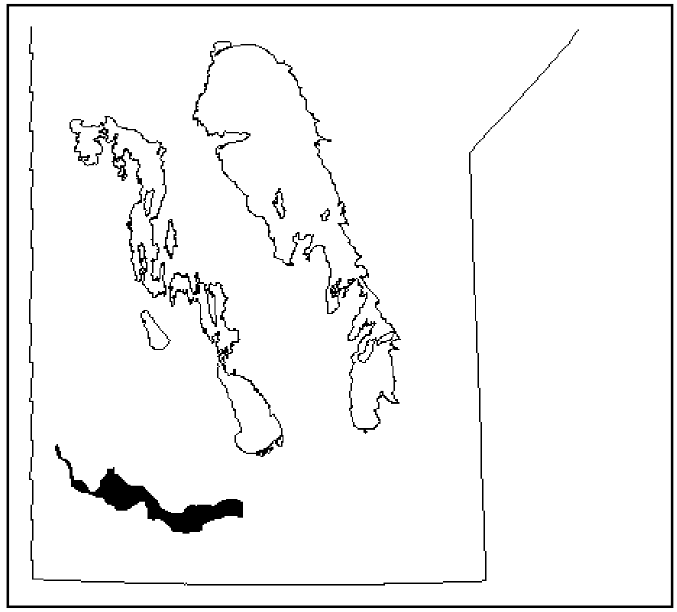
Land Use

The town of Neepawa in the northern sector is by far the largest community in the ecodistrict and is a major service centre for the ecodistrict and adjacent ones.

In the southern sector, the Spruce Woods Provincial Park covers about one-third of the ecodistrict and has been set aside for recreation. To the west of the park, the Canadian Forces Base Camp Shilo occupies a large tract of land, and is used as an artillery firing range and for tank manoeuvers.

The coarse soils near Brandon are used for the dryland production of spring wheat, other cereal grains, flax, hay and limited production of alfalfa, corn and potatoes under irrigation. The steeply sloping, erosive silty soils in the eastern section grow a similar range of crops using dryland management practices. These latter soils exhibit moderate to severe water and wind erosion. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of water and wind erosion. Level sandy soils are increasingly being brought under cultivation and irrigated for the production of potatoes.

758. Stockton Ecodistrict (3438 km²)



The Stockton Ecodistrict lies along, and to the south of, the Assiniboine River and includes the river valley.

Climate

This ecodistrict is situated in a subdivision of the Grassland Transition Eoclimatic Region that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.4°C, the average growing season is 181 days and growing degree-days number about 1670.

The mean annual precipitation is about 490 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average moisture deficit over the year is about 250 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.

Data from Brandon CDA and Cypress River climate stations is presented below.

Selected Climate Data[1] for Brandon CDA

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.2	18.0	15.4	19.2	-18.1
Precip. mm (equiv.)	472.7	212.9	312.0	71.6	20.6
Rain/Snow (mm/cm)	365.0/108.1	212.9/0.0	311.3/0.7	71.6/0.0	0.0T/21.3
Growing degree-days >5°C	1733.0	1192.3	1607.5	441.9	0.0

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

Selected Climate Data[1] for Cypress River

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.7	18.2	15.7	19.5	-17.3
Precip. mm (equiv.)	525.8	234.3	342.9	77.4	25.8
Rain/Snow (mm/cm)	399.6/125.8	234.3	340.9/1.8	77.4/0.0	0.0T/25.7
Growing degree-days >5°C	1785.0	1211.8	1645.3	449.0	0.0

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

Physiography and Drainage

The Stockton Ecodistrict is a relatively long and narrow, level to hummocky pro-glacial lacustrine plain lying between the Pembina Hills and Tiger Hills on the south and the Assiniboine River Valley on the north. The mean elevation of the district is about 366 masl. While the loamy areas are smooth and level, a narrow band of duned sands adjacent to the Assiniboine River are hummocky and characterized by short slopes less than 50 m in length, with gradients between 6 and 15 percent.

The Assiniboine River Valley is the most striking topographic feature in the ecodistrict, with local relief of 30 to 60 m, locally steep valley walls and a strongly meandering river. The valley west of the confluence with the Souris River is broad and shallow. From a point just east of Brandon extending to the west, the valley is trough-like, with some cut banks and terraces. East of the confluence with the Souris River, the valley is a trough about 1.5 km wide and 30 to 60 m deep. This section of the valley contains five to six sets of terraces, some of which are covered by sand dunes. The valley section within the Spruce Woods Provincial Park is quite spectacular with locally very steep valley walls.

The ecodistrict falls into two drainage divisions. The western sector lies in the Hamiota division, while the eastern is in the Brandon division of the Assiniboine River watershed, which is part of the Nelson River drainage system.

Soils

Well drained Black Chernozemic soils developed on strongly calcareous, fine loamy sediments are dominant in the area. The sandy, duned area is characterized by very droughty Humic Regosols. Local areas of imperfectly drained saline Gleyed Rego Black Chernozems and Gleyed Black Solonetzic soils occur in areas along the base of the hills to the south. Most of the cultivated soils have been affected to some degree by wind erosion.

Vegetation

The vegetation varies with soil texture, drainage, aspect and slope. The duned area has vegetation very similar to that described for part of the Shilo Ecodistrict. Thus, the vegetation on rapidly drained and well drained sites is generally a grassland with hazel, common and horizontal juniper, white spruce, scrub trembling aspen and sometimes scrub bur oak. North facing slopes generally support heavier forest cover with less grass and no juniper. Imperfectly drained sites commonly have trembling aspen and balsam poplar and dense alder and dogwood. Poorly drained sites have willow, alder and dogwood with grass and sedge groundcover.

The vegetation in the Assiniboine River Valley varies considerably. Alluvial floodplains have natural vegetation of deciduous forest with white elm, green ash, Manitoba maple, balsam poplar and an understory of alder, dogwood and high bush cranberry. Most higher terraces are currently cultivated, but supported deciduous forest in the past. The highest and driest terraces also have mixed deciduous forest including bur oak.

The valley portion within the Spruce Woods Provincial Park contains shallow and deep sloping peatlands developed on seepage slopes. Vegetation on these organic deposits varies from willow, dogwood, sedges and reed to tamarack, stunted black spruce and sedges in fens to green ash, Manitoba maple, white elm, alder, high bush cranberry, dogwood and ferns in swamps.

The natural vegetation in the remainder of the ecodistrict has for a large part been replaced by cultivated fields, but once consisted of aspen and balsam polar groves interspersed with areas of mixed-grass prairie vegetation.

Water

The principal source of water is variable quality groundwater available from deep stratified silts and sands. Quality of the water decreases approaching the base of the Pembina Hills and Tiger Hills to the south.

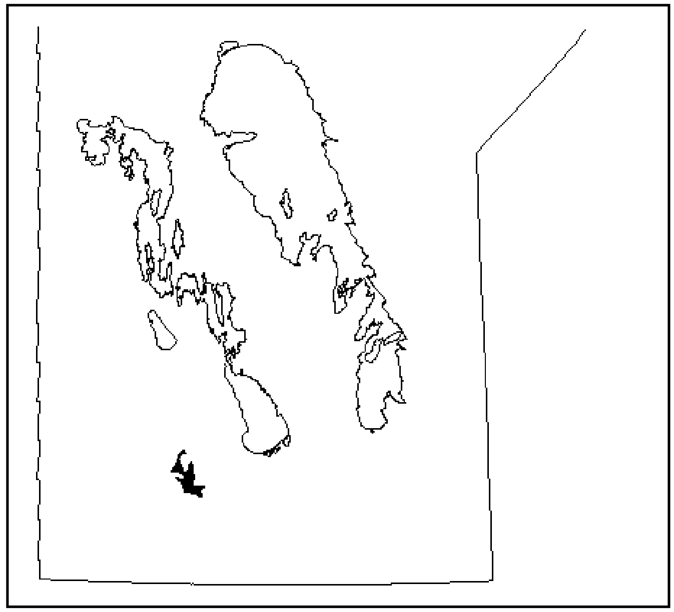
Land Use

The city of Brandon is by far the largest centre in the ecodistrict. It is a service and administrative centre serving most of southwestern Manitoba. Swan Lake (Indian Gardens) is the only First Nation community.

Much of the Stockton Ecodistrict is cultivated for the production of spring wheat, other cereal grains, oil seeds and some hay. The saline and Solonetzic soil areas are used for pasture and hay production. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of wind erosion.

759. Carberry Ecodistrict (575 km^2)

The Carberry Ecodistrict is a fairly level area surrounded on three sides by the Shilo Ecodistrict.



Climate

This ecodistrict is in a subdivision of the Grassland Transition Ecoclimatic Region that lies between the driest area to the southwest and the more humid area to the east. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.4^{o}C, the average growing season is around 181 days, and growing degree-days number about 1630.

The mean annual precipitation is about 470 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 190 mm.

The ecodistrict has a cool, subhumid, Boreal to moderately cold, subhumid, Cryoboreal soil climate.

There are no climate stations in this ecodistrict. Data from Neepawa Water (757. Shilo Ecodistrict) and Cypress River (758. Stockton Ecodistrict) stations is relevant.

Physiography and Drainage

Like the Shilo Ecodistrict, this smooth, level area forms a significant part of the Upper Assiniboine Delta that extends eastward to the Manitoba Plain. The ecodistrict consists largely of shallow, (75 to 120 cm thick) medium textured glaciolacustrine sediments overlying stratified deltaic sands. The topography is smooth and level, interrupted only where drainage channels have been cut and where underlying sandy deposits emerge at the surface as sandy islands. The mean elevation of the district is about 366 masl. The area tilts imperceptibly to the east. Slopes are usually less than 0.5 percent and generally longer than 150 m.

The ecodistrict lies wholly in the Lake Manitoba southwest division of the Dauphin River watershed, which in turn is part of the Nelson River drainage system.

Soils

Well drained, thick Black Chernozemic soils predominate on loam to clay loam surface sediments overlying the stratified sandy and gravelly deltaic deposits of the Assiniboine Delta. Virtually all of these uniformly excellent agricultural soils are cultivated and show little evidence of wind erosion damage. The surface soils tend to be acidic and cultivated soils may require liming.

Vegetation

Nearly all of the native vegetation has been replaced by cultivated fields. Prior to settlement, this area was covered by tall prairie grasses and associated herbs, with only small areas of aspen or willow groves.

Water

The principal source of water in the area is good quality groundwater from the deep, stratified, sandy and gravelly Carberry aquifer. This aquifer provides sufficient water for irrigation of commercially grown corn and potatoes.

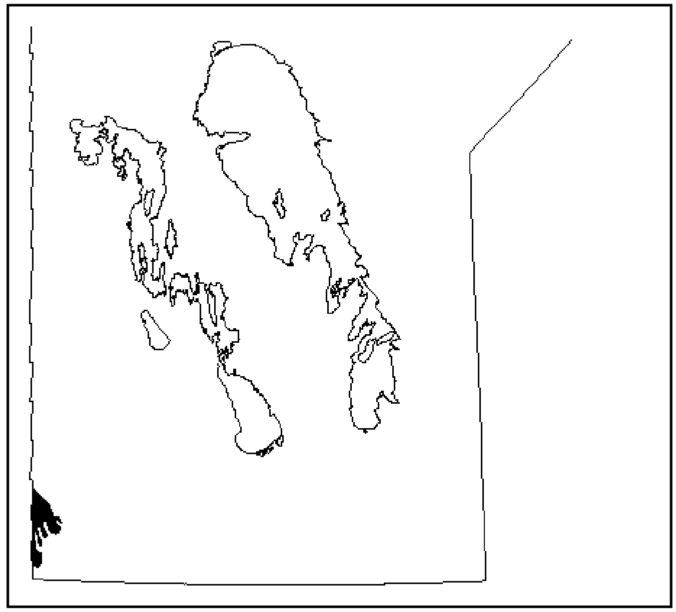
Land Use

Carberry is the major settlement.

Dryland production of spring wheat, other cereal grains, oil seeds, hay, and limited production of alfalfa and corn under irrigation occurs on virtually all of the land in the Carberry Ecodistrict. In recent years, the production of potatoes under irrigation has expanded rapidly, similar to the expansion that has taken place in the Shilo and Stockton ecodistricts.

760. Gainsborough Creek Ecodistrict (1115 km²)

The Gainsborough Creek Ecodistrict straddles the border with Saskatchewan. Only about one-sixth of the district lies within Manitoba.



Climate

This ecodistrict is in the driest subdivision of the Grassland Transition Ecoclimatic Region in southwestern Manitoba. The climate is characterized by short, warm to very warm summers and long, cold winters. The mean annual temperature is about 2.6°C, the average growing season is 180 days, and the number of growing degree-days is about 1610.

The mean annual precipitation is approximately 450 mm of which less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through early summer. Average moisture deficit over the year is about 280 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.

Data from the climate station at Pierson, located in the southeastern corner of the ecodistrict on the border with the Oak Lake Ecodistrict, is given below. Also, data from Virden (752. Melville Ecodistrict) and the now-closed Melita station (763. Oak Lake Ecodistrict) is relevant to the Manitoba portion of the Gainsborough Creek Ecodistrict.

Selected Climate Data[1] for Pierson

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	3.1	18.3	15.8	19.7	-16.3
Precip. mm (equiv.)	449.9	186.5	286.1	61.3	24.8
Rain/Snow (mm/cm)	339.2/110.4	186.5/0.0	284.6/1.2	61.3/0.0	0.2/24.6
Growing degree-days >5°C	1702.0	1225.6	1661.4	454.2	0.0

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

Physiography and Drainage

The Gainsborough Creek Ecodistrict has a mean elevation of about 485 masl. The area is an undulating and kettled glacial till plain with low local relief of less than 30 m. Slopes along the edge of the Graham, Jackson and Pipestone creeks that dissect the plain, tend to be steeper and longer than the more prevalent and more gentle and shorter slopes (about 3 percent and 50-150 m long) in the kettle or prairie pothole section of the plain.

The district lies within the Souris River watershed; the northern section is in the Hartney division and the southern section is in the Melita division. All are part of the Nelson River drainage system.

Soils

Well drained Black Chernozemic soils developed on very strongly calcareous, loamy glacial till derived from local bedrock shale, and limestone and granitic rock are predominant in the area. Local areas of imperfectly drained, variably saline, carbonated Gleyed Rego Black soils ring poorly drained Gleysolic soils in depressions. Most of the cultivated soils on well drained knolls have been affected by moderate to severe wind and water erosion.

Vegetation

Most of the natural vegetation has disappeared due to cultivation. The natural vegetation reflects the variable conditions from dry, generally low knolls to wet depressions. Grassland vegetation, which includes grama and June grass, mixed with pasture sage, woolly yarrow and milk vetch was dominant on the knolls. On moister slopes, species such as little blue-stem and spear grass associated with golden ragwort, prairie sage and hoary puccoon dominated.

Around depressions, the vegetation appears as bands or narrow zones which reflect varying moisture conditions. Aquatic plants in the wet centres of depressions, if water remains throughout the summer, and plants such as rushes, sedges and slough grasses occur in close association. Willows usually surround these depressions, which in turn may be circled by a belt of trembling aspen. This is followed upslope by a belt of shrubs with species such as silverberry, prairie-rose, snowberry, and others.

Water

Variable annual rainfall is the principal source of water where it is retained in the numerous sloughs and potholes characteristic of this kettled to hummocky terrain. Surface water in dugouts and behind small retention dams along the creeks which dissect this plain are also important water sources. Significant supplies of groundwater for domestic and livestock use are also found in small sandy and gravelly aquifers associated with the glacial till. The dominant shale bedrock underlying the till yields very little water.

Land Use

There are few communities in the ecodistrict.

Most of the Gainsborough Creek area is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of water and wind erosion. This area, characterized by numerous sloughs and ponds, is a major breeding habitat for continental mallard and pintail duck populations. While considerable pothole drainage has taken place in the past, public and private agencies are now advocating a reversal of this trend as a means of achieving a more balanced sustainable development of the area.

763. Oak Lake Ecodistrict (3424 km^2)

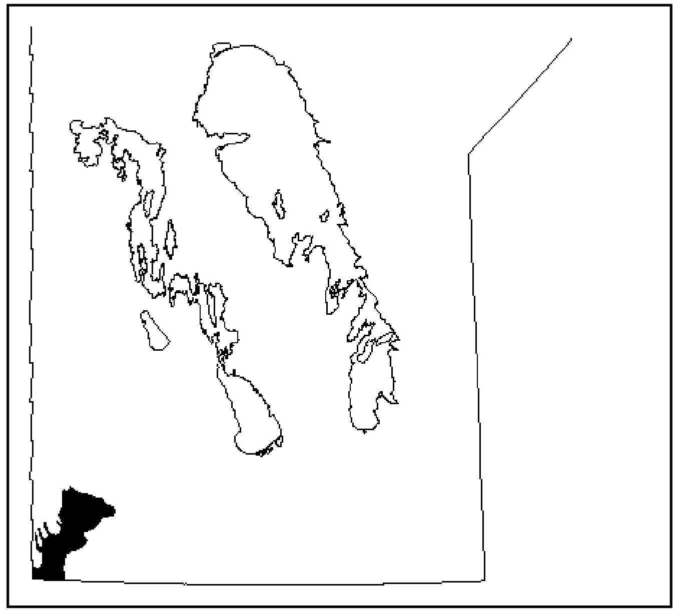
The Oak Lake Ecodistrict straddles the border with Saskatchewan on the west and North Dakota on the south. Only a small area of the Canadian portion of the ecodistrict lies in Saskatchewan.

Climate

This ecodistrict occurs in the driest subdivision of the Grassland Transition Ecoclimatic Region in southwestern Manitoba. The climate is characterized by short, warm to very warm summers and long, cold winters. The mean annual air temperature is about 2.8^{o}C, the average growing season is 182 days, and growing degree-days number about 1700.

The mean annual precipitation is about 470 mm; less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 300 mm.

The ecodistrict has a cool to moderately cool, subhumid, Boreal soil climate.



There are no climate stations in the ecodistrict. Data from the former station at Melita is presented. Data from Virden (752. Melville Ecodistrict) is relevant for the district.

Selected Climate Data[1] for Melita

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.4	18.1	15.6	19.4	-18.6
Precip. mm (equiv.)	493.6	231.3	336.4	64.8	19.2
Rain/Snow (mm/cm)	381.6/110.5	231.3/0.0	333.0/2.5	64.8/0.0	0.3/18.9
Growing degree-days >5^{0}C	1769.0	1210.3	1637.8	446.6	0.0

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

Physiography and Drainage

The Oak Lake Ecodistrict occupies most of the Souris River basin in southwestern Manitoba. The ecodistrict is not uniform due to differences in surface form, drainage and depth to water table, and texture and depth of the surface deposits.

Along the western edge is situated a strip of outwash and delta gravels with a thin sandy-loam surface. The central portion is a smooth plain of sandy-loam deltaic sediments. A significant area of hummocky terrain lies to the southeast of Oak Lake in the northern section of the ecodistrict. This topography consists of arid, duned sand, with 5 to 10 percent slopes that usually are less than 50 m long. Along the southeastern border is a strip of land consisting of water-modified clay loam till.

The mean elevation is about 442 masl with a general slope to the northeast. The drainage of this dominantly loamy, level, glaciolacustrine and fluvioglacial plain ranges from good to imperfect. Major streams and creeks in the district include the Souris River and tributaries Gainsborough, Jackson and Graham creeks. Stony Creek flows into Oak

Lake, which drains through Plum Creek into the Souris River. The former and present day channels of the Souris River are some of the more interesting physiographic features of the ecodistrict.

The ecodistrict lies in the Souris River watershed. The northern sector is part of the Hartney division, while the southern sector is part of Melita division. The Souris River watershed is part of the Nelson River drainage system.

Soils

Well drained to imperfectly drained Chernozemic Black soils are predominant in the district, with the drier soils more to the south and the moister soils to the north where the water table is higher. The Chernozemic Black soils have developed both on the sandy loams found in the central portion and in the more gravelly areas to the west. Significant areas of Regosolic soils, interspersed with Gleysolic soils in depressions, occur in the duned sand area southeast of Oak Lake. The till area contains areas of Black Solonetzic soils. Saline phases of imperfectly drained Gleyed Rego Black Chernozems and poorly drained Rego Humic Gleysolic soils are found throughout the ecodistrict as well, but are more widespread in the vicinity of Oak Lake. Extensive areas of light textured soils were injured by severe soil drifting in the 1930's.

Vegetation

The natural vegetation varies according to surface texture and groundwater influence. Most of the natural vegetation has been removed or altered through cultivation or grazing.

The duned area south of Oak Lake has the most varied vegetation, consisting of trembling aspen, willows, meadow grasses and cattails in depressions to grass vegetation on slopes and knolls. The central area supported largely prairie and meadow grasses, the latter more prevalent in the northern sector. The gravel area in the west supported largely mixed and short grass prairie vegetation.

Water

The gravelly deltaic outwash deposits along the Souris River and those along the numerous channels that once flowed into glacial Lake Souris from the west form the only aquifers suitable for irrigation wells. They are recharged by annual spring snow meltwater, but yield is variable. The Pipestone, Stony, Jackson, Gainsborough, Coulter and Antler creeks, Oak Lake and numerous dugouts provide additional important sources of surface water for domestic, livestock and wildlife use. Groundwater quality is variable and is a contributor to the salinity in the soils of the area.

Land Use

Besides Melita, which is the largest community in the ecodistrict, there are several other settlements including the Oak Lake First Nation community.

Most of the ecodistrict is continuously cropped to spring wheat, other cereal grains, oil seeds and hay crops. Much of the coarse loamy soils have been subjected to severe wind erosion damage as a result of exposure during the 1930's when summerfallow was a common farm management practice. Extensive areas of farmland abandoned at that time have since been brought back into cultivation or are being used as hayland. Today, the risk of wind erosion is greatly reduced because of continuous cropping, the retention of crop residue as surface cover and by the presence of tree shelter belts.

The ecodistrict also provides important waterfowl and upland wildlife habitat.

764. Hilton Ecodistrict (1347 km2)

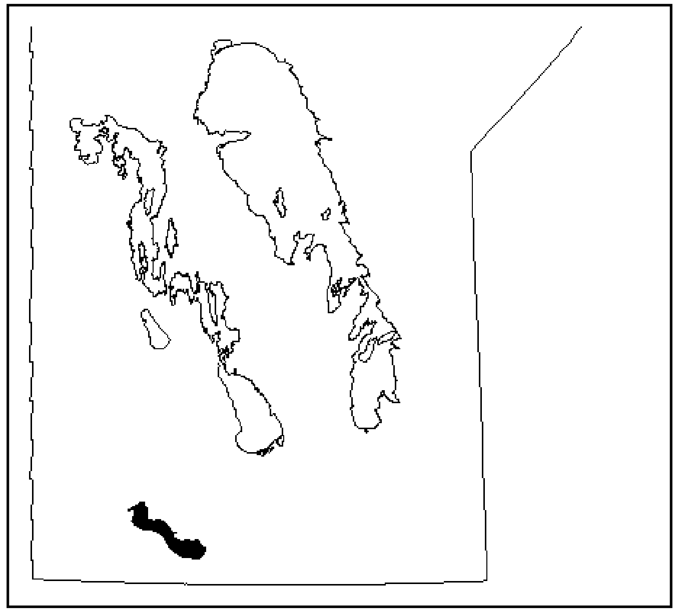
The Hilton Ecodistrict lies north of, and is bordered by, the Pembina River Valley.

Climate

This ecodistrict is in a subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is about 2.4°C, the average growing season is 182 days, and growing degree-days number about 1650.

The mean annual precipitation is approximately 510 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through early summer. Average moisture deficit over the year is about 220 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.



Baldur is the only climate station in the ecodistrict. However, data from Brandon CDA and Cypress River (758. Stockton Ecodistrict) is also relevant.

Selected Climate Data[1] for Baldur

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.4	18.8	15.3	19.2	-17.2
Precip. mm (equiv.)	533.7	232.6	341.2	73.9	23.7
Rain/Snow (mm/cm)	400.3/133.5	232.6/0.0	338.9/2.2	73.9/0.0	0.0T/23.7
Growing degree-days >5°C	1711.0	1177.7	1586.6	439.5	0.0

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

Physiography and Drainage

The Hilton Ecodistrict is an undulating to hummocky or kettled end moraine lying north of the broad Pembina River Valley. Its mean elevation is about 440 masl.

It is an area with moderate local relief of about 30 m. Slopes are gentle to moderate with 6 to 15 percent gradients and are quite short, usually less than 50 m long. Deeply incised channels and gullies, draining mainly into the Pembina River, occur near the southern edge of this upland.

This ecodistrict is part of three drainage divisions. The northwestern and eastern corners lie in the Brandon division of the Assiniboine River watershed, most of the western and central areas lie in the Hartney division of the Souris River watershed, and the southeastern corner lies in Pilot Mound division of the Red River watershed. All watersheds are part of the Nelson River system which drains into Hudson Bay.

Soils

Well drained, very shallow Black Chernozemic soils developed on very strongly to extremely calcareous glacial till derived from local bedrock shale, and limestone and granitic rock are predominant in the ecodistrict. Local areas of imperfectly drained, carbonated Gleyed Rego Black Chernozems ring poorly drained Gleysolic soils found in depressions. A significant area of saline and poorly structured Solonetzic soils occurs along the northern foothills of this upland plain. Most of the cultivated soils on well drained knolls have been variably affected by moderate to severe wind and water erosion.

Vegetation

While much of the area has been brought under cultivation, the vegetative cover in its natural state was a mixture of woods and grassland. The southern and western slopes of knolls and hills were covered with grasses and herbs, while woodland vegetation dominated the northern and eastern slopes.

Water

Variable annual rainfall is a principal source of water where most of it is retained in numerous small lakes, ponds, sloughs and dugouts in the depressions of this hummocky morainal area. Supplies of variable quality groundwater for domestic and livestock use are found in aquifers associated with the glacial till. The dominantly shale bedrock underlying the till yields very little water.

Land Use

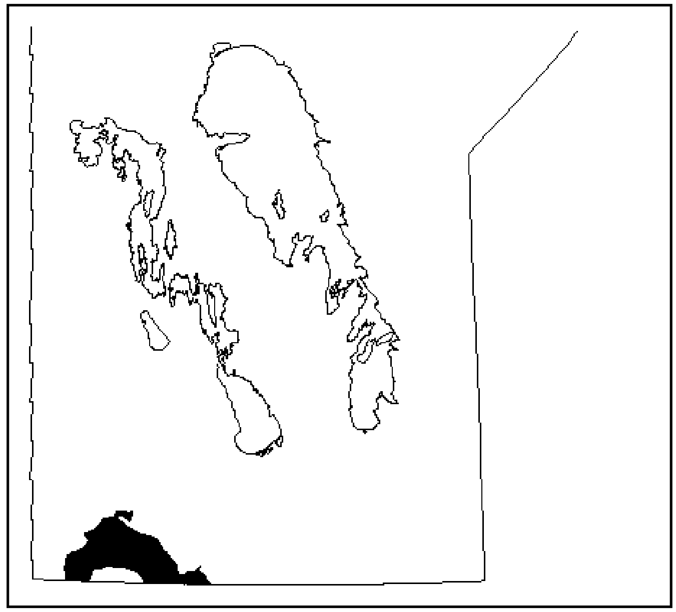
There are a number of small communities in the ecodistrict.

Much of the land is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. The saline and Solonetzic soil areas are used for pasture and hay production. Current continuous cropping practices, reduced summerfallow and retention of crop residues for surface cover has greatly reduced the risk of water and wind erosion.

The numerous wetlands are important breeding habitat and staging area for waterfowl.

765. Killarney Ecodistrict (5163 km^2)

The Killarney Ecodistrict forms an arch around Turtle Mountain, starting and terminating at the International Boundary.



Climate

This ecodistrict is in the driest subdivision of the Grassland Transition Ecoclimatic Region in southwestern Manitoba. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is about 2.8^{o}C, the average growing season is 183 days, and the number of growing degree-days ranges from about 1400 to 1500.

The mean annual precipitation is approximately 500 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through early summer. Average moisture deficit over the year is about 235 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.

There are no climate stations in the ecodistrict. Data from the Deloraine station, which is now closed, is presented. Data from Melita (763. Oak Lake Ecodistrict) and Baldur (764. Hilton Ecodistrict) has limited relevance.

Selected Climate Data[1] for Deloraine

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.7	18.1	15.5	19.4	-17.6
Precip. mm (equiv.)	490.2	225.2	329.9	67.5	20.9
Rain/Snow (mm/cm)	375.9/114.1	225.2/0.2	328.1/2.0	67.5/0.0	0.1/20.7
Growing degree-days >5^{0}C	1755.0	1204.1	1622.2	442.3	0.0

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

Physiography and Drainage

The Killarney Ecodistrict is a dissected, level to very gently rolling morainal plain lying north of Turtle Mountain in southwestern Manitoba. Elevations range from about 580 masl along the border with the Turtle Mountain Ecodistrict to about 460 masl along its northeastern edge. Its mean elevation is about 470 masl.

The ecodistrict is characterized by low relief of less than 30 m and slopes that are relatively long, generally more than 150 m, usually with gradients between 5 and 10 percent. Whitewater Lake is contained within a large imperfectly to poorly drained, level, glacial lake basin that is variably saline. Intermittent creeks issue from deeply incised channels and gullies along the southern edge of the ecodistrict at the foot of Turtle Mountain, carrying runoff into Whitewater Lake and the Pembina River.

The extreme western corner of the ecodistrict is part of the Melita drainage division, and the western and central sections are part of the Hartney drainage division, both of which are part of the Souris River watershed. The eastern section is part of the Killarney division of the Red River watershed. Both the Souris River and Red River watersheds are part of the Nelson River system, which drains into Hudson Bay.

Soils

Well drained Black Chernozemic soils developed on very strongly calcareous, loam to clay loam glacial till derived from local bedrock shale, and limestone and granitic rock are predominant in the ecodistrict.

A significant area of imperfectly drained, variably saline, carbonated Gleyed Rego Black and poorly structured Black Solonetzic soils occurs in the Whitewater Lake basin. This is as a result of discharging hydrological conditions. The occurrence of salinity in the basin is variable because of the presence of thin, discontinuous, fine-textured lenses in the subsoils that act as barriers to the upward movement of salt-laden groundwater.

Local areas of imperfectly drained, variably saline carbonated Gleyed Rego Black soils also ring poorly drained Gleysolic soils in depressions. Cultivated soils on well drained sites have not been as seriously affected by wind and water erosion as similar soils on the rougher, hummocky terrain in adjacent ecodistricts.

Vegetation

As is usual for the Prairies Ecoregion, the natural vegetation in the Killarney Ecodistrict has all but disappeared through the spread of arable agriculture. The native vegetation consisted largely of a mixture of tall-grass and short-grass prairie. Aspen groves were only present in the eastern and northeastern part. Tree cover was, and still is, present on sheltered sites such as slopes of deep ravines where more favourable conditions exist due to the additional moisture provided by snow trapped during the winter.

Water

Variable annual rainfall is the principal source of water where some of it is retained in numerous dugouts. Surface water is also stored behind numerous small headwater retention dams along the channels and gullies which dissect this plain. Significant supplies of variable quality groundwater for domestic and livestock use are found in sandy and gravelly aquifers associated with glacial till and inter-till deposits. The dominantly shale bedrock underlying the till yields very little water.

Land Use

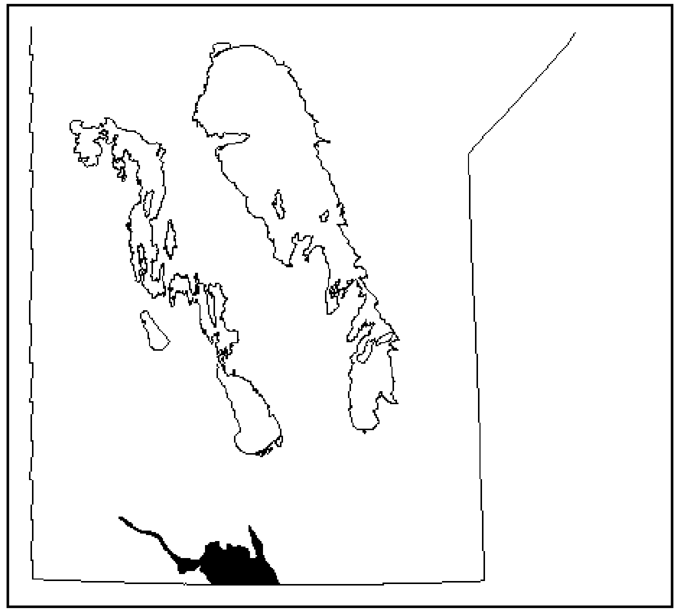
The major communities in this ecodistrict are Deloraine, Boissevain and Killarney.

Most of the land is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Much of the saline and Solonetzic soils in the Whitewater Lake basin are used for pasture and hay production. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of wind and water erosion.

Whitewater Lake and surrounding wetland is an important breeding habitat, staging and rest area for migratory waterfowl.

766. Manitou Ecodistrict (3295 km²)

The Manitou Ecodistrict is located along the border with the United Sates in south-central Manitoba and extends west along the Pembina River Valley.



Climate

This ecodistrict is in a subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba that lies between the driest subdivision to the southwest and the most humid subdivision to the east and northeast. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is about 2.7°C, the average growing season is about 183 days, and growing degree-days number 1700.

The mean annual precipitation is approximately 530 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average moisture deficit over the year is about 160 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate.

Data from the short-term station at Pilot Mound is presented below. As the Morden (CDA) climate station (852. Winkler Ecodistrict) is situated below the Manitoba Escarpment, the data from this station has only limited relevance to the eastern portion of the ecodistrict.

Selected Climate Data[1] for Pilot Mound

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.1	17.7	15.0	18.7	-18.0
Precip. mm (equiv.)	19.0	221.1	338.9	75.8	21.6
Rain/Snow (mm/cm)	398.5/122.1	221.1/0.0	334.6/2.7	75.8/0.0	0.0T/21.7
Growing degree-days >5°C	1679.0	1159.2	1554.7	429.3	0.0

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

Physiography and Drainage

The Manitou Ecodistrict encompasses an undulating to hummocky glacial till plain and the broad Pembina River Valley coursing southeastward through this plain, in addition to the western portion of the Pembina River Valley and the eastern portion of the Souris River Valley. The mean elevation of the district is about 457 masl.

The till plain consists of nearly level areas of moderate local relief of about 30 m. Slopes are very gentle to moderate, ranging from less than 5 percent to about 15 percent. Slope lengths are generally medium, ranging from 50 to 150 m.

The Pembina River Valley is a broad meltwater channel in which an underfit Pembina River flows. The valley or channel contains a number of lakes created by natural dams of sedimentation deposited on the valley floor by streams flowing out of contributory ravines. The valley west of Bone Lake falls westward to the Souris River.

For the most part, the valley is deeply incised with steep valley walls having slopes usually greater than 15 percent. The valley walls are hummocky with slope lengths that range from 50 to 150 m. Maximum relief from valley wall crest to valley floor is approximately 60 m.

Deep channels and gullies are also present along the Manitoba Escarpment, which forms the eastern edge of this upland. The escarpment, which descends about 150 to 200 m over a distance of 15 to 20 km, marks the eastern boundary of the Saskatchewan Plain where it gives way to the Manitoba Plain.

This ecodistrict is part of several drainage divisions. The most westerly section is part of the Hartney division of the Souris River watershed. The remainder of the ecodistrict is in the Red River watershed, with the western part in the Killarney division, the central portion in the Pilot Mound division, while the extreme northeast and southwest sections are part of the Morris River and Red River south divisions respectively. Both watersheds are part of the Nelson River drainage system, that drains into Hudson Bay.

Soils

Well drained Black Chernozemic soils developed on strongly calcareous glacial till derived from local bedrock shale, and from limestone and granitic rock, and on thin glaciolacustrine veneers are predominant. Local areas of imperfectly drained, carbonated Gleyed Rego Black soils ring poorly drained Gleysolic soils in depressions. A significant area of saline and poorly structured Solonetzic soils occurs in the Snowflake area south of the Pembina valley. Most of the cultivated soils on well drained knolls have been variably affected by wind and water erosion.

Vegetation

As is common throughout the ecoregion, the natural vegetation of the ecodistrict has largely been supplanted by cultivated fields. Only on steeper slopes, along valley walls, and in ravines and gullies do significant patches of natural vegetation still remain.

The till plain was largely vegetated with park-like vegetation consisting aspen groves on favourable sites and tall prairie grasses and associated herbs on the remainder.

The vegetation along the valley varies. The western section supports trembling aspen and bur oak on north-facing and east-facing slopes, while the west and south-facing slopes have vegetation of grass and artemisia. In the central section, the valley bottom lands, if they haven't been cleared, support white elm, Manitoba maple, green ash, white birch, balsam poplar and willow. The banks of the valley in this section are generally wooded with trembling aspen on north-facing slopes and bur oak on south-facing slopes, associated with a variety of shrubs and herbs. The steep banks of the eastern section of the valley are generally wooded with a combination of bur oak, trembling aspen, hazel and saskatoon, which becomes more vigorous and denser on the sloping valley floor.

Water

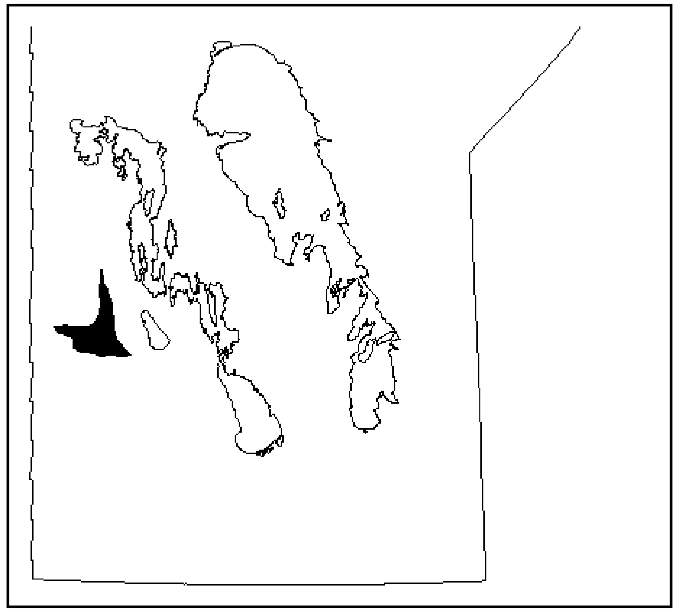
Variable annual rainfall is a principal source of water where limited amounts are retained in small ponds, sloughs and depressions. Additional surface waters are stored in dugouts and small headwater retention ponds. Significant supplies of variable quality groundwater for domestic and livestock use are found in small aquifers in the glacial till as well. The dominantly shale bedrock underlying the till yields very little water.

Land Use

There are several small communities within the ecodistrict such as Crystal City and Pilot Mound.

Most of the land is cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. The saline and Solonetzic soil areas are used for the production of hay and pasture. Current continuous cropping practices, reduced summerfallow and retention of crop residues as surface cover has greatly reduced the risk of wind and water erosion. The undrained wetlands in the area are important breeding habitat for waterfowl.

839. Grandview Ecodistrict (2219 km²)



The Grandview Ecodistrict is nestled between Riding Mountain to the south and Duck Mountain to the north and occupies all of the 161. Aspen Parkland Ecoregion.

Climate

This ecodistrict is located in the most moist subdivision of the Grassland Transition Ecoclimatic Region. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is about 1.2°C, the average growing season is 173 days, and the number of growing degree-days is around 1470.

The mean annual precipitation is approximately 500 mm of which over one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 140 mm.

The ecodistrict has a moderately cold, subhumid, Cryoboreal soil climate.

Data for the Gilbert Plains climate station is presented below. Data from the station at Dauphin (840. Dauphin Ecodistrict) is also relevant, especially for the eastern sector.

Selected Climate Data[1] for Gilbert Plains

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.2	16.9	14.3	18.2	-15.7
Precip. mm (equiv.)	497.0	209.9	318.3	70.8	18.9
Rain/Snow (mm/cm)	358.0/138.9	209.9/0.0	312.9/5.3	70.8/0.0	0.0T/18.9
Growing degree-days >5°C	1569.0	1101.3	1467.7	409.7	0.0

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

Physiography and Drainage

The Grandview Ecodistrict is situated in the erosional gap between Duck Mountain and Riding Mountain. It lies above and to the west of the Manitoba Escarpment. Its mean elevation is about 345 masl. Along the adjacent uplands to the north and south, it rises to about 520 masl.

The ecodistrict is a smooth, level to gently to moderately sloping glaciolacustrine and morainal plain with slopes ranging from level to about 10 percent in the morainal areas. General relief drops about 3.6 m per km eastward from its western boundary and at about 7.6 m per km from the north and south toward the Valley River which courses eastward through the centre of the ecodistrict. Significant changes in relief occur along the Valley River and along the numerous meandering streams and creeks emanating from the surrounding uplands, where steep relief of 5 to 10 m are encountered as a result of riverbank erosion.

The major waterway is the Valley River which collects water from several tributary creeks originating in Duck and Riding mountains. The ecodistrict lies in the Dauphin River watershed, with the northern sector in the Lake Winnipegosis division and the central and southern parts in the Mossy River division. The watershed is part of the Nelson River drainage system which drains into Hudson Bay.

Soils

The soils in the Grandview Ecodistrict are dominantly well to imperfectly drained Black Chernozems that have developed on shallow, strongly calcareous, loamy sand to clayey glaciolacustrine sediments overlying extremely calcareous glacial till, and on exposed till. At higher elevations Dark Gray Chernozems are the dominant soils on till. Local areas of poorly drained peaty Gleysolic soils, shallow mesic and fibric organic soils occur throughout the ecodistrict. Areas of imperfectly drained Gleyed Regosols are also found on alluvial sediments.

Vegetation

The extent of the natural vegetation has been reduced significantly by agriculture. Most of the ecodistrict had a parkland vegetation of groves of trembling aspen and balsam poplar with willow, dogwood and hazel shrub undergrowth, interspersed with grass and herb vegetation. Higher up the slopes to Duck and Riding mountains, white spruce appears in the forest mixture. Poorly drained depressions have balsam poplar, willow to sedges and reeds. Peaty areas have tamarack and black spruce as part of the vegetative cover.

Water

The principal sources of water are variable quality groundwater extracted from shallow, stratified, sandy and gravelly aquifers associated with till and inter-till deposits, and surface water from the Valley River and the numerous creeks and streams emanating from the uplands. Water well development is variable from the Swan River bedrock formation because of the variable concentrations of salt in these waters. Salt concentrations in groundwater at a depth of 30 to 60 m below the surface can exceed 4000 mg/l. The Swan River formation lies below the glacial deposits.

Land Use

There are several small communities in the ecodistrict such as Gilbert Plains, Grandview and Tootinaowaziibeeng (Valley River) First Nation.

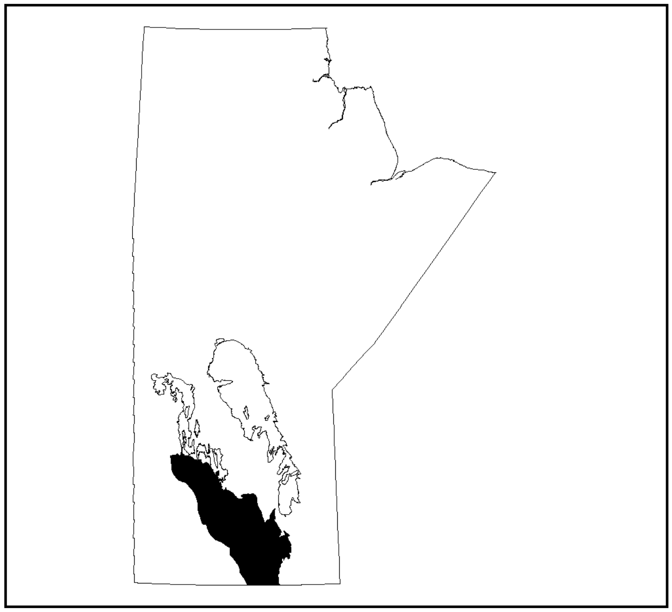
Most of the soils in the Grandview district are cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Areas where drainage has not been improved are used for native pasture and hay. The wooded areas provide wildlife habitat for white-tailed deer, black bear and ruffed grouse. The district also contains habitat for waterfowl.

Gilbert Plains

Gilbert Plains is a farming community located in the Grandview Ecodistrict, which forms the most northerly extension of the Prairies Ecozone in Manitoba.

162. Lake Manitoba Plain Ecoregion

The Lake Manitoba Plain Ecoregion stretches northwestward from the International Boundary to Lake Dauphin in southern Manitoba. The Manitoba Escarpment marks its western boundary. Before settlement this ecoregion was a mosaic of trembling aspen/oak groves and rough fescue grasslands.



Climate

This ecoregion forms a portion of the extensive Grassland Transition Ecoclimatic Region which extends in a broad arc from southern Manitoba northward through Saskatchewan to its most northern extent in central Alberta. It is one of the warmest and most humid ecoregions on the Prairies. Short, warm summers and long, cold winters are characteristic of the regional climate. The mean annual average air temperature ranges from 1.7^{o}C in the north to 3.3^{o}C along the Canada-United States border. The mean annual temperatures vary from 1.8^{o}C to 3.1^{o}C, with mean summer temperatures around 16^{o}C and the mean winter temperatures of about -12.5^{o}C.

The mean annual precipitation ranges from 485 to 540 mm and varies greatly from year to year. Precipitation is highest during the growing season. Mean yearly moisture deficits range from 100 to 210 mm. About one-quarter of the precipitation falls as snow. The average growing season varies from 177 to 187 days, and the number of growing degree-days ranges from 1550 to about 1840.

This ecoregion has a cool, subhumid, Boreal to moderately cold, subhumid to humid, Cryoboreal soil climate.

The climate data from the stations at Dauphin and Winnipeg illustrates the range of climate conditions encountered.

Selected Climate Data[1] for Dauphin

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.0	-14.9	-7.7	2.6	10.5	16.0	18.6	17.3	11.3	5.3	-5.3	-14.9	1.7
Precip. mm	19.3	16.1	25.7	31.7	52.7	77.5	69.3	63.3	62.0	31.2	22.7	20.5	491.9
Growing degree-days	0.0	0.0	1.4	44.4	184.2	330.7	422.1	380.0	195.6	68.3	4.8	0.0	1631.0

Selected Climate Data[1] for Winnipeg

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-18.3	-15.1	-7.0	3.8	11.6	16.9	19.8	18.3	12.4	5.7	-4.7	-14.6	2.4
Precip. mm	19.3	14.8	23.1	35.9	59.8	83.8	72.0	75.3	51.3	29.5	21.2	18.6	504.4
Growing degree-days	0.0	0.0	1.8	54.1	214.0	357.8	457.6	413.6	224.0	74.9	4.3	0.0	1802.0

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

Surficial Deposits, Landforms, Soils

This ecoregion is situated in the Manitoba Plain, the lowest and most level of the three prairie steps. It is underlain by low-relief, flat-lying Paleozoic limestone bedrock and is covered by glacial till and by silts and clays deposited by glacial Lake Agassiz. Lake Dauphin and the southern half of Lake Manitoba are part of this ecoregion. Lower and smoother than the Saskatchewan Plain to the west, the plain has an elevation ranging from about 410 masl near the Manitoba Escarpment to about 240 masl near Lake Winnipeg.

The northern half has a distinct, north-south trending, drumlinoid or ridge and swale topographic pattern. The fluted, and often grooved, ridges are about 400 to 800 m wide and are separated by broad swales or depressions up to 800 m wide. Following the retreat of the continental glacier, the surface of this ridged till plain was modified by wave action and by icebergs scouring the ridges as glacial Lake Agassiz retreated. Wave action has resulted in local textural differentiation; the ridges are moderately coarse textured, as well as cobbly and gravelly, and the depressions are finer textured. Iceberg scouring has created strongly intersecting micro-grooves or flutes that are usually curvi-linear in shape.

The southern half of the lowland has been smoothed by thick, generally varved deposits of clays and silts of glacial Lake Agassiz. Relic beaches wind along the lower part of the Manitoba Escarpment, marking successively lower water levels or stages of Lake Agassiz.

Soils

The soils of the ecoregion are dominantly Black Chernozemic soils developed on loam and clay-loam till materials, and Humic Vertisolic, Black Chernozemic and Gleysolic soils developed on clay glaciolacustrine sediments. Areas of Black Chernozemic soils are also present on sandy-loam and sandy glaciolacustrine sediments, and on sandy-loam to clay-loam alluvial materials.

Some of the most productive agricultural soils in Manitoba are found in this ecoregion. The soils associated with the fine-textured glaciolacustrine sediments are especially suited to a wide variety of crops including cereals, oilseeds and pulses.

Vegetation

In Manitoba, trembling aspen and shrubs occur on moist sites, while bur oak and grassland communities occupy increasingly drier sites. Dominant grasses include fescue grasses, wheat grasses, June grass and Kentucky bluegrass. A wide variety of deciduous shrubs and herbs are abundant. Poorly drained sites support slough grasses, marsh reed grass, sedges, cat-tails, sedge and shrubby willow.

Wildlife

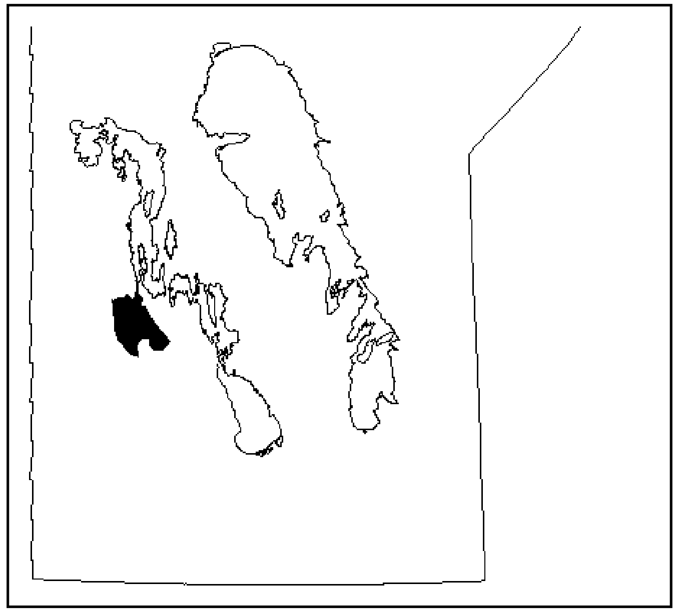
The region includes habitat for white-tailed deer, coyote, rabbits, ground squirrels, and waterfowl.

Land use

Production of spring wheat and other cereal grains by continuous cropping and dryland methods dominates the agriculture of the ecoregion. Oilseeds and hay are more prevalent in the northern section of the plain..

There are twelve ecodistricts within the Lake Manitoba Plain Ecoregion in Manitoba.

840. Dauphin Ecodistrict (2109 km²)



The Dauphin Ecodistrict is located in the northwestern corner of the Lake Manitoba Plain Ecoregion and includes Dauphin Lake.

Climate

This ecodistrict lies within the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is around 1.8°C, the average growing season is 177 days, and growing degree-days number about 1545.

The mean annual precipitation is approximately 500 mm of which one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 160 mm.

The ecodistrict has a moderately cold to cold, humid, Cryoboreal soil climate.

Selected Climate Data[1] for Dauphin

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.7	17.3	14.7	18.6	-18.0
Precip. mm (equiv.)	491.9	210.1	324.8	69.3	19.3
Rain/Snow (mm/cm)	366.3/137.9	209.9/0.2	318.3/6.3	69.3/0.0	0.3/21.5
Growing degree-days >5°C	1631.0	1132.8	1512.6	422.1	0.0

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

Physiography and Drainage

The Dauphin Ecodistrict lies along the foot of the Manitoba Escarpment and has a mean elevation of about 290 masl. The area is a smooth, level to very gently sloping glaciolacustrine plain with slopes ranging from level to less than 2 percent. Local relief changes approximately 3.4 m per km. Some stronger relief of 5 to 10 m occurs along the meandering Edwards Creek and Vermillion, Wilson and Valley rivers as a result of river bank erosion. The ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Nearly all of the soils in the area are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, very strongly calcareous, loamy-sand to clayey sediments. The sandy and silty soils are shallower and are also much more susceptible to wind erosion than the clayey soils. Local areas of imperfectly drained Regosolic soils, poorly structured Solonetzic Black Chernozems and poorly drained Gleysolic soils also occur.

Vegetation

The natural vegetation has been strongly altered by agricultural development. The ecodistrict was originally a mixture of tree bluffs and grassland. Where forest cover remains, it is dominated by trembling aspen stands and bluffs. The associated understory consists of shrubs, dominantly beaked hazelnut, but also red-osier dogwood, high bush cranberry, rose, pin cherry and saskatoon. Associated herbs include wild sarsaparilla, red baneberry and sweet-scented bedstraw. On poorly drained sites, it is associated with balsam poplar. Flood plains have Manitoba maple, green ash, some white elm and willow.

Water

The principal source of water is variable quality groundwater extracted from shallow, sandy and gravelly aquifers associated with glacial till and channel deposits. The Swan River formation and Devonian limestone aquifers are also used as water sources for domestic use and livestock. However, quality in these aquifers ranges from good to beyond the limit recommended for human and livestock use (more than 4000 mg soluble salts per litre).

Land Use

The city of Dauphin is by far the largest community in the ecodistrict and is the service and administrative centre for this and adjacent ecodistricts.

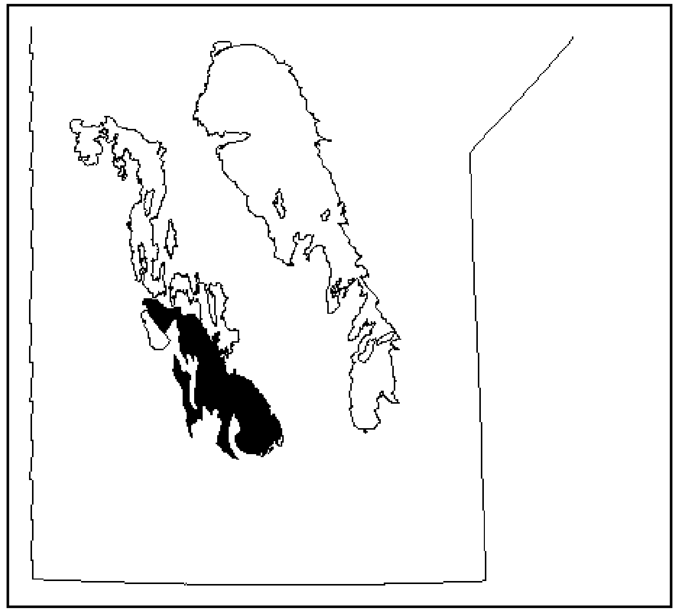
Most of the soils are cultivated for the production of spring wheat, other cereal grains, oilseeds and hay crops. The wooded strips of land along creeks and rivers provide wildlife habitat and recreational sites.

Wind erosion

Wind can remove large quantities of top soil on light textured soils. The problem is most severe in spring and fall when soils are bare. Practices to reduce the potential for wind erosion include planting shelterbelts and maintaining a crop residue cover.

841. Alonsa Ecodistrict (7568 km^2)

The Alonsa Ecodistrict lies in the northwestern section of the Lake Manitoba Plain Ecoregion, and extends from north of Dauphin Lake to near the southern extent of Lake Manitoba, and includes the southern basin of the lake.



Climate

This ecodistrict is located in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is around 2.0^{o}C, the average growing season is 177 days, and the number of growing degree-days is around 1600.

Mean annual precipitation is approximately 510 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 100 mm.

The ecodistrict has a moderately cold, subhumid to humid, Cryoboreal soil climate.

The station at Vogar is situated along the shore of Lake Manitoba, and for that reason the data may be somewhat less valid for those areas that lie some distance inland.

Selected Climate Data[1] for Vogar

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	1.7	18.0	15.3	19.5	-18.3
Precip. mm (equiv.)	510.9	212.9	325.1	66.0	24.7
Rain/Snow (mm/cm)	383.7/127.2	212.9/0.0T	322.2/2.9	66.0/0.0	0.2/24.4
Growing degree-days >5^{0}C	N	N	N	444.1	0.0

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

Physiography and Drainage

The Alonsa Ecodistrict, situated on the west side of Lake Manitoba, has a mean elevation of about 274 masl. The ecodistrict has a distinct, north-south trending, drumlinoid or ridge and swale topographic pattern. The fluted, and often grooved, ridges are about 400 to 800 m wide and are separated by broad swales or depressions up to 800 m wide.

Following the retreat of the continental glacier, the surface of this ridged till plain was modified by wave action and by icebergs scouring the ridges as glacial Lake Agassiz retreated. Wave action has resulted in local textural differentiation. Ridges are coarser textured and cobbly and gravelly, especially on the surface, and the depressions have finer textured sediments. Iceberg scouring has created strongly intersecting micro-grooves or flutes that are usually curvi-linear in shape. Slopes range from level to less than 5 percent.

Regional relief changes approximately 1.5 m per km, while local relief from apex of ridge to bottom of swale ranges from 1 to 5 m. The ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

The soils on well drained to imperfectly drained ridges are dominantly Rego Black and Gleyed Rego Black Chernozems that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay-loam, water-worked glacial till. Significant areas of poorly drained Gleysolic soils occur in the swales, with most having thin peaty surface layers. Soil profile development is very shallow (usually less than 15 cm thick). Glacial deposits can vary in thickness from less than 100 cm to more than 30 m.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope and lack of natural drainage contribute to the soil problems in the area.

Vegetation

The native vegetation has been strongly modified by agriculture. Where native vegetation remains, it is generally a mixture of trembling aspen groves and grassland, and on well drained, moderately coarse textured soils, bur oak and grasses. On wetter sites, balsam poplar is often mixed with the aspen. Associated shrubs are beaked hazelnut, pin cherry, saskatoon, rose and red-osier dogwood. Most shrubs are prevalent along the edges of the groves. Herbs include sarsaparilla and sweet-scented bedstraw. Common grasses are big and little bluestem and wild rye. On river flats, white elm, green ash, Manitoba maple, basswood and willow are found.

Water

The principal source of water is variable quality groundwater extracted from shallow aquifers of sand and gravel associated with till, beach deposits, inter-till outwash, river alluvium and channel deposits. Water well development is poor from bedrock aquifers of Jurassic formations because of the very high concentrations of salt. Devonian limestone aquifers are made up of fractured rock and both water quantity and quality are variable.

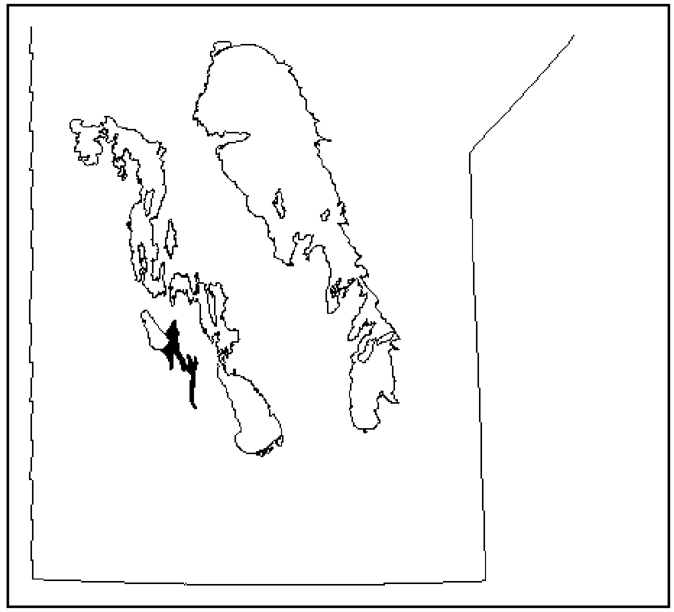
Land Use

There are several communities in the ecodistrict including Amaranth, Alonsa, Eddystone and Ebb and Flow First Nation.

Only limited portions of the ecodistrict are cultivated for the production of spring wheat, other cereal grains, oilseeds and hay crops. Much of the land is public land and leased for native pasture and hay. The ecodistrict contains important wildlife and waterfowl breeding habitat, and provides staging and rest areas for migratory birds.

843. Ste. Rose Ecodistrict (922 km²)

The Ste. Rose Ecodistrict is a fairly small, elongated area to the southeast of Dauphin Lake.



Climate

This ecodistrict is in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is marked by short, warm summers and long, cold winters. The mean annual temperature is about 2.4°C, the average growing season is 179 days, and growing degree-days number about 1610.

The mean annual precipitation is approximately 525 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. Average yearly moisture deficit is about 100 mm.

The ecodistrict has a moderately cold, subhumid to humid, Cryoboreal soil climate.

There is no climate station in the ecodistrict. Climate data from the Dauphin station (840. Dauphin Ecodistrict) is fairly representative.

Physiography and Drainage

The Ste. Rose Ecodistrict is situated at the south end of Dauphin Lake. Its mean elevation is about 274 masl.

The topography is a smooth, level to very gently sloping glaciolacustrine plain with slopes ranging from level to less than 2 percent. Relief falls approximately 1.0 m per km to the north. A more significant change of relief of approximately 3.0 to 5.0 m occurs along the meandering Turtle and Hansen creeks as a result of river bank erosion. This ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Nearly all of the soils are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, very strongly to extremely calcareous, silty to sandy sediments, many of which overlie very strongly to extremely calcareous loamy till. These soils are susceptible to wind erosion and exhibit slight to moderate wind erosion damage. Local areas of poorly drained Gleysolic soils, well drained Black Chernozemic soils on till ridges and former strandlines, as well as some well drained Dark Gray Luvisols are present on some of the sandy soils. South of Dauphin Lake, an area of Terric (shallow) Mesisols occurs in a former lake bottom.

Vegetation

The vegetation reflects the general impeded drainage conditions. Imperfectly drained sites have vegetation of trembling aspen with balsam poplar, willows and grasses. Wetter sites have sedges, reed grasses, meadow grasses, clumps of willows and some trembling aspen and balsam poplar. Some of the better drained, coarse textured ridges have vegetation that varies from trembling aspen and shrubs to mixtures of trembling aspen, bur oak and grasses, and on some occasions, jack pine. The peatland areas have vegetation of sedges, reeds, meadow grasses, swamp birch and clumps of willows.

Water

The principle source of water is variable quality groundwater from shallow aquifers of sand and gravel associated with till, beach deposits, inter-till outwash, river alluvium and channel deposits. Water well development is poor from bedrock aquifers of Jurassic formations because of the very high concentrations of salt. Devonian limestone aquifers are made up of fractured rock and both quantity and quality are variable.

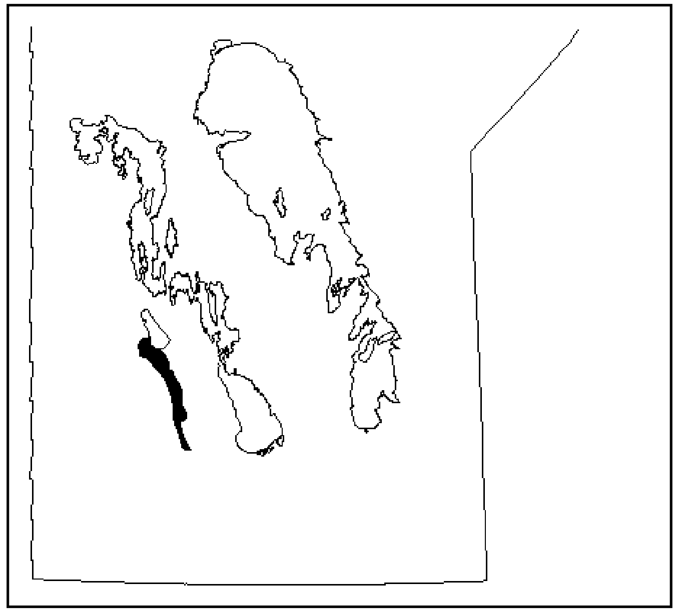
Land Use

Ste. Rose du Lac is the major community in the ecodistrict.

Most of the soils are cultivated and used for the production of spring wheat, other cereal grains, oil seeds and hay crops. The wooded strips of land along creeks and rivers, and on coarse textured ridges, provide wildlife habitat and recreational sites.

844. McCreary Ecodistrict (1446 km²)

The McCreary Ecodistrict is an elongated area along the northwestern side of the Manitoba Plain Ecoregion at the foot of the Manitoba Escarpment east of Riding Mountain.



Climate

This ecodistrict is situated in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.3^{o}C, the average growing season is 179 days, and the number of growing degree-days is about 1610.

The mean annual precipitation is approximately 520 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average moisture deficit over the year is about 110 mm.

The ecodistrict has a moderately cold, subhumid to humid, Cryoboreal soil climate.

The are no climate stations in the ecodistrict, but the data from stations at Dauphin (840. Dauphin Ecodistrict) and Neepawa (757. Shilo Ecodistrict) is somewhat relevant.

Physiography and Drainage

The ecodistrict ranges in elevation from about 365 m along its southwestern edge to about 270 masl along its northeastern boundary at Dauphin Lake. The mean elevation is about 305 masl.

The topography is a smooth, level to very gently sloping, glaciolacustrine and glaciofluvial plain in which slopes range from level to less than 2 percent. A number of relic beach ridges also occur in the district, marking various stages of glacial Lake Agassiz. Relief falls approximately 3.0 m per km to the east. A significant change in relief of approximately 3.0 to 5.0 m occurs as a result of river bank erosion along meandering streams and creeks emanating from the escarpment. The ecodistrict is subject to flooding in spring and after heavy summer storms, which causes further erosion of channels and roadside ditches that carry runoff from the escarpment. The ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

Nearly all of the soils in the McCreary Ecodistrict are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, very strongly calcareous, loamy to clayey glaciolacustrine sediments overlying water-worked, very strongly calcareous till, and Gleyed Cumulic Regosols on deeper fluvial sediments. Significant local areas of poorly drained Gleysolic soils and areas of imperfectly drained saline soils also occur. The soils are subject to flooding in spring and after summer storms. Significant amounts of shaly sediment are often deposited along the escarpment by flooding water.

Vegetation

The vegetation has been strongly modified by agriculture. Imperfectly drained soils have natural vegetation of trembling aspen, balsam polar, red-osier dogwood and willows, herbs and grasses. Poorly drained areas have sedges, meadow grasses and willows. The coarse textured beach ridges have vegetation varying from bur oak to trembling aspen with associated vegetation of shrubs such as beaked hazelnut, pin cherry and saskatoon or grasses and herbs. The fluvial sediments had a vegetation dominated by white elm, green ash, Manitoba maple, willows and associated shrubs and herbs. In most cases, only narrow bands of this type of vegetation still remain along creeks and rivers today.

Water

The principal source of water is variable quality groundwater extracted from shallow, stratified, sandy and gravelly aquifers associated with till and channel deposits. Water well development is poor from the Jurassic formations that occur below the glacial deposits because of the very high concentrations of salt in these groundwaters.

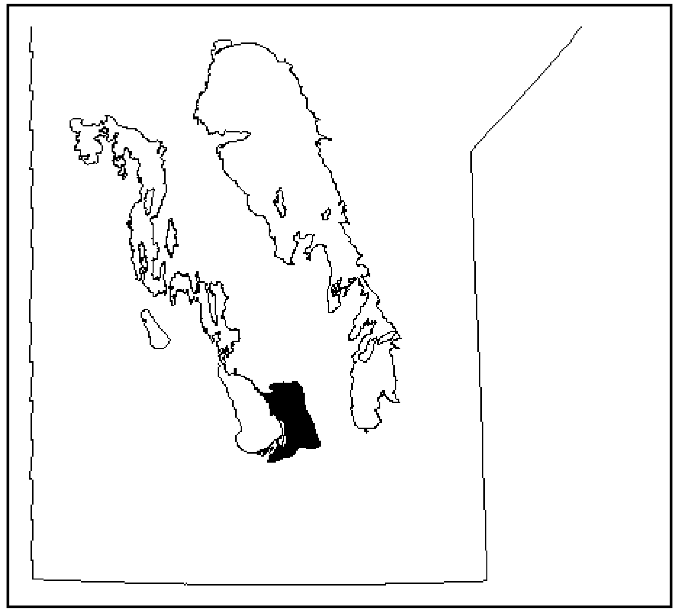
Land Use

There are several communities, of which McCreary is the largest.

Most of the soils are cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Saline-affected areas are used for native pasture and hayland. The wooded strips of land along creeks and gullies provide wildlife habitat and recreational sites.

846. Lundar Ecodistrict (2580 km^2)

The Lundar Ecodistrict is located in the northeastern part of the Lake Manitoba Plain Ecoregion, east of Lake Manitoba.



Climate

This ecodistrict is in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is around 2.2°C, the average growing season is 181 days, and growing degree-days number about 1670.

The mean annual precipitation is approximately 485 mm, of which less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is about 190 mm.

The ecodistrict has a moderately cold, humid to subhumid, Cryoboreal soil climate.

The climate station at Lundar is now closed, but data collected prior to its closure is likely still relevant.

Selected Climate Data[1] for Lundar 4SW

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	1.1	17.4	15.1	18.8	-20.9
Precip. mm (equiv.)	451.7	198.3	303.2	55.7	20.1
Rain/Snow (mm/cm)	357.9/95.5	198.3/0.0	302.9/0.7	55.7/0.0	0.0/20.1
Growing degree-days >5°C	1655.0	1139.0	1558.0	427.0	0.0

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

Physiography and Drainage

The Lundar Ecodistrict, situated on the east side of Lake Manitoba, has a mean elevation of about 251 masl. The ecodistrict has a north-south trending, drumlinoid or ridge and swale topographic pattern. The fluted or grooved ridges, ranging from about 400 to 800 m wide, are separated by variable-sized swales or depressions up to 800 m wide.

Following the retreat of the continental glacier, the surface of this gently undulating till plain was modified by wave action and by icebergs scouring the ridges as glacial Lake Agassiz retreated. Wave action has resulted in local textural differentiation; materials on the ridges are more coarse, cobbly and gravelly, and the depressions are finer textured. Iceberg scouring has created strongly intersecting micro-grooves or flutes that are usually curvi-linear in surface form. Slopes range from level to less than 5 percent.

Relief falls approximately 0.6 m per km, generally to the west, while local relief from ridge apex to swale bottom ranges from 0.5 to 3.0 m. The ecodistrict is part of the Dauphin River drainage division, which is part of the Nelson River drainage system.

Soils

The soils on well to imperfectly drained ridges are dominantly Rego Black and Gleyed Rego Black Chernozems that have developed on extremely to very strongly calcareous, very cobbly to gravelly, loamy to clay-loam water-worked glacial till. Significant areas of poorly drained Gleysolic soils occur in the swales and most of these soils have thin peaty surface layers. In general, soil profile development is very shallow (usually less than 15 cm thick). Locally, some better drained till areas have shallow Dark Gray Luvisolic and Dark Gray Chernozemic soils.

Gleysolic soils are also widespread and associated with extensive areas of marshland along Lake Manitoba and around the Shoal Lakes. The latter area also has extensive saline areas. Glacial deposits in the district can vary in thickness from less than 10 cm, where limestone bedrock outcrops, to more than 30 m.

Excessive amounts of stones and cobbles, an irregular topographic pattern that runs perpendicular to the general regional slope, and lack of natural drainage contribute to the soil problems in the area.

Vegetation

Vegetation on imperfectly drained soils is largely sedges and willows, with salt-tolerant plants where salts are close to or at the surface. Where drainage is slightly better, trembling aspen, willows, some bur oak mixed with areas of meadow and other grasses are found.

Well drained shallow till areas support stunted trembling aspen, bur oak, beaked hazel nut and prairie grasses, while deeper till areas may have some white spruce scattered throughout. Many stands of trembling aspen and bur oak have been impoverished by cattle grazing and shrub fires.

Poorly drained soils have slough grasses, reeds and sedges, and salt-tolerant plants where salinity is a problem.

Water

The principal source of water is variable quality groundwater extracted from shallow aquifers of sand and gravel associated with till, beach and inter-till outwash deposits. Water well development is poor from Devonian bedrock formations. Limestone aquifers are made up of fractured rock and both water quantity and quality are variable.

Land Use

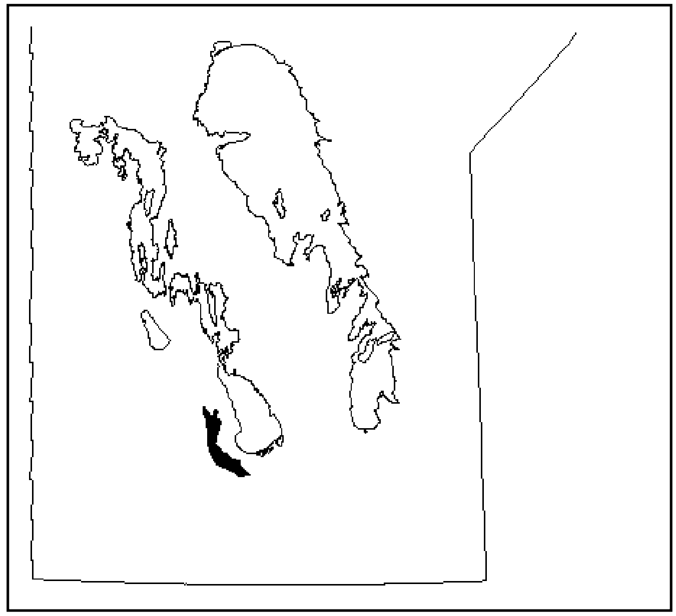
Lundar is the largest community in the ecodistrict.

Only limited portions are cultivated for the production of spring wheat, other cereal grains, oil seeds and hay crops. Much of the land is public land and leased out for native pasture and hay. The environment provides important wildlife and waterfowl breeding habitat.

Canada geese

Canada geese are a common sight in southern Manitoba during spring and fall migration. Although the geese breed throughout Manitoba, most migrate in the spring to northern regions. In the fall, the extensive grain fields in the south provide opportunity to prepare for the next stages of the journey south.

847. Gladstone Ecodistrict (1026 km²)



The Gladstone Ecodistrict occupies a relatively small area of the west-central portion of the Lake Manitoba Plain Ecoregion.

Climate

This ecodistrict lies in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.2°C, the average growing season is 179 days, and the number of growing degree-days is about 1630.

The mean annual precipitation is approximately 490 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is about 170 mm.

The ecodistrict has a moderately cold, subhumid to humid, Cryoboreal soil climate.

There are no climate stations in the ecodistrict, but the data from the climate station in Portage la Prairie (851. Portage la Prairie Ecodistrict) is relevant.

Physiography and Drainage

The Gladstone Ecodistrict is located immediately east of the sandy Lower Assiniboine Delta, below the 274 masl contour. The district is a level to very gently sloping glaciolacustrine plain with a mean elevation of about 267 masl. Slopes range from level to less than 2 percent and are smooth and long (longer than 150 m). Relief falls approximately 0.8 m per km in a northeasterly direction. Some change in relief of approximately 3.0 to 5.0 m occurs along the meandering Whitemud River coursing eastward through the ecodistrict. The ecodistrict is part of the Lake Manitoba Southwest drainage division, which is part of the Nelson River drainage system.

Soils

Most of the soils are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, slightly to strongly calcareous, loamy to clayey glaciolacustrine sediments. Internal drainage is impeded by the presence of clay surface textures in the south and a clay substrate in the northern section, causing high water tables. Local areas of poorly drained Gleysolic soils and imperfectly drained, variably saline Black and poorly structured Black Solonetzic soils also occur.

Cultivated loamy soils in the northern section of the ecodistrict have been subjected to variable wind erosion damage since cultivation.

Vegetation

The native vegetation has been considerably changed by cultivation. Native vegetation consisted of groves of trembling aspen separated by grasses, forbs, and shrub-dominated vegetation. The vegetation of Big Grass Marsh is dominated by reed grasses, sedges and cat-tails.

Water

The principal source of water is good quality surface water from the Whitemud River. Variable quality groundwater is also available from shallow sandy and gravelly aquifers associated with till and inter-till aquifers that lie below the loamy to clayey surface deposits. Water well development from the Jurassic formations lying below the glacial deposits is poor because of the very high concentrations of salt in the groundwater.

Land Use

Gladstone is the largest community in the ecodistrict.

Much of the ecodistrict is cultivated and used for the production of spring wheat, other cereal grains, oil seeds and hay crops. The saline and Solonetzic soil areas are used for tame and native hay production and for pasture.

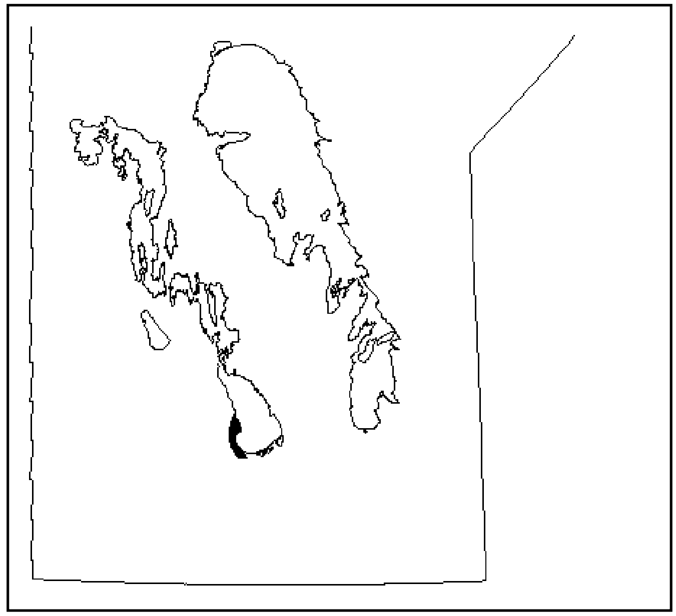
The wooded strips of land along the Whitemud River provide wildlife habitat and water-oriented recreational sites. Big Grass Marsh is important to waterfowl as breeding habitat, and a resting and staging area.

Water erosion control structure

To reduce the potential for water erosion, control structures like the one shown above are constructed in ditches.

848. Langruth Ecodistrict (361 km²)

The Langruth Ecodistrict occupies a fairly narrow strip of land along the southwest shore of Lake Manitoba.



Climate

This ecodistrict is located in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.2°C, the average growing season is 178, days and the number of growing degrees is around 1640.

The mean annual precipitation is approximately 520 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is about 110 mm.

The ecodistrict has a moderately cold, humid to subhumid, Cryoboreal soil climate.

The data from the climate station at Langruth is valid, but incomplete.

Selected Climate Data[1] for Langruth

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.3	17.8	15.4	19.2	-17.4
Precip. mm (equiv.)	531.6	223.4	329.7	69.0	24.0
Rain/Snow (mm/cm)	398.4/133.1	223.4/0.0	328.3/1.5	69.0/0.0	0.2/23.8
Growing degree-days >5°C	N	1179.9	N	440.7	0.0

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

Physiography and Drainage

The Langruth Ecodistrict lies immediately west of Lake Manitoba and has a mean elevation of about 267 masl. It is a level to very gently sloping glaciolacustrine plain. Slopes range from level to less than 2 percent and are smooth and long (more than 150 m). Relief falls approximately 0.3 m per km to the east. Local relief of approximately 3.0 to 5.0 m occurs along the lake shore. The ecodistrict is part of the Lake Manitoba Southwest drainage division, which is part of the Nelson River drainage system

Soils

Most of the soils in the Langruth Ecodistrict are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, extremely to strongly calcareous, loamy to sandy-loam glaciolacustrine sediments. Internal drainage in the district is impeded by a fine textured substrate resulting in high water tables. There are significant local areas of poorly drained Gleysolic soils nearer the lake shore. Cultivated loamy soils in the district have been subjected to variable water erosion damage since cultivation.

Vegetation

The vegetation has been considerably changed by cultivation. Native vegetation consists of meadow grasses interspersed with small groves of trembling aspen and balsam poplar on imperfectly-drained sites. Meadow grasses, reeds and sedges dominate poorly drained sites, including the shallow peatlands bordering part of the shore of Lake Manitoba.

Water

The principal water sources are shallow sandy and gravelly aquifers associated with till and inter-till aquifers that lie below the loamy surface deposits. Water well development from the Jurassic formations below the glacial deposits is poor because of the very high concentrations of salt in these groundwaters.

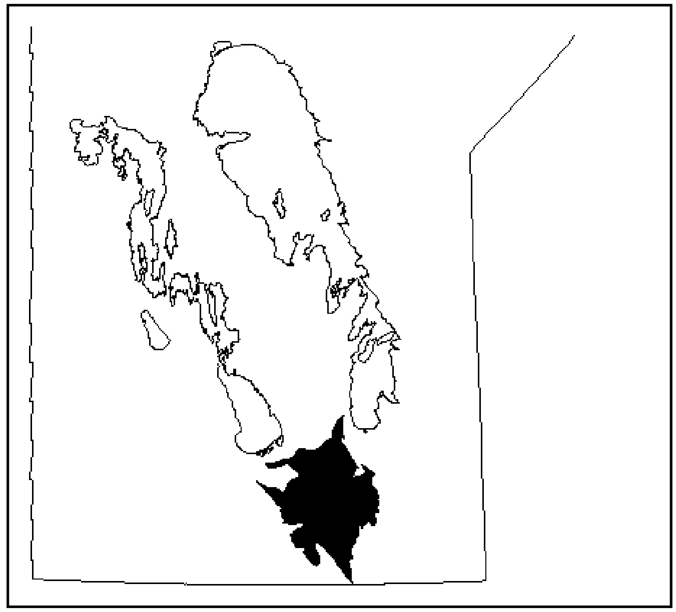
Land Use

Langruth and Sandy Bay First Nation are the largest communities in the ecodistrict.

Most of the soils are cultivated and used for the production of spring wheat, other cereal grains, oil seeds and hay crops. Saline areas are used for native pasture and hayland.

849. Winnipeg Ecodistrict (9212 km^2)

The Winnipeg Ecodistrict occupies most of the southeastern portion of the Lake Manitoba Plain Ecoregion. It extends from the Canada-US border to about 50° 30' N.



Climate

This ecodistrict is in the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.4°C, the average growing season is 183 days, and growing degree days number about 1720.

The mean annual precipitation is approximately 515 mm of which less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average yearly moisture deficit is about 200 mm.

The ecodistrict has a cool, subhumid to humid, Boreal to a moderately cold, subhumid, Cryoboreal soil climate.

Selected Climate Data[1] for Winnipeg Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.4	18.3	15.8	19.8	-18.3
Precip. mm (equiv.)	504.4	231.1	342.2	72.0	19.3
Rain/Snow (mm/cm)	404.4/114.8	231.1/0.0T	339.8/2.4	72.0/0.0	0.3/22.6
Growing degree-days >5°C	1802.0	1229.0	1667.0	457.6	0.0

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

Selected Climate Data[1] for Morris

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.6	18.6	16.1	20.0	-18.7
Precip. mm (equiv.)	516.0	215.6	323.5	76.0	26.9
Rain/Snow (mm/cm)	385.2/127.8	215.6/0.0	322.2/0.8	76.0/0.0	0.2/26.7
Growing degree-days >5°C	1867.0	1256.0	1717.0	462.0	0.0

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

Physiography and Drainage

The Winnipeg Ecodistrict lies in the central lowland of the Red River Plain. It is a smooth, level to very gently sloping, clayey glaciolacustrine plain with a mean elevation of about 236 masl.

The Red River meanders northward through the centre of the plain and empties into Lake Winnipeg, a remnant of former glacial Lake Agassiz, at 218 masl. Slopes range from level to less than 2 percent and are smooth and long (exceeding 150 m). Relief falls approximately 0.4 m per km from the western edge of the plain to the Red River and at the rate of about 1.0 m per km from its eastern edge to the Red River. Relief from south to north through the basin is about 0.3 m per km. Some stronger relief of about 5 to 10 m occurs along the Red and its major tributaries. These are the Morris, La Salle, and Assiniboine rivers flowing from the west and the Roseau, Rat, and Seine rivers flowing from the east.

The northwestern part of the ecodistrict is part of the Assiniboine River drainage division, while the remainder is part of the Red River drainage division, which both are part of the Nelson River drainage system.

Soils

The soils are predominantly imperfectly drained Gleyed Humic Vertisols and Gleyed Vertic Black Chernozems, and poorly drained Gleysolic Humic Vertisols and Humic Gleysols which have developed on calcareous, clayey glaciolacustrine sediments. These sediments range in thickness from more than 60 m deep near the U.S. border to less than one metre locally in the northern part of the basin.

Gleyed Rego Black Chernozemic and Gleysolic soils also occur on shallow, extremely to very strongly calcareous, loamy to silty sediments, some of which occur in the form of intersecting bars and spits and were formed during the latter stages of Lake Agassiz. These medium textured soils are found northwest of Winnipeg and in the southern and eastern sections of the basin.

Vegetation

The native vegetation of the ecodistrict originally consisted of tall prairie grass, meadow prairie grass and meadow grass communities depending on natural drainage conditions. As a result of cultivation and the development of an extensive network of drainage ditches, the natural vegetation has largely disappeared. Only local pockets remain in some poorly drained locales, and as small portions of land that due to their small size or limited access have not been broken.

Although tree cover was never very extensive, this type of vegetation has actually survived better than the grassland communities, although it is also significantly diminished. In most of the ecodistrict, trees grow naturally only as a fringe along stream channels. On the better drained sites above and usually some distance away from the channels, bur oak and trembling aspen with an undergrowth of snow berry, hazelnut and red-osier dogwood commonly occur. On the alluvial floodplain deposits and lower river terraces, white elm, basswood, cottonwood, Manitoba maple and green ash with an undergrowth of willow, ferns and associated herbaceous plants are found. These are indicative of periodic inundation. Shrubs such as saskatoon, high bush cranberry and nannyberry are found both on the floodplains and on the highest terraces.

Water

The principal sources of water are the major rivers and streams that course through the area. Limited supplies of variable quality groundwater for domestic and livestock use are available from small, sandy and gravelly aquifers that are associated with till underlying the surface clayey deposits. Well development from underlying bedrock is poor, in particular from the saline Jurassic formations. Limited supplies of variable quality groundwater under artesian pressure is available from Ordovician and/or Silurian limestone bedrock. The Winnipeg sandstone formation is a significant aquifer on the eastern side of the basin.

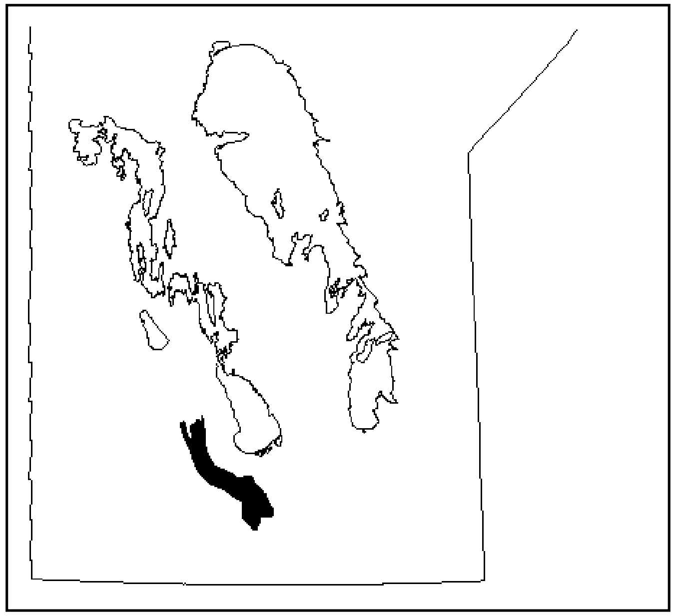
Land Use

The city of Winnipeg is the largest community in the ecodistrict, and in all of Manitoba. Approximately two-thirds of Manitoba’s people live in Winnipeg and vicinity. Among the many smaller communites are the towns of Morris and Starbuck.

Virtually all of the soils are cultivated and used for spring wheat, other cereal grains and oil seeds under dryland production methods. Limited production of potatoes, corn and a variety of garden crops are also grown under irrigation using water, for the most part, from the Red and Assiniboine rivers, to supply a seasonal market in Winnipeg and for export.

850. MacGregor Ecodistrict (2906 km^2)

The MacGregor Ecodistrict is a south-north elongated area located on the west side of the Lake Manitoba Plain Ecoregion, just below the Manitoba Escarpment.



Climate

This ecodistrict is in the warmest subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 2.6^{o}C, the average growing season is 182 days, and the number of growing degree-days is about 1700.

The mean annual precipitation is approximately 500 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average annual moisture deficit is about 190 mm.

The ecodistrict has a cool, sub-humid Boreal soil climate. The Portage la Prairie Airport climate station is on the eastern border of the ecodistrict.

Selected Climate Data[1] for Portage la Prairie Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	2.8	18.4	15.9	19.8	-17.2
Precip. mm (equiv.)	525.2	230.7	337.6	76.9	23.8
Rain/Snow (mm/cm)	398.0/156.1	230.7/0.0T	334.2/3.4	76.9/0.0	0.3/25.3
Growing degree-days >5^{0}C	1819.0	1238.0	1677.7	459.9	0.0

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

Physiography and Drainage

The MacGregor Ecodistrict is part of the Lower Assiniboine Delta at about the 366 masl elevation, the contour that marks the Manitoba Escarpment in this area. Its mean elevation is about 328 masl.

It is a smooth, level to very gently sloping sandy glaciolacustrine plain with slopes that range from level to less than 2 percent. Local relief changes approximately 3.0 m per km with stronger relief of approximately 3 to 5 m occurring along the meandering Whitemud River and the Assiniboine River that flow eastward. The tributary creeks and gullies to these rivers, such as the Pine, Squirrel and Willowbend creeks, have lower erosional banks.

The northern part of the ecodistrict is part of the Dauphin River (Lake Manitoba southwest) division, while the remainder is part of the Assiniboine River and Red River divisions, which in turn are part of the Nelson River drainage system.

Soils

Nearly all of the soils in the MacGregor Ecodistrict are imperfectly drained Gleyed Rego Black Chernozems that have developed on shallow, slightly to strongly calcareous, sandy glaciolacustrine and deltaic sediments of the Lower Assiniboine Delta. Internal drainage is impeded by a clay substrate at about the 1 to 3 m depth, resulting in high water tables. Local areas of poorly drained Gleysolic soils are very common.

The soils have been subjected to severe wind erosion since cultivation resulting in significant areas of Regosolic soils along road allowances and groves of trees where drifting soil tended to accumulate.

Vegetation

As is common in most of the Lake Manitoba Plain Ecoregion, the vegetation in this ecodistrict has also been strongly modified by cultivation, with only minor areas of native vegetation remaining in an unaltered state. The native vegetation consisted of areas of tall prairie grasses, meadow grasses and sedges, interspersed with areas of willow and stands of trembling aspen and balsam poplar with associated shrubs such as snowberry, red-osier dogwood, willow and saskatoon and associated herbs.

Water

The principal source of water is good quality groundwater extracted from shallow, sandy, surface deposits and gravelly aquifers associated with till. Water well development is poor from the Jurassic formations below the glacial deposits because of the very high concentrations of salt in these groundwaters.

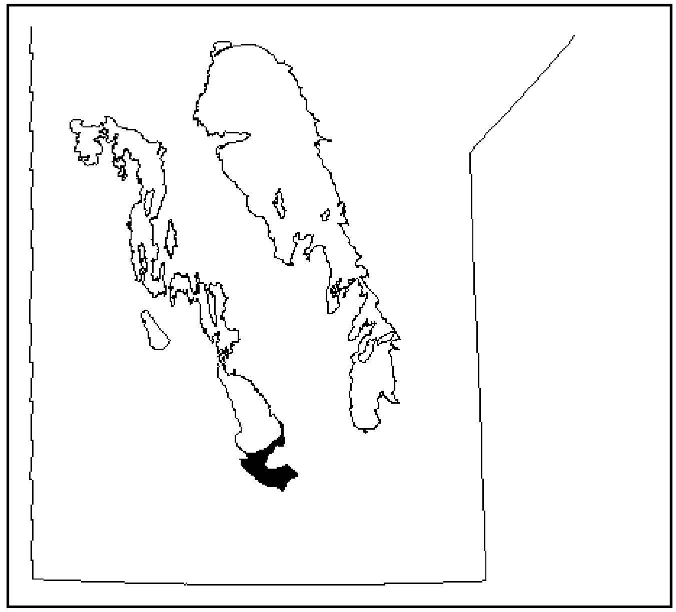
Land Use

There are several small communities in the ecodistrict, of which MacGregor is the largest. Dakota Tipi, Long Plain and Dakota Plains are First Nation communities.

Most of the soils are cultivated and used for the production of spring wheat, other cereal grains, oilseeds and hay crops. The wooded areas in the duned soils and along creeks and gullies provide wildlife habitat and recreational sites. Limited corn production occurs near the Assiniboine River. Potato production is an expanding enterprise, especially in the southern half of the ecodistrict and along the Assiniboine River.

851. Portage Ecodistrict (1392 km2)

The Portage Ecodistrict is located in the central portion of the Lake Manitoba Plain Ecoregion and extends to the south shore of Lake Manitoba.



Climate

This ecodistrict is in the warmest subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 2.5°C, the average growing season is 181 days, and the number of growing degree days is about 1700.

The mean annual precipitation is approximately 515 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through summer. The average annual moisture deficit is about 170 mm.

The ecodistrict has a cool, subhumid, Boreal soil climate. Data from the climate station at Marquette and from the station at Portage la Prairie Airport (850. MacGregor Ecodistrict) is relevant.

Selected Climate Data[1] for Marquette

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	2.8	18.5	16.1	19.9	-17.4
Precip. mm (equiv.)	530	225.8	338.6	69.0	23.7
Rain/Snow (mm/cm)	406.1/125.5	225.8/0.0	337.9/1.0	69.0/0.0	0.2/23.5
Growing degree-days >5°C	N	N	N	N	N

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

Physiography and Drainage

The Portage Ecodistrict lies immediately south of Lake Manitoba. Its mean elevation is about 259 masl.

It is a level to very gently sloping alluvial and glaciolacustrine plain. Slopes range from level to less than 2 percent and are smooth and long (exceeding more than 150 m). Local relief falls approximately 0.3 m per km in a northerly direction. Some change of relief, approximately 3 to 10 m, occurs along the meandering Assiniboine River near its southern boundary. Lower micro-relief, 0.5 to 1.0 m is encountered along former Assiniboine River oxbows and blind channels that formed when the river flowed directly into Lake Manitoba.

The northern portion is part of the Dauphin River (Lake Manitoba Southwest) division, while the remainder is part of the Assiniboine River and Red River divisions, all of which are part of the Nelson River drainage system.

Soils

The soils are predominantly well to imperfectly drained Rego Black Chernozems that have developed on shallow, strongly calcareous, loamy to clayey alluvial and glaciolacustrine sediments. Significant areas of moderately well to imperfectly drained Regosols occur on the more recently deposited alluvial sediments near the Assiniboine River. In the northern sector, local areas of Gleysolic soils border Delta Marsh.

Vegetation

The native vegetation of the Portage Ecodistrict has largely been replaced with cultivated fields. The only area remaining in a relatively natural state is the Delta Marsh, but even the marsh has changed considerably due to water control measures which limit the fluctuation of water levels of Lake Manitoba, reducing flooding of the marsh and flushing of sediments. The dominant vegetation in the marsh are reeds, willow thickets with associated herbs, and Manitoba maple and poplars on higher ground and along beach ridges.

The remainder of the ecodistrict was mainly tall-grass prairie with some aspen groves. Most forest cover was, and is, confined to floodplains and levees of streams and rivers, where dense stands of white elm, green ash, Manitoba maple and basswood grow. Bur oak is present as an additional species on higher sites not prone to flooding.

Water

The principal sources of water are surface water from the Assiniboine River and groundwater from the shallow sandy aquifer that underlies the alluvial and glaciolacustrine surface sediments in the area.

Land Use

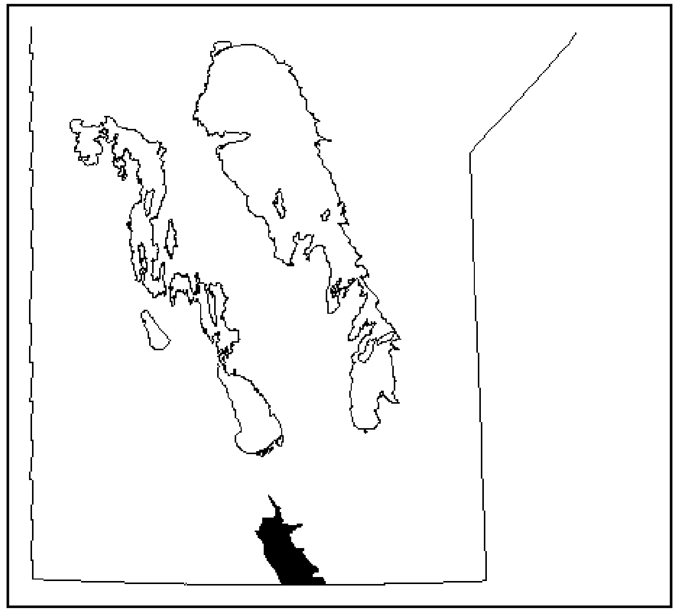
The city of Portage la Prairie is the largest community in the ecodistrict and is the service and administrative centre for this and adjacent ecodistricts.

Virtually all of the soils are cultivated and used for spring wheat, other cereal grains, and oil seeds grown under dryland production methods. Potatoes, corn and a variety of garden crops are grown under irrigation, using water, for the most part, from the Assiniboine River.

The beaches along Lake Manitoba have attracted cottage development and water-oriented recreation. Delta Marsh is an internationally recognized wetland of great importance as a nesting, staging and resting habitat for waterfowl.

852. Winkler Ecodistrict (2594 km2)

The Winkler Ecodistrict extends northwestward along the Manitoba Escarpment from the U.S. border.



Climate

This ecodistrict lies in the warmest subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is 3.1°C, the average growing season is 185 days, and the number of growing degree-days is about 1800.

The mean annual precipitation is approximately 515 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through early summer. The average yearly moisture deficit is about 210 mm.

The ecodistrict has a moderately cool, subhumid, Boreal soil climate.

Climate data from two long-term stations is presented.

Selected Climate Data[1] for Altona

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	3.1	18.9	16.4	20.2	-17.1
Precip. mm (equiv.)	511.9	214.3	322.7	72.5	28.4
Rain/Snow (mm/cm)	392.9/118.6	214.3/0.0	321.9/0.8	72.5/0.0	0.5/27.9
Growing degree-days >5°C	1908.0	1283.9	1756.0	474.2	0.0

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

Selected Climate Data[1] for Morden CDA

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	3.6	19.0	16.5	0.4	-16.0
Precip. mm (equiv.)	520.3	216.4	333.7	70.3	20.1
Rain/Snow (mm/cm)	399.4/125.3	216.4/0.0	331.5/2.2	70.3/0.0	0.3/21.5
Growing degree-days >5°C	1948.0	1293.0	1775.6	477.8	0.0

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

Physiography and Drainage

The Winkler Ecodistrict lies immediately east of the Manitoba Escarpment and north of the U.S. boundary. Its mean elevation is about 267 masl.

It is a level to very gently sloping glaciolacustrine plain. Slopes range from level to less than 2 percent and are smooth and long, usually longer than 150 m. The ecodistrict slopes northeastward at a rate of approximately 3.8 m per km. Relief of approximately 1 to 3 m occurs along the numerous meandering creeks emanating from the escarpment and flowing generally northeastward toward the Red River or Morris River.

The ecodistrict is a part of the Red River watershed, which is part of the Nelson River drainage system that drains into Hudson Bay. The northern section lies in the Morris River division, while the southern sector lies in the Riviere Sale division.

Soils

The soils in the Winkler Ecodistrict are predominantly moderately well drained to imperfectly drained Black Chernozems that have developed on shallow, strongly calcareous, loamy to clayey glaciolacustrine sediments. Local areas of dominantly clayey Gleysolic soils are also common.

Vegetation

The native vegetation of tall prairie grasses and associated herbs has largely disappeared as a result of cultivation. Native forest was found as strips along waterways and is still present, although it is not as widespread as before settlement. These wooded strips comprised of green ash, white elm and Manitoba maple with associated shrubs such as hazel and saskatoon. Bur oak could be found on river banks not prone to flooding.

Water

The principal source of water is groundwater from a narrow band of shallow sandy and gravelly aquifers that occur below the escarpment and underlie the glacial surface deposits. The most important of these is the Winkler aquifer.

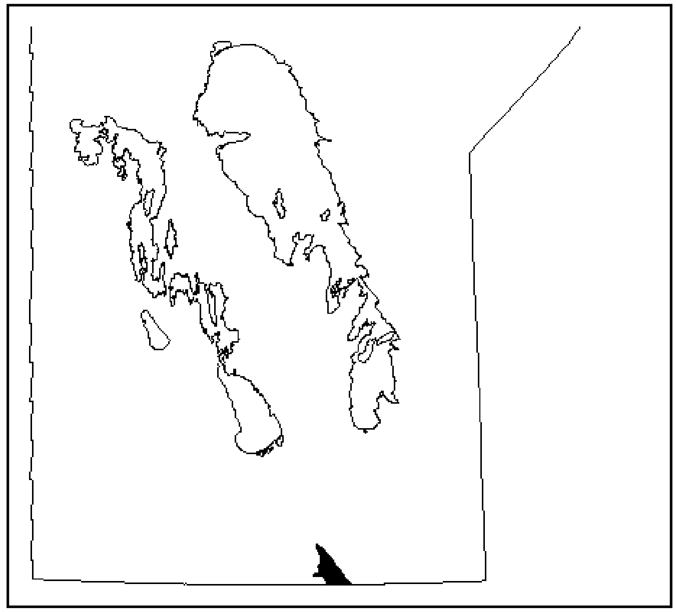
Land Use

There are several communities in the ecodistrict, of which the towns of Morden and Winkler are the largest.

Virtually all of the soils are cultivated and used for spring wheat, other cereal grains, and oil seeds employing dryland production methods. Potatoes, corn and a variety of garden crops are also grown under irrigation, using water, for the most part, from a limited supply of groundwater from the Winkler aquifer.

853. Emerson Ecodistrict (701 km^2)

The Emerson Ecodistrict is a small ecodistrict that extends north from the U.S. border.



Climate

This ecodistrict is in the warmest subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba. The climate is characterized by short, warm summers and long, cold winters. The mean annual temperature is about 3.1^{o}C, the average growing season is 187 days, and the number of growing degree-days is about 1840.

The mean annual precipitation is approximately 540 mm of which about less than one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from late spring through early summer. The average yearly moisture deficit is about 210 mm.

The ecodistrict has a cool, subhumid Boreal soil climate.

Climate data for the Emerson station is presented below. Data from Morden CDA and Altona (852. Winkler Ecodistrict) is also relevant.

Selected Climate Data[1] for Emerson.

	Year	June-Aug	May-Sept	July	Jan
Temperature ^{0}C	3.3	19.0	16.6	20.2	-17.0
Precip. mm (equiv.)	546.6	231.3	343.4	77.8	26.1
Rain/Snow (mm/cm)	421.2/125.2	231.3/0.0	342.4/0.9	77.8/0.0	0.3/0.0
Growing degree-days >5^{0}C	1944.0	1288.9	1779.2	472.1	0.0

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

Physiography and Drainage

The Emerson Ecodistrict extends northward from the U.S. boundary in the central lowland of the Red River Plain. Its mean elevation is about 240 masl.

It is a smooth, level to very gently sloping, silty glaciolacustrine plain. The meandering Red River enters at the U.S. border at about 260 masl and flows northward through the centre, emptying into Lake Winnipeg, a remnant of former glacial Lake Agassiz, at the 218 masl elevation. Slopes range from level to less than 2 percent and are smooth and long, generally more than 150 m in length.

Relief falls approximately 0.4 m per km from the western edge of the plain to the Red River and at a rate of about 1.0 m per km from its eastern edge to the Red River. Relief from south to north through the basin falls at about 0.3 m per km. Changes in relief of approximately 5 to 10 m occur along the Red River and along the Roseau River, which forms part of the eastern boundary.

The ecodistrict is part of the Red River watershed, which is part of the Nelson River drainage system, which drains into Hudson Bay. Most of this ecodistrict is part of the Red River south division, and only the extreme eastern section is part of the Roseau River division.

Soils

The soils are predominantly imperfectly drained Gleyed Rego Black Chernozems and poorly drained Gleysolic soils that have developed on shallow, extremely to very strongly calcareous, loamy to silty clay glaciolacustrine sediments ranging in thickness from less than 1 m to more than 3 m. The clay sediments usually include intersecting bars and spits, and can extend to a depth of 60 metres or more.

Vegetation

The native vegetation of tall prairie grasses and associated herbs has largely disappeared as a result of cultivation. Native forest was found as strips along waterways and is still present, although not as widespread as before. These wooded strips were comprised of green ash, white elm and Manitoba maple with associated shrubs such as hazel and saskatoon. Bur oak can be found on higher river banks not prone to flooding.

Water

The principal source of water is the Red River. Limited supplies of variable quality groundwater for domestic and livestock use are available from small, sandy and gravelly aquifers associated with till underlying the surface clayey deposits. Groundwater under artesian pressure of variable quality is found in Silurian and/or Ordovician limestone bedrock.

Land Use

The town of Emerson is the largest community. Other communities include Letellier, St. Jean Baptiste and Roseau River First Nation.

Virtually all of the soils are cultivated and are used for spring wheat, other cereal grains and oil seeds employing dryland production methods. Limited production of potatoes, corn and a variety of garden crops are also grown under irrigation, using water, for the most part, from the Red River.

163, 164. Southwest Manitoba Uplands Ecoregion

The Southwest Manitoba Uplands Ecoregion consists of two distinct uplands. The Turtle Mountain Upland straddles the border with the U.S. in the southwestern portion of the province, while the Pembina Hills Upland is located in south-central Manitoba.

Climate

In Manitoba, this ecoregion is part of the subhumid, Low Boreal Ecoclimatic Region, which is characterized by short, warm summers and long, cold winters. The mean annual air temperature is about 2.5^{o}C, the average growing season ranges from 179 to 182 days, and the number of growing degree-days ranges from 1570 to 1670.

The average annual precipitation varies from 540 mm in the Pembina Hills section (Ecoregion 163) to about 600 mm in the Turtle Mountain section (Ecoregion 164), and varies greatly from year to year. Precipitation is highest during the growing season. Moisture deficits range from about 120 mm to over 150 mm.

The ecoregion has a subhumid, moderately cold Cryoboreal to subhumid, cool Boreal soil climate.

There are no climate stations in the Pembina Hills (Ecoregion 163), while the data from the Peace Garden station on Turtle Mountain is incomplete.

Surficial Deposits and Landforms

The Pembina Hills and Turtle Mountain Uplands are comprised of Cretaceous and Tertiary shales respectively. These shales are covered almost entirely by thick, kettled to hummocky, calcareous glacial till and fluvioglacial deposits. Elevations range from 440 masl along the lower boundary of the Pembina Hills to about 700 masl atop Turtle Mountain. Associated with the rougher topography of the morainal deposits are a large number of small lakes, ponds and sloughs occupying shallow depressions.

Soils

Well drained Dark Gray and Black Chernozemic soils are predominant. Local areas of Gray Luvisols are widespread in these uplands, especially on Turtle Mountain. Associated soils are usually peaty Gleysols and some Organic Mesisols.

Vegetation

These two ecodistricts differ in that the Pembina Hills presents a mosaic of farmland and forest, while the Turtle Mountain Upland is generally covered with deciduous forest, except where white spruce plantations have been established. A cover of trembling aspen with secondary quantities of balsam poplar and bur oak, and an understory of mixed herbs and tall shrubs is the predominant vegetation in the Pembina Hills, while trembling aspen forms the dominant tree cover on Turtle Mountain. Water-filled depressions and poorly drained sites are usually covered with sedges and willow. Thus, parts of these uplands remain in their native state, especially in the Turtle Mountain section.

Wildlife

Owing to the variety of habitat, this ecoregion provides habitat for a wide variety of wildlife. White-tailed deer is widespread and takes special advantage of the mixture of native cover and farm fields in the Pembina Hills. There is also habitat for black bear, ruffed grouse, red-tailed hawk, common flicker and beaver, coyote, rabbit and hare. Many bird species use the ecoregion including a variety of sparrows such as the Le Conte's and the song sparrow.

The wetlands in both sections provide important habitat for ducks and coots, and in the fall for additional migratory waterfowl.

Land Use

Agriculture is much more widespread in the Pembina Hills section (163) than in the Turtle Mountain section (164). A large part of the Turtle Mountain is a provincial park, and recreation in the form of camping, hiking and boating are popular activities. Forestry is an additional land use as is recreational hunting.

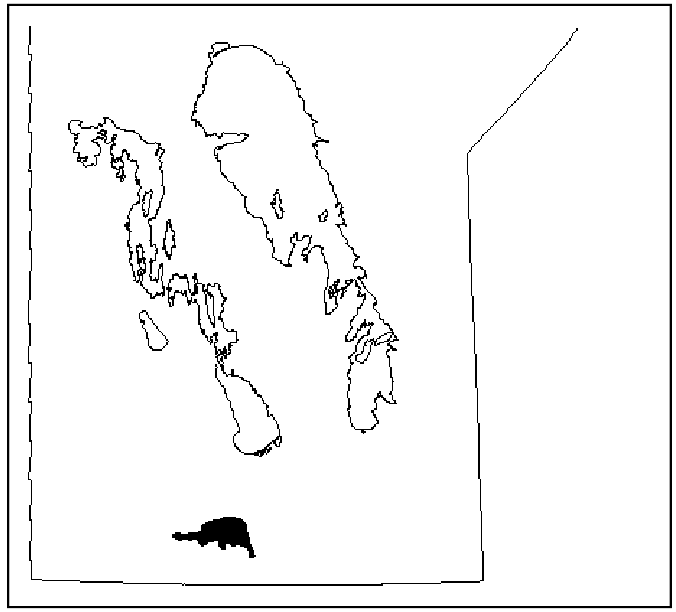
In the Pembina Hills section, production of spring wheat, other cereals, oilseeds and hay crops are characteristic. Pastures are more prevalent on the steeper slopes of both uplands.

There are two ecodistricts within the Southwest Manitoba Uplands Ecoregion in Manitoba.

Pembina Hills

The Pembina and Tiger Hills form part of the Manitoba Southwest Uplands Ecoregion (163). Part of the hills have very rough topography formed by terminal moraines and eroded hills of shale. The warmer and drier south and west-facing slopes have grassland vegetation, while the cooler and more humid valley bottoms, and north and east-facing slopes have woodland vegetation.

854. Pembina Hills Ecodistrict (1540 km²)



The Pembina Hills Ecodistrict is the sole district in Ecoregion 163.

Climate

This ecodistrict is in a warmer subdivision and outlier of the Subhumid Low Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, warm summers and cold winters. The mean annual air temperature is about 2.5°C, the mean growing season is 182 days, and the average number of degree-days is about 1670.

The mean annual precipitation is about 540 mm of which about one-quarter falls as snow. Precipitation varies greatly from year to year, and is highest from late spring through summer. The average yearly moisture deficit is about 150 mm.

The ecodistrict has a subhumid, moderately cold to cold, Cryoboreal to Boreal soil climate.

Data from the Cypress River climate station (758. Stockton Ecodistrict) has some relevancy to the ecodistrict.

Physiography and Drainage

The Pembina Hills rise some 200 m above the adjacent Manitoba Plain to the east and about 30 to 100 m above the surrounding, relatively smoother sections of the Saskatchewan Plain to the west.

This morainal ecodistrict is characterized by strongly undulating and rolling to hummocky topography, but smoother areas indicating former lake action are present in the eastern sector. Elevations range from about 440 to about 530 masl at its highest point. Slopes on the upland are moderately steep, ranging from 5 to about 15 percent and are from 50 to 100 m long. In some places, local relief can exceed 30 m. The ecodistrict is dissected with well developed channels and gullies that drain northward, eastward and southward.

Soils

Soils have developed on calcareous, variably thick, loamy to clayey glacial till.

In the northern and eastern sector, the soils are generally well drained Dark Gray Chernozems and, to a lesser extent, Gray Luvisols, indicating that soil development generally took place under woodland vegetation.

However, in the western and southern portion, soils are generally Black Chernozems, even though at time of settlement most of these areas were also under woodland vegetation. The Black Chernozems likely developed under grassland vegetation with the woodland vegetation gradually invading as land use and climate changed. This ecological change has been inferred from the increased leaching pedologic change that has taken place in some of the Black Chernozems. In depressions, poorly drained Gleysolic soils occur.

Vegetation

The vegetation of the Pembina Hills prior to settlement was primarily woodland, largely composed of trembling aspen and bur oak with the latter on the drier and warmer slopes. Associated shrubs consisted of hazel, saskatoon and pin cherry, with grasses and herbs as ground cover. Very dry sites had grassland vegetation, while along drainage ways, Manitoba maple and green ash, dogwood and willow could be found.

The native vegetation is still present on steeper slopes not suitable for agriculture, but has been severely reduced on more gently sloping terrain.

Water

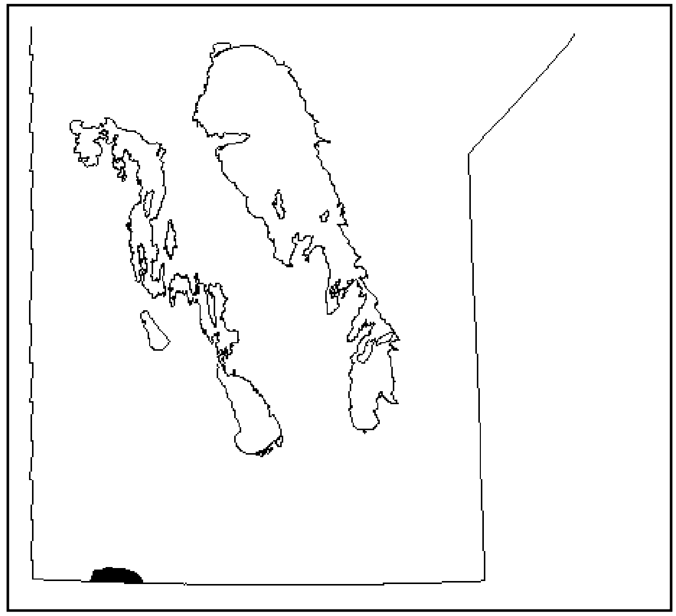
Variable annual rainfall is a principal source of water where limited amounts of it is retained in numerous small ponds and sloughs in depressions in glacial till. Additional surface water is stored in dugouts and small headwater retention ponds. Significant supplies of variable quality groundwater for domestic and livestock use are found in small sandy and gravelly aquifers in the glacial till as well. The shale bedrock underlying the till yields very little water.

Land Use

The village of Swan Lake and Swan Lake First Nation are two communities in this ecodistrict.

Less steeply sloping land is used for the production of spring wheat, other cereal grains, oil seeds and hay crops. Very steeply sloping farmland is used for livestock pasture and native hay. Wetlands are important breeding habitat for waterfowl. Wooded valleys and steeply sloping uplands provide habitat for white-tailed deer, black bear, small mammals and songbirds.

855. Turtle Mountain Ecodistrict (644 km^2)



The Turtle Mountain Ecodistrict is the sole ecodistrict in Ecoregion 164.

Climate

Turtle Mountain is in a warmer subdivision and outlier of the extensive Low Boreal Ecoclimatic Region in Manitoba. The climate is characterized by short, warm summers and cold winters. The mean annual air temperature is 2.5^{o}C, the mean growing season is 179 days, and the average number of growing degree days is around 1570.

The mean annual precipitation is about 600 mm of which less than one-third falls as snow. Precipitation is variable from year to year and peaks in early summer. The average yearly moisture deficit is about 120 mm.

The ecodistrict has a humid, moderately cold Cryoboreal soil climate.

Physiography and Drainage

Turtle Mountain Ecodistrict is a prominent wooded upland consisting of a glacial till mantle overlying a Tertiary shale and sandstone outlier. It straddles the Canada-USA border and rises some 200 m above the surrounding, relatively smooth plain to the north.

The till mantle deposited as ablation till is hilly and hummocky on the higher altitudes of the mountain, resulting in the development of numerous depressions and small lakes. At lower altitudes, the terrain consists of smooth gently rolling slopes incised with deep ravines. In particular, the north slope is frequently and deeply incised with ravines and gullies.

Elevations of this hummocky morainal upland range from 580 masl to 700 masl at its highest point. Slopes are steep, usually more than 15 percent, and range in length from 50 to 100 m. Local relief frequently exceeds 30 m. The ecodistrict has a topography of hills with numerous basins which result in natural drainage varying from excessive to confined. Only along its edge, where the mountain loses altitude, drainage channels of intermittent streams carry water off the mountain.

Most of this ecodistrict is part of two drainage divisions of the Souris River watershed: the Hartney division for the northern part and the Melita division for the southern sector. The eastern portion is part of the Killarney division of the Red River watershed. Both watersheds are part of the Nelson River drainage system which drains into Hudson Bay.

Soils

Soil development reflects the wooded nature of the district. Well drained Dark Gray Chernozemic and weakly developed Gray Luvisolic soils developed on calcareous, loamy to clayey glacial till predominate. Local areas of poorly drained peaty Gleysolic soils are common in the lower parts of basins and smaller depressions.

Vegetation

The native vegetation of the Turtle Mountain, which is largely intact, consists of deciduous trees and shrubs with an undergrowth of herbs and grasses. Trembling aspen is the most widespread tree, mixed with white birch on higher elevations, and with bur oak on lower levels. Green ash, Manitoba maple and balsam poplar are found throughout. Shrubs include hazel, chokecherry, pin cherry, saskatoon, raspberry, dogwood and high bush cranberry. Ground cover species include sarsparilla, false Salomon's seal, vetch, wood strawberry, wood anemone and grasses. Willow is frequent in moist, low-lying areas.

Water

Variable annual rainfall is the principal source of water. Limited amounts of precipitation are retained in numerous small ponds and sloughs in the depressions of this glacial till area. Some additional surface water is stored in dugouts and small headwater retention ponds. Significant supplies of variable quality groundwater for domestic and livestock use are found in small aquifers in the glacial till as well. The shale bedrock underlying the till yields very little water.

Land Use

There are no communities in the ecodistrict.

Most of the land is wooded and is used for recreation and wildlife habitat. Less steeply sloping land is utilized for the production of spring wheat, other cereal grains, oil seeds and hay crops. Very steeply sloping farmland is used for livestock pasture and native hay. Wetlands are important breeding habitat for waterfowl. The ecodistrict provides opportunities for camping and limited water-oriented recreation. Wooded uplands provide habitat for white-tailed deer, black bear, small mammals and songbirds.

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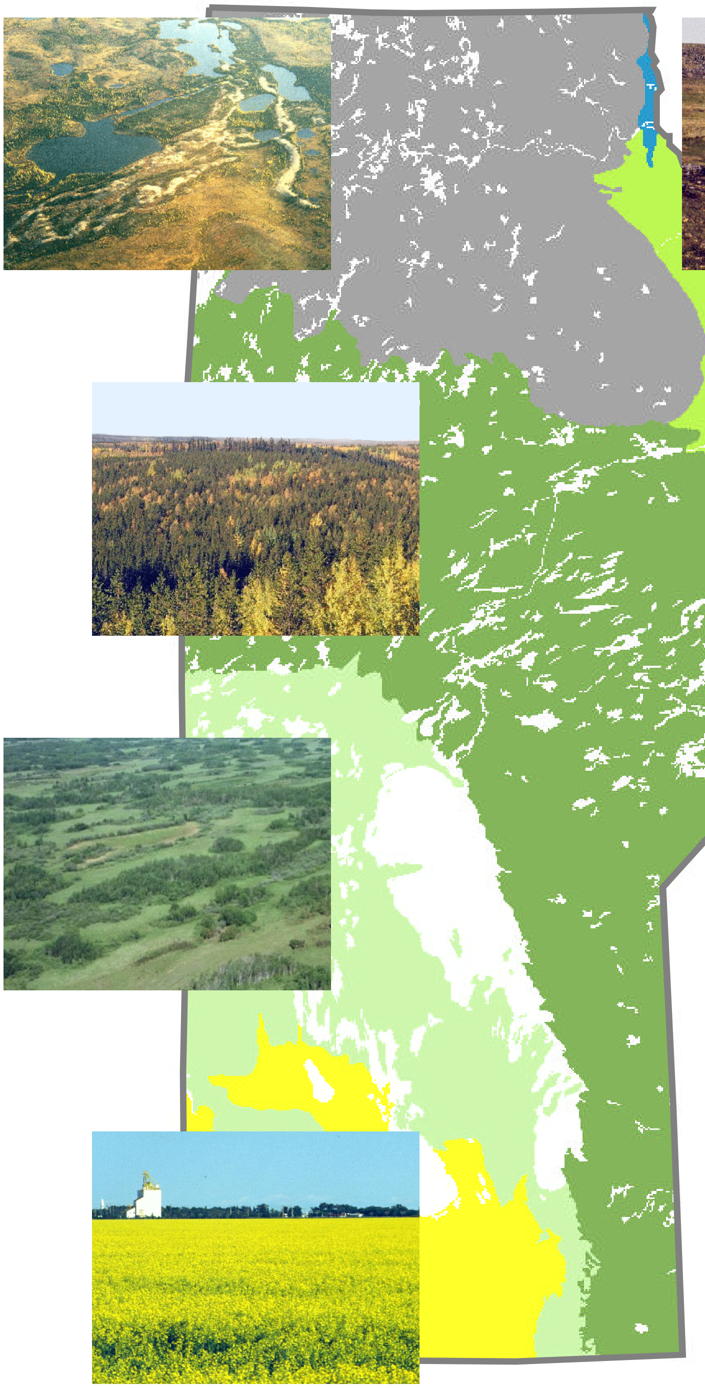
Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



Research Branch
Technical Bulletin 1998-9E

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Hudson Plains Ecozone

The Hudson Plains Ecozone is centred in northern Ontario and extends into northeastern Manitoba and western Quebec. Its main characteristic is that it is dominated by wetlands in the form of fens and bogs. Permafrost is widespread, especially in the Manitoba portion of the zone.

Climate

The climate of the ecozone is strongly influenced by the cold and moisture-laden Hudson Bay Low and Polar High air masses, producing a climate that is marked by short, cool summers and long, very cold winters. Mean annual temperatures generally range from -4°C to -1°C , but are generally lower in Manitoba, ranging as low as -7°C in places.

Precipitation varies from about 400 mm in the northwest to 800 mm in the southeast. One-third to one-half of the precipitation falls as snow.

The ecozone has a very cold Subarctic soil climate.

The climate station at Churchill Airport is the only station in the Manitoba portion of the ecozone and represents the northern part. The climate station at Moosonee on the James Bay coast represents the climatic conditions of the more southerly portion of the ecozone. Both stations are located near the coast and may not necessarily present an accurate account of climatic conditions farther inland.

Surficial Deposits and Landforms

The ecozone is an extensive lowland plain consisting of a complex of wetlands overlying largely marine and, to some extent, glacial sediments. Bedrock outcrops are rare and upland areas are limited. The zone is bordered by Precambrian bedrock-controlled terrain to the west, south and east.

Relief of the lowland has been significantly affected by post-glacial marine submergence and subsequent emergence due to isostatic rebound. As a result, many beaches and strandlines have formed. When the beaches are well developed with respect to height and length, they form very striking features. Well developed beaches are especially common along the southern part of the Hudson Bay coast, along the western James Bay coast and along subdued uplands.

Due to isostatic rebound, age of emerged terrain increases with distance from the coast. As a consequence, soil development is stronger and depth of peat increases with distance from the coast as well.

Permafrost varies in distribution and is widespread in the Manitoba part of the zone where polygonal peat plateau bogs (north) and peat plateau bogs are widespread. In the part north of the Nelson River, fens with permafrost are also common as are palsa fens.

Soils

Well to imperfectly drained saline and non-saline Regosolic soils are found on recent beaches, and poorly drained saline Rego Gleysols are found on silty and clayey marine sediments along the coast. Farther inland, beaches and marine or till uplands have Eutric Brunisolic and, to some extent, Turbic and Static Cryosolic soils, while Organic Cryosols are dominant on permanently frozen bogs and fens. Slightly decomposed Fibrisolic and moderately decomposed Mesisolic Organic soils are dominantly associated with non-frozen fens.

Vegetation

Along the coast, unvegetated mudflats are extensive, and recent beaches have little vegetation as well. Associated wetlands are marine marshes and shallow fens. Older beaches farther inland, and which have not been covered by peat, support black spruce and white spruce as well as shrubs, mosses and lichens, especially in the Ontario part of the zone.

Peatlands become increasingly deep and varied in development with distance from the coast. Horizontal and patterned fens have a sedge or sedge-brown moss vegetation with varying quantities of shrubs, with increasing tamarack in the more southern areas. Polygonal peat plateau bogs have generally moss and lichen vegetation with ericaceous low shrubs. Peat plateau bogs have moss, lichen and ericaceous shrub vegetation with increasing black spruce with distance from the coast, especially in the areas south of Hudson Bay.

Wildlife

The polar bear is a characteristic mammal of the ecozone. The bears spends most of July to November, when the Hudson Bay is largely free of ice, on land in the coastal region. Other mammals characteristic of the area include woodland caribou, moose and black bear in the southern regions, as well as marten, arctic fox and fisher.

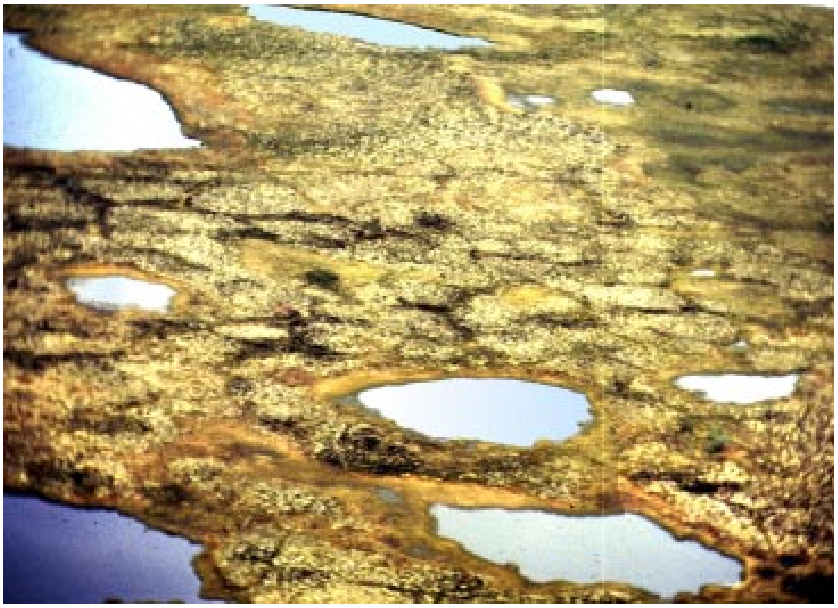
The coastal part of the ecozone is also a major habitat for significant populations of breeding waterfowl, especially snow and Canada geese. The snow geese population has increased significantly in the last few decades, which could result in extensive damage to this habitat through overgrazing. Other birds include rock and willow ptarmigan, and many migratory species, including shore birds.

Land use

Land uses are limited to hunting, including marine mammal hunting, and trapping, fishing, recreation and tourism. Ecotourism, which includes viewing wildlife such as polar bears, beluga whales and birds, the field study of arctic flora and so on, is developing rapidly and has become a major industry in Churchill.

There are two ecoregions within the Hudson Plains Ecozone in Manitoba.

Polygonal peat plateau bog and tundra ponds



The lichen-covered (light coloured) polygonal peat plateau bogs are the dominant feature in this picture. These peatlands are underlain by permafrost that extends from near the surface to well into the underlying mineral materials. The active layer (maximum depth of thaw) is less than 50 cm.

The polygonal pattern of the peatland is caused by the formation of ice-wedges, which causes trenches to develop bordered by raised shoulders. Some of the shoulders show up as dark lines as a result of wind erosion that has removed the surface and exposed dark coloured peat.

The small lakes are tundra ponds, which have peat shores and peat bottoms, and may still be underlain by permafrost. Tundra ponds may develop as a result of melting of the permfrost (thermokarsting) which causes a depression to develop in which water can pool. The ponds may keep expanding for many years and several may join eventually. When an expanding pond intercepts a creek or other water way, the pond may drain, and the peat bottom is exposed. In some areas these ponds appear to expand with their long axis parallel to the prevailing wind direction. Small fens, which may have been tundra ponds at one time, are present throughout the area.

Snow geese

Snow geese spend the breeding season along the west coast of Hudson Bay. The level, poorly drained terrain favours the growth of sedges, and provides prime habitat. There is concern that the recent increase in numbers of snow geese will result in long-term damage to their northern habitat. During the fall migration the geese use cereal fields as staging areas. Flocks can do considerable damage to standing crops.

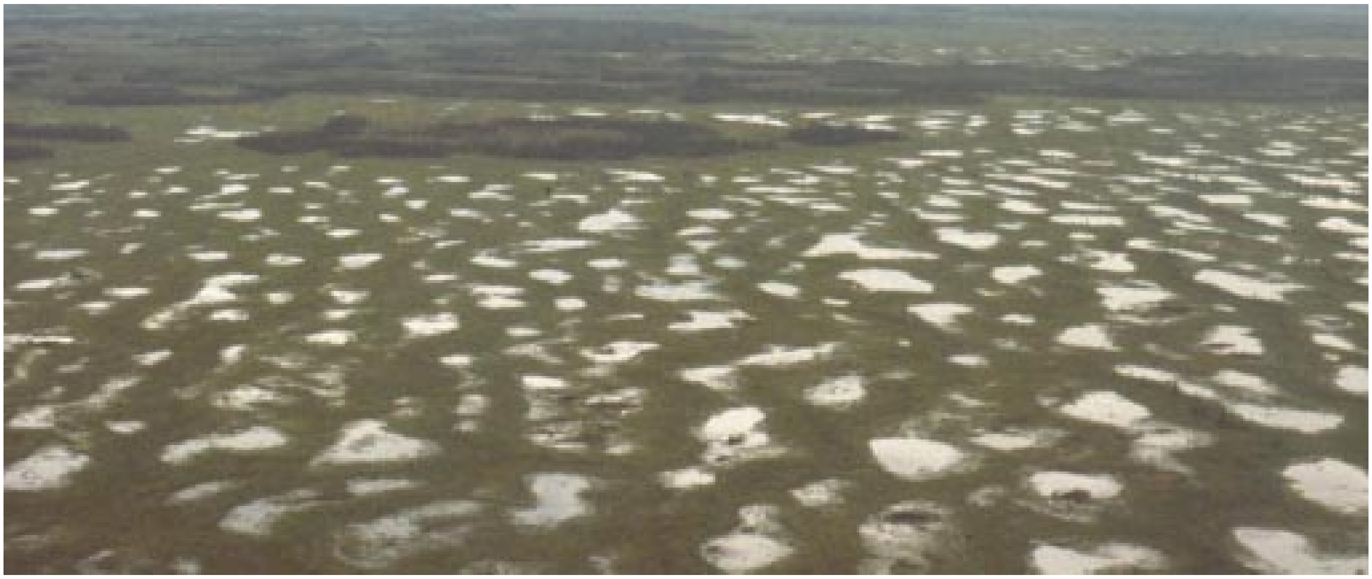


Plate HP1.
Net fen with peat plateau bogs in background. The area shown in the photograph depicts an area close to Hudson Bay. Peatlands have already developed, and are composed dominantly of shallow net fens. This fen type consists of broad shallow peat ridges enclosing shallow pools. Older peatlands, consisting of peat plateau bogs, are visible in the background. The area in the foreground has emerged relatively recently from Hudson Bay through isostatic rebound. If climatic conditions remain the same as at present the area in the foreground will eventually develop permanently frozen bog peatlands as well.

Plate HP2.
Polygonal peat plateau bog. Polygonal peat plateau bogs have a polygonal surface pattern. The polygons are typically between 15 and 40 m across. They are marked by linear depressions called trenches, which may vary in depth and width. The trenches mark the location of ice-wedges, which are massive ground-ice features. They are elongated triangular in cross section, and consist of almost pure, foliated ice. They may penetrate several metres below the surface. These features are formed when the peatland surface cracks because of rapid, intense cooling. During the spring, water will flow into the cracks and freeze, preventing the cracks from closing. The wedges continue to grow when the cracks open the following winter, and re-freezing of melt water in spring adds another layer. The ice-wedges may form after the peatland has developed or when it is still developing. As the wedges grow the soil immediately along the crack is pushed up forming shoulders. These shoulders become increasingly dry and mosses may die, allowing wind erosion of the peat to occur. Eventually the widening trenches may become conduits for meltwater, or collect water at intersections, resulting in a partial or complete melting of ice-wedges and the surrounding permafrost. This may initiate the formation of small lakes or pools, which may continue to grow and coalesce.

Plate HP3.
Tundra with scattered trees. The northern part of the ecozone is much more arctic in appearance than the southern part. All of the area shown is underlain by permafrost and covered by shallow to deep peat. The area in the foreground has a lichen and moss cover, while the centre area is wetter and is covered by sedges. The dark area in the right-centre part of the picture shows damage to the tundra surface by vehicles. The wheels churn the peat surface, causing the albedo to change, resulting in a deepening of the active layer. Some subsidence through compression of the surface leads to the formation of pools, which then leads to accelerated thermokarsting. This type of damage to the land surface will remain visible for a long time. The black spruce in the foreground shows the effect of snow blasting. A better example of these phenomenon is shown in Plate TS2.

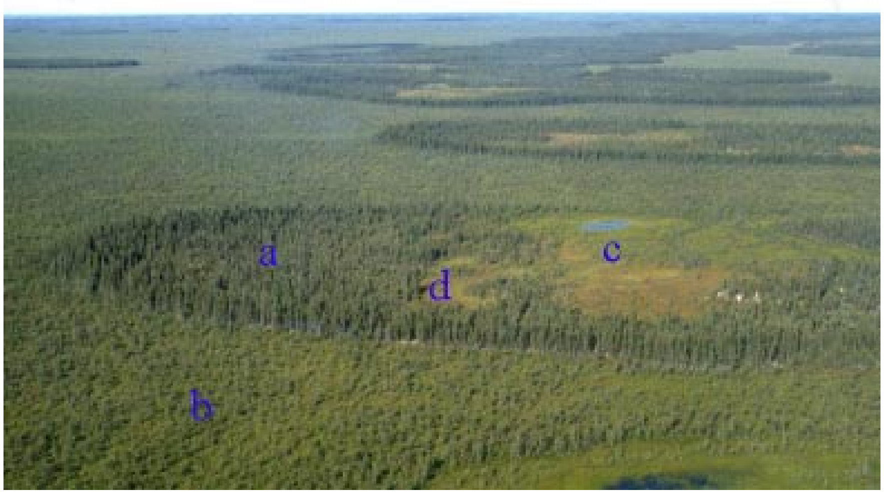


Plate HP4.
Peat plateau bog (a), treed horizontal fen (b), collapse fen (c) and collapse bog (d). The picture shows circular peat plateau bogs surrounded by treed horizontal fens. The peat plateau bogs contain permafrost, while the fen will likely not have permafrost or will have permafrost at depths greater than 1 m. The peat plateau bogs are raised about 1 m above the surrounding fen due to the formation of ice lenses in the peat and underlying mineral material and to the accumulation of Sphagnum peat. The plateaus are likely initiated by the formation of palsa fens and/or bog mounds, which expand and coalesce to form larger bog islands. Individual peat plateau bogs may range from a few hectares to over one hundred hectares in size. The peat plateau bog in the picture shows significant thermokarsting.

Plate HP5.
Peat plateau bogs, collapse fens and collapse bogs. Peat plateau bogs are widespread in the southern half of the Manitoba portion of the Hudson Plains Ecozone. The peat plateau bogs in this area are very susceptible to thermokarsting, probably due to both age and climatic conditions. Disturbances like wildfire, as well as stand and ground cover mortality, may trigger a deepening of the active layer and the formation of small pools that initiate a more extensive melting of the permafrost. When these areas are completely contained within the peat plateau bog, and therefore solely dependent on precipitation for nutrient input, they are referred to as collapse bogs. If they occur along the edge of the peat plateau bog or are open to the surrounding fen, exchange of groundwater and nutrients takes place, and they are then referred to as collapse fens.

Plate HP6.
Peat Plateau bog surface. The surface of a peat plateau bog is generally level with hummocky micro-topography as a result of Sphagnum moss hummock formation. The tree cover is open, slowly growing black spruce, with an understory of swamp birch, Labrador tea and other ericaceous shrubs. The groundcover consists of Sphagnum mosses, feather mosses and lichens, with some cloudberry and sedges.

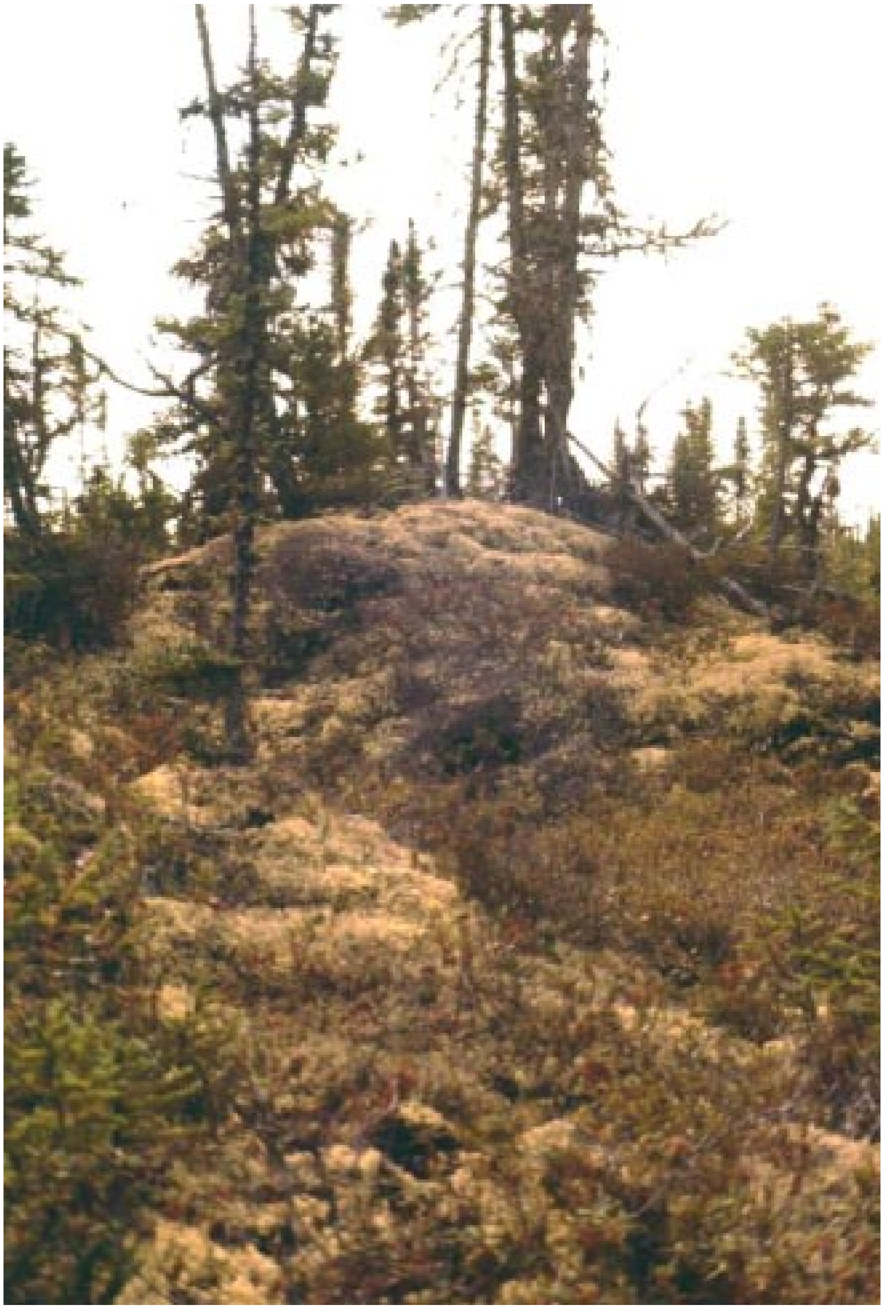
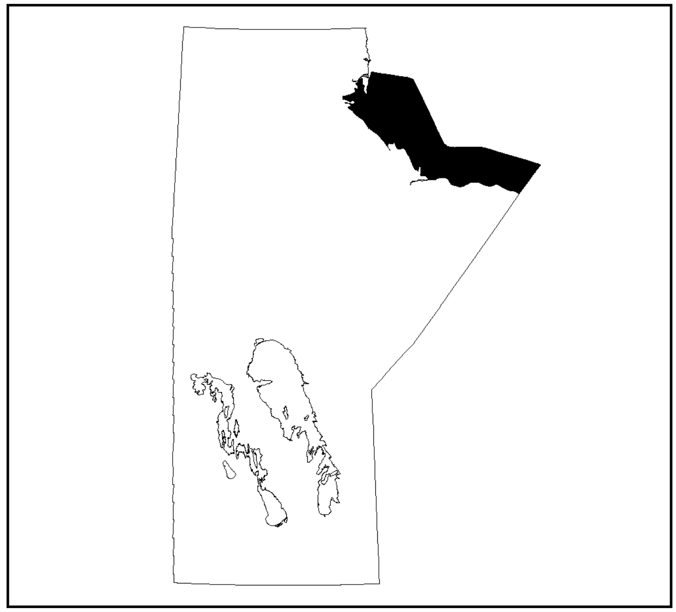


Plate HP7.

Palsa bog. Palsa bogs are peatlands formed by permafrost. They form in fens, and therefore most of the peat core is composed of sedges and brown mosses. This is covered by varying thicknesses of Sphagnum and/or feather moss peat. Individual palsa bogs are usually less than 100 m in diameter, but they may rise 5 m above the surface of the surrounding fen or peat plateau bog. Most of the elevation is due to the formation of massive ice lenses in the peat and underlying fine textured mineral materials. Palsas are widespread in the more southerly portion of the Ecozone. The palsa shown rises several metres above the surface of the surrounding peat plateau bog that likely formed after the palsa had developed, replacing the fen in which the palsa originally formed. The palsa appears old with lichens covering a Sphagnum peat surface. Palsas like these become very dry at the surface and are susceptible to thermokarsting induced by wildfire and/or the cracking of the surface through dessication. Palsas are commonly surrounded by fens. The melting of permafrost, usually from the edge inward, will cause the palsa to collapse and the surface will drop below or level with the surface of the surrounding peatland.

215. Coastal Hudson Bay Lowland Ecoregion

This ecoregion straddles the Ontario border and encompasses the flat, wet lowlands that border Hudson Bay in northeastern Manitoba and northwestern Ontario. Within Manitoba, this portion of the Subarctic forms part of a zone of transition between the tundra region to the north and the boreal forest to the south. The latitudinal limits of tree growth (the tree line) is reached in this ecoregion.



Climate

This ecoregion is part of the very extensive High Subarctic Ecoclimatic Region which extends from the highlands of Newfoundland and Labrador, across northern Quebec, Ontario, Manitoba and Saskatchewan into Nunavit and the Northwest Territories and to the Yukon-Alaska border. The climate is marked by short, cool summers and long, very cold winters. The mean annual air temperature ranges from about -7.1^{o}C to -2.6^{o}C. The average growing season varies from 100 to 143 days, and the number of growing degree-days ranges from about 500 to 1000.

The average annual precipitation ranges from about 400 mm to over 600 mm and varies greatly from year to year. About two-fifths to one-third of the precipitation falls as snow. Precipitation is highest during the growing season. Yearly moisture deficits average from 15 to 20 mm.

The region has a very cold, humid Subarctic soil climate. The only climate station in the ecoregion is at Churchill Airport. Although the station is located in the most northerly section of the ecoregion, the data is relevant to the ecoregion as a whole, although more so in the north and along the coast than in southern and inland areas.

Selected Climate Data[1] for Churchill Airport

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr.
Temp. ^{0}C	-26.9	-25.4	-20.2	-10.0	-1.1	6.1	11.8	11.3	5.5	-1.4	-12.5	-22.7	-7.1
Precip. mm	17.3	12.8	18.3	22.6	30.5	44.5	50.7	60.5	52.6	46.5	35.5	19.7	412.0
Growing degree-days	0.0	0.0	0.0	1.6	14.4	78.0	215.0	195.0	53.7	4.3	0.0	0.0	562.0

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

Surficial deposits and landforms

In Manitoba, the Coastal Hudson Bay Lowland Ecoregion is underlain by flat-lying marine sediments. It is a low, peat-covered plain with subdued glacial features and areas of raised sandy beaches bordering Hudson Bay. Permafrost is widespread and almost continuous in the peatlands in the northwest sector.

The relief of the lowland has been considerably affected by post-glacial marine submergence and isostatic rebound of the land surface. Raised beaches, especially well developed and numerous east of the Nelson River, present a striking pattern of parallel lines separated by peat-filled depressions. As the distance from the Hudson Bay coast increases, the raised beaches support increasing numbers of black spruce, and the peat deposits increase in depth. Some distance from the coast, most low-level beaches and calcareous loamy till deposits overlain by silty marine veneers and blankets are covered by peat.

Extensive mudflats are exposed along the coast at low tide. Marine deposits are thickest in lower-lying river valleys and are partially exposed in eroded valley walls. The lowland slopes very gently northeastward and elevations range from about 150 masl along the pronounced Tyrrell Sea beach along the northwest boundary, to sea level at Hudson Bay.

Numerous small unconnected lakes and undrained ponds are characteristic. The Churchill River flows through the northern section, while the Nelson and Hayes rivers flow for a short distance through the ecoregion before emptying into Hudson Bay. Most drainage is provided by the numerous creeks draining directly into Hudson Bay.

Soils

Organic Cryosols dominate and occur on polygonal peat plateau and peat plateau bogs. They are comprised mainly of fibric sphagnum moss peat over sedge peat.

Organic Mesisols and Organic Cryosols developed on moderately decomposed sedge and moss peat associated with horizontal fens are co-dominant. Other significant soils include imperfectly to well drained Regosolic soils found on raised sandy beaches and poorly drained saline Rego Gleysols on silty and clayey mudflats along the coastal shoreline.

The age of beach materials increases with distance from the coast as does the degree of soil development. Near the coast, well drained beaches have Regosolic soils, while farther inland, Brunisolic soils have developed on these beach materials. Therefore, Eutric Brunisols and some Turbic and Static Cryosols are found on older beaches, and on glaciofluvial deposits and till materials.

Vegetation

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 predominant.

Polygonal peat plateaus, widespread in the northern section, lack tree cover. The more recently emerged area along the coast is also devoid of trees or tall shrubs

Where trees are present, cover is generally patchy. Drier sites (especially older beaches) can be dominated by open stands of white spruce. Farther inland, black spruce dominates on drier sites, with ground covers of rock cranberry, bearberry, crowberry, dwarf birch, moss and lichen. Poorly drained sites usually support tussocks of sedge, cotton grass, brown mosses and sphagnum moss. Balsam poplar, white spruce and paper birch are common along rivers and associated alluvial sediments.

Low-shrub tundra, usually dwarf birch and willow, is common on upland sites.

Wildlife

The polar bear is one of the characteristic mammals of the ecozone and it is common along the coast. The polar bears of the South Coast Lowland population spend July to November on land. They remain along the coast or wander farther inland seeking solace from the summer warmth by excavating dens to the permafrost table in peat banks along creeks and lakes. Pregnant females spend additional time in maternity dens until the cubs are old enough to move out onto the ice in March to April. The bears are common from Cape Churchill to Cape Henrietta Maria.

Beluga whales occur in fairly large numbers in coastal waters during the summer, and are especially common in the area of the mouth of the Churchill River. The region also provides habitat for woodland caribou, arctic fox, osprey, and especially waterfowl, such as snow and Canada geese, and shorebirds.

Land use

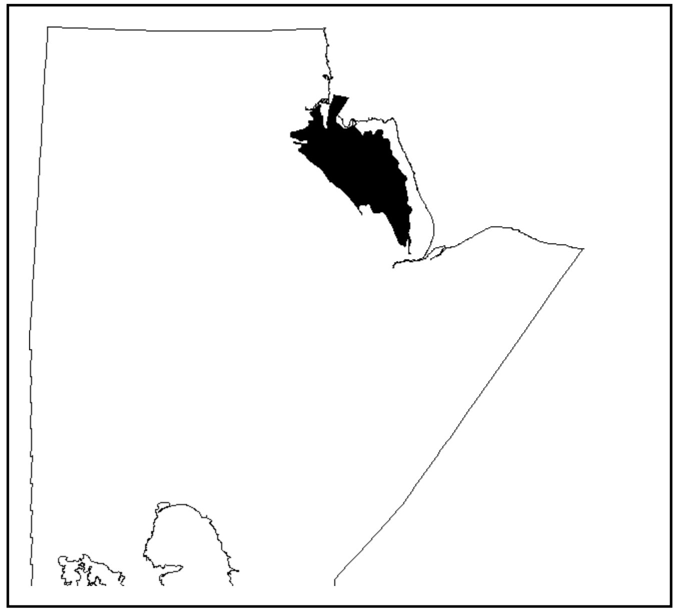
Land uses include local trapping and hunting and some water-oriented recreation. Some of these activities are associated with lodges located along the rivers traversing the northern area.

Churchill is connected via rail and air to the rest of Manitoba. Economic activity associated with the harbour in Churchill revolves around shipping grain to European destinations. Important economic activity is also connected with tourism. Significant numbers of people visit the town to participate in polar bear, beluga whale and bird viewing. The rocket range added economic activity in the past, but is not used at present.

There are three ecodistricts within the Coastal Hudson Bay Lowland Ecoregion in Manitoba.

1020. Churchill Ecodistrict (15 861 km^2)

This ecodistrict occupies the inland portion of the northern part of the Coastal Hudson Bay Lowland Ecoregion. The ecodistrict lies completely within Manitoba.



Climate

The Churchill Ecodistrict lies in the High Subarctic Ecoclimatic Region. The climate is marked by short, cool summers and long, very cold winters. Mean annual air temperature is about -7.1°C, and the average growing season is 100 days with about 500 growing degree-days.

The average annual precipitation is about 410 mm and can vary greatly from year to year. More than two-fifths of the yearly precipitation falls as snow. Precipitation is highest during the growing season. The average yearly moisture deficit is about 15 mm.

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

The ecodistrict has no climate station. Data from the station at Churchill Airport (1021. York Factory Ecodistrict) is relevant.

Physiography and Drainage

The Churchill Ecodistrict lies over Palaeozoic limestone bedrock. Elevations range from about 150 masl along the western margin of the district to about 8 masl near the coastal lowland to the north and east. The northern boundary of this flat wetland plain borders on the Kazan River Upland. The land slopes at a rate of about 1.5 m per km from west to east.

The relief of this lowland has been affected considerably by post-glacial marine submergence and up-warping of the land surface. Although raised beaches and strandlines are present, many are not conspicuous because most of the area is covered by peat which covers the beaches as well as the intervening low areas.

Permafrost is almost continuous in this ecodistrict. Thickness of the permafrost varies, but in older parts may reach 30 m, and about 60 m in the vicinity of the town of Churchill. Active layers in the bogs are about 50 m, and somewhat deeper in fens, to about 100 m.

Thermokarsting is a widespread phenomenon and has resulted in a myriad of tundra pools and small lakes. When expanding, these water bodies may coalesce and form more extensive ponds or lakes.

Permafrost is widespread and almost continuous in the peatlands in the northwest sector of the region. In the southern section of the ecodistrict, the location of the permanently frozen peat plateau bogs appears to reflect the configuration of former beaches. Farther inland east of the Churchill River, the ecodistrict is dominated by permanently frozen polygonal peat plateau bogs that are largely covered by sphagnum moss, lichens and low ericaceous shrubs. Fens are common throughout, but more so in the eastern and southern sections. These fens are underlain by permafrost, at least in part.

Tree cover is sparse and limited to mineral soil exposures, some bogs, and in the Churchill River valley and along other rivers.

The numerous small, mostly unconnected lakes and tundra ponds are characteristic of the district. Although the Knife, Lower Churchill, Owl and Broad rivers are the largest drainage ways in the ecodistrict and traverse northeastward through the ecodistrict, a significant part of the ecodistrict is drained by creeks draining directly into Hudson Bay. The northern part of the ecodistrict is part of the Knife River drainage system, while the central part lies in the Port Churchill division of the Churchill River lower region watershed. The southern and eastern sections are part of the Owl River drainage division.

Soils

The dominant soils in the Churchill Ecodistrict are poorly drained Organic Cryosols, comprised mainly of fibric sphagnum and sedge peat. They are associated with significant areas of Organic Cryosols derived from mesic sedge and brown moss peat. These soils are associated with polygonal peat plateau and peat plateau bogs, palsa bogs and some fens.

Typic (deep) Mesisols developed from sedges and brown mosses overlying calcareous loamy till and clayey and silty marine sediments are associated with patterned and horizontal fens. Local areas of mineral soils are dominantly well to imperfectly drained Turbic Cryosols and Eluviated Eutric Brunisols and are commonly found on raised marine beaches, fluvioglacial deposits and some till exposures.

In addition to severe climatic conditions, the poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Limited water holding capacity and a low store of nutrients are severe additional constraints to the use of coarse textured mineral soils.

Vegetation

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 predominant. Polygonal peat plateaus, widespread in the northern section, lack tree cover.

Where trees are present, cover is generally patchy. Drier sites (especially older beaches) can be dominated by open stands of white spruce, and farther inland, black spruce with a ground cover of rock cranberry, bearberry, crowberry, dwarf birch, mosses and lichens. Poorly drained sites usually support tussocks of sedge, cotton grass, brown mosses and sphagnum mosses. Balsam poplar, white spruce and paper birch occur along rivers and on associated alluvial sediments. Medium shrub tundra, usually dominated by dwarf birch and willow, is common on upland sites.

Water

The primary sources of water are the many very small lakes and undrained ponds found throughout the area as well as the Knife, Churchill, Owl rivers and other rivers and creeks draining directly into Hudson Bay.

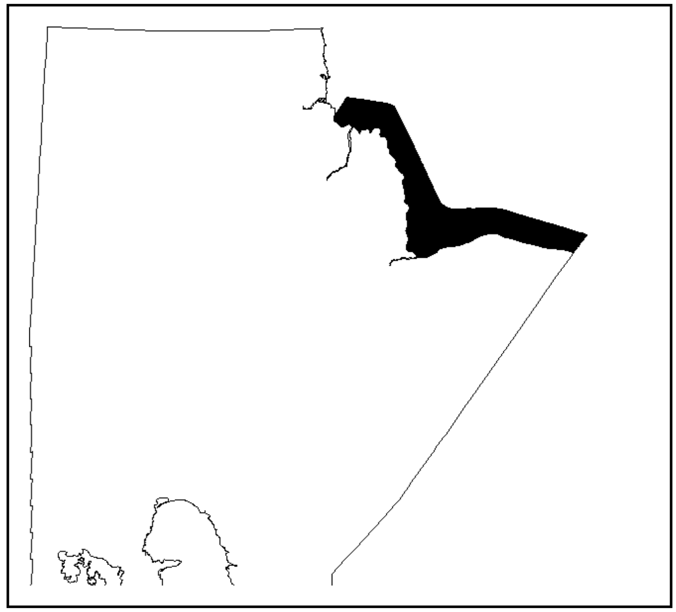
Land use

There are no settlements in this ecodistrict.

Fishing, trapping and hunting are the dominant uses of land. Eco-tourism associated with polar bears, beluga whales and tundra ecology has become a locally important industry in the town of Churchill, which is located just outside the ecodistrict. Catering to birdwatchers has also become a growing tourist enterprise.

1021. York Factory Ecodistrict (20 737 km²)

The York Factory Ecodistrict spans the border with Ontario extending south from Churchill along the Hudson Bay coast to the Nelson River and from there eastward to the mouth of the Winisk River in northern Ontario. This is an area largely of relatively recently emerged land as a result of isostatic rebound.



Climate

The York Factory Ecodistrict lies in the High Subarctic Ecoclimatic Region, and has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature is about -4.9°C. The average growing season is 121 days with about 720 growing degree-days.

The average annual precipitation is about 510 mm, of which about two-fifths fall as snow. Precipitation varies greatly from year to year and is highest during the growing season. The yearly moisture deficit averages around 15 mm.

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

The only climate station in the ecodistrict is located at Churchill Airport, which is in the most northern location of the ecodistrict. Although the climate data is relevant for the ecodistrict as a whole, it will be more relevant for the northern than the southern section.

Selected Climate Data[1] for Churchill Airport

	Year	June-Aug	May-Sept	July	Jan
Temperature °C	-7.1	9.7	6.7	11.8	-26.9
Precip. mm (equiv.)	411.6	155.7	238.8	50.7	17.3
Rain/Snow (mm/cm)	0.0T/20.1	151.4/4.2	211.1/29.2	50.7/0.0T	0.0T/20.1
Growing degree-days >5°C	562.0	488.5	556.6	215.4	0.0

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

Physiography and Drainage

The York Factory Ecodistrict is a level to gently sloping marine plain ranging in elevation from about 30 masl along its southern margin to sea level to the north, decreasing at the rate of about 0.5 m per km.

Relief of the ecodistrict has been affected considerably by post-glacial marine submergence and isostatic rebound of the land surface. The plain is marked with many subdued beach ridges and strandlines. The beaches are separated by shallow fens and marshes in the intervening depressions.

Permafrost is widespread but not continuous, as recently emerged land lacks both peat cover and time for permafrost to have become established.

The ecodistrict's eastern and northern boundaries with Hudson Bay are marked by extensive tidal flats that, at low tide, extend for many kilometres into the bay. Farther inland, where peat deposition is deeper, peat plateau bogs on peat deposits covering subdued beaches and horizontal fens are found. Small, mostly unconnected lakes and ponds are present, but they are not nearly as numerous as in the districts to the south and west.

The Churchill, Nelson, Hayes rivers in Manitoba and the Severn River in Ontario are the largest rivers, each traversing the ecodistrict for a short distance before emptying into Hudson Bay. Most of the ecodistrict is drained by the many creeks flowing directly into Hudson Bay. Consequently, the ecodistrict is part of several watershed and drainage divisions. The northern sector lies in the Owl River division of the Owl River watershed. The northeastern sector is part of the Kaskattama River division of the Kaskattama-Kettle rivers watershed, and the central portion is part of the Hayes River lower division of the Hayes River watershed and the Nelson River lower drainage division of the Nelson River watershed.

Soils

Along the coast, the dominant soils are poorly drained, saline Rego Glyeysols associated with silty and clayey brackish tidal flats which form a belt along the shoreline of the bay. Farther inland, peat has developed, increasing in depth with distance from the coast. The dominant soils farther inland are therefore a complex of very poorly drained Terric (shallow) and Typic (deep) Mesisols formed from sedges and brown mosses overlying calcareous, loamy to clayey marine sediments. Areas of Organic Cryosols associated with permanently frozen peat plateau and palsa bogs raised above the surrounding fens, are also present and have developed on older peat deposits.

Sandy, imperfectly to well drained Regosols are found on beach ridges and strandlines. Soils on local areas of till and glaciofluvial deposits and on older sandy beaches are dominantly well to imperfectly drained Eluviated Eutric Brunisols and Turbic Cryosols.

The severe climatic conditions prevent the use of the ecodistrict for forestry or agriculture. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Limited water holding capacity, a low store of nutrients and salinity are additional severe constraints to the use of mineral soils.

Vegetation

Vegetation is virtually lacking on the tidal flats extending into Hudson Bay. However, tidal marshes do occur along the shore. Inland beaches and strandlines support vegetation of low shrubs and sedges. Father from the coast, the vegetation is dominated by mosses, sedges and low shrubs associated with the various peatlands. Islands in the mouths of the Hayes and Nelson rivers and on the piece of land separating the two rivers support black spruce, white spruce and balsam poplar stands.

Water

The primary sources of water are the very small, largely unconnected lakes and undrained ponds found throughout the area as well as the Knife, Churchill, Owl and numerous other rivers and creeks draining into Hudson Bay.

Land use

Most of the economic activity and use of the land is associated with the town of Churchill. Eco-tourism, which includes the viewing of birds, beluga whales and polar bears, is a thriving and growing business. These activities are generally carried out in the area south of Churchill and, with respect to beluga whale watching, in the mouth of the Churchill River. Trapping and hunting are also significant uses of land in this area, especially the hunting of waterfowl such as Canada and snow geese.

Polar bears

There is a sizeable population of polar bears along the Hudson Bay coast of Manitoba.

1022. Fort Severn Ecodistrict (6642 km²)

The Fort Severn Ecodistrict extends westward from the west coast of James Bay in northern Ontario along the Hudson Bay coast to the mouth of the Hayes River in Manitoba. Only a small part of the ecodistrict is in Manitoba.

Climate

The Fort Severn Ecodistrict lies in the High Subarctic Ecoclimatic Region, and has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature is about -2.6°C. The average growing season is 143 days with about 1000 growing degree-days.

The average annual precipitation is approximately 600 mm and can vary greatly from year to year. About one-third of the annual precipitation falls as snow. Precipitation is highest during the growing season. The average moisture deficit is nearly 20 mm.

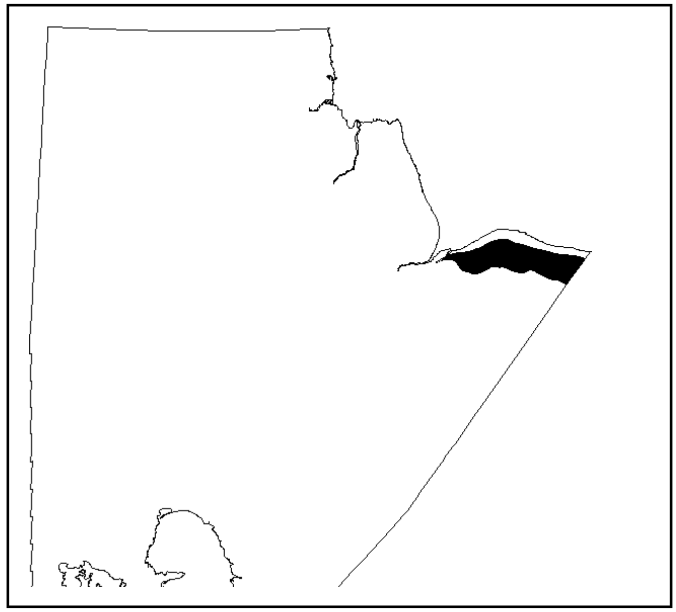
The ecodistrict has a very cold, humid, Subarctic soil climate.

Physiography and Drainage

The ecodistrict is a level to very gently sloping marine plain broken by groups of parallel beach ridges. It ranges in elevation from about 30 masl along its southern margin to a few metres above sea level along its northern boundary, decreasing at the rate of about 0.5 m per km.

The relief has been considerably affected by post-glacial marine submergence and isostatic rebound of the land surface. Raised beaches present a striking pattern of successive black spruce covered ridges, alternating with depressed ribbed and horizontal fens, and peat plateau and palsa bogs. Permafrost is widespread but not continuous.

Numerous very small unconnected lakes and undrained ponds are characteristic. Many small rivers flow directly into the bay. The Severn and Winisk rivers are the primary drainage ways through the Ontario portion of the ecodistrict. The Manitoba portion of the ecodistrict is part of the Kaskattama-Kettle rivers watershed. The western section lies in the Kaskattama River division, and the eastern sector is part of the Kettle River division.



Soils

The dominant soils are a complex of very poorly drained Typic (deep) and Terric (shallow) Mesisols formed from sedges and brown mosses overlying calcareous, loamy to clayey marine sediments. Significant areas of Organic Cryosols are associated with permanently frozen peat plateau and palsa bogs, and locally, veneer bogs. East of the Winisk River in Ontario and close to Hudson Bay, local areas of exposed mineral soils are dominantly well to imperfectly drained Static and Turbic Cryosols and Eluviated Dystric Brunisols on raised marine beaches, and on local areas of exposed mineral marine and till deposits.

The severe climatic conditions prevent the use of the ecodistrict for forestry or agriculture. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils.

Vegetation

The vegetation varies with distance from Hudson Bay and the type of surficial material. Poorly drained fens are dominated by sedge, swamp birch and willows, with some tamarack farther from the coast. Peat plateau bogs are dominated by sphagnum mosses, ericaceous shrubs, swamp birch, feather mosses and lichens, with a sparse covering of stunted black spruce. On mineral soils, mixtures of black spruce, various shrubs, mosses and lichens are found. White spruce are also present, especially on former beaches and usually with an understory of low shrubs and lichens.

Water

The primary sources of water are the many very small unconnected lakes and undrained ponds found throughout the area as well as the numerous creeks and rivers draining directly into Hudson Bay.

Land Use

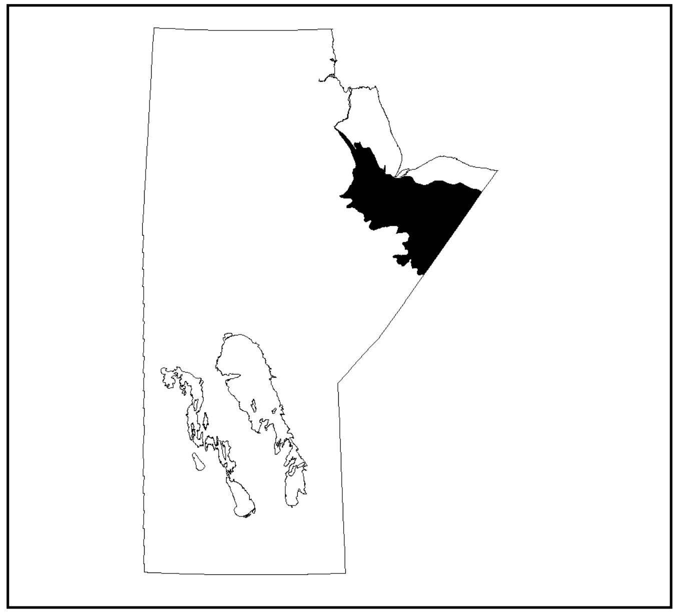
Use of this ecodistrict, at least in Manitoba is very limited. There are no permanent settlements. Subsistence fishing, trapping and hunting by people from areas to the south are the dominant land uses.

Peat plateau and palsa bog with pond.

The peat plateau and palsa bog elements have coalesced in this area. The higher peat landform is a palsa, while the lower area is peat plateau bog. The black spruce tree cover is very stunted. The surface is largely covered by lichens, and ericaceous shrubs. Peat accumulation is very slow or non-existent at present. The pond in the foreground likely started out as a small thermokarst scar, but has expanded over time. The far shore appears to be stable, and sedge peat accumulation is taking place along the near shore.

216. Hudson Bay Lowland Ecoregion

The Hudson Bay Lowland Ecoregion is a wetland-dominated ecoregion extending eastward from the Churchill River in northeastern Manitoba to James Bay in northern Ontario.



Climate

The ecoregion is part of the low Subarctic Ecoclimatic Region which extends westward from the highlands of Newfoundland and Labrador to Nunavit and the Northwest Territories and to the Yukon-Alaska border. It has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature varies from approximately -4.4^{o}C to -2.5^{o}C. The average growing season varies from 127 to 145 days, with the number of growing degree-days ranging from about 850 to 1000.

The average annual precipitation varies from about 500 to 700 mm, and can vary greatly from year to year. About one-third falls as snow. Precipitation is highest during the growing season. Yearly average moisture deficits range from about 20 to 40 mm.

The ecoregion has a very cold, humid, Cryoboreal soil climate.

There are no climate stations in the ecoregion. Data from Churchill Airport and Moosonee (215. Coastal Hudson Bay Lowland Ecoregion) is to some extent relevant.

Surficial deposits and landforms

For the most part, the ecoregion consists of peatlands overlying mostly marine sediments which in turn rest on calcareous till which outcrops occasionally. The underlying bedrock is a flat, low relief Paleozoic limestone. The region borders on the south and west on the Severn and Kazan uplands.

The relief of this lowland has been considerably affected by post-glacial marine submergence and isostatic rebound of the land surface. Permafrost is widespread but discontinuous, and largely associated with organic depsosits. Peat plateau bogs, patterned bogs and horizontal and patterned fens overly clayey glaciolacustrine and marine sediments. Veneer bogs cover part or most of the subdued, loamy till uplands.

The Manitoba portion of the ecoregion slopes very gently northward from about 150 masl to 30 masl. Numerous very small, usually unconnected lakes and ponds are characteristic. The Nelson, Hayes and Gods rivers are the primary drainage ways traversing the ecoregion in Manitoba and the Severn and Winisk rivers are the primary rivers draining into Hudson Bay in Ontario. However, most of the ecoregion is drained by the many creeks flowing through, and originating in the ecoregion.

Soils

The dominant soils are organic soils, most of which are deep to very deep, and a large portion of them are permanently frozen. Thus a dominant group of soils in the region is a complex of Organic Mesisols and Organic Cryosols.

Typic (deep) Mesisolic, and to some extent Fibrisolic, Organic soils that have developed on the deep sedge and brown moss peat associated with horizontal and northern ribbed fens are widespread. Shallow Organic Cryosols and Terric (shallow) Mesisolic soils are associated with mesic and fibric woody peat of veneer bogs. Deeper Organic Cryosols are associated with fibric sphagnum peat overlying sedge and brown moss peat which composes the peat deposits of peat plateau bogs and palsa bogs. These are predominant in the Manitoba portion of the ecoregion.

Significant inclusions of Eutric Brunisolic soils are found on the few exposed prominent fluvioglacial deposits, beaches and calcareous, loamy till deposits.

Vegetation

This ecoregion is part of the transition from the closed boreal forests to the south and the tundra to the north.

The closed cover of typical boreal forest gives way to open stands of low black spruce, with understorys of dwarf birch, Labrador tea, lichen and moss. This occurs in part because of climatic constraints, and in part because of the predominance of organic terrain.

Drier mineral sites generally support taller and more closed stands of black spruce, white spruce and paper birch, with a discontinuous low shrub cover of bearberry, bog cranberry and other evergreen species and extensive lichen and moss groundcover typical of the area. White spruce, birch and aspen also occur along rivers and in river valleys.

Bog - fen complexes dominate this poorly drained, peat-filled lowland in Manitoba. Bogs support low black spruce, Labrador tea, blueberry, bog rosemary and cloudberry, and sphagnum moss and lichen vegetation. Fens have a cover of sedge, brown mosses, swamp birch and occasionally stunted tamarack.

Wildlife

The ecoregion provides wildlife habitat for woodland caribou and moose, snowshoe hare, spruce grouse, osprey, waterfowl including ducks, geese, swans, and other birds. Polar bears wander in from the coast along the numerous creeks in search of denning areas.

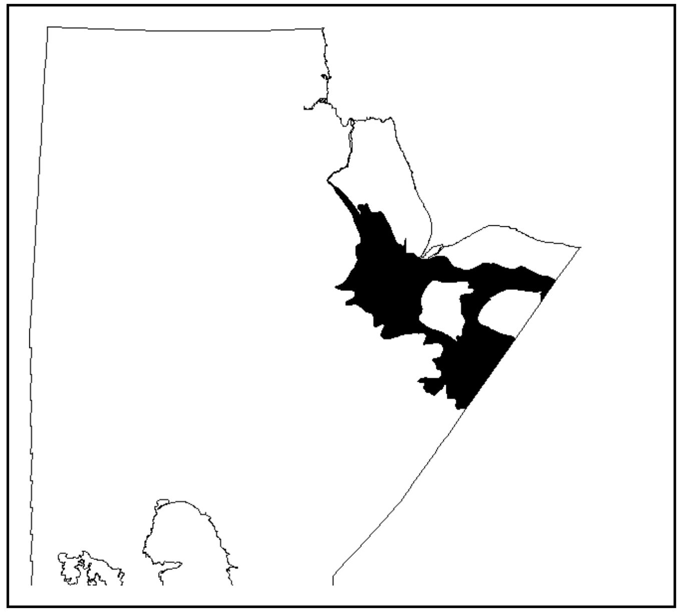
Land use

Fishing, trapping and hunting, and water-oriented recreation and tourism are the dominant uses of land in this ecoregion.

There are three ecodistricts within the Hudson Bay Lowland Ecoregion in Manitoba.

1024. Winisk River Lowland Ecodistrict (32 283 km^2)

The Winisk River Lowland Ecodistrict covers a large area both in Manitoba and Ontario.



Climate

The ecodistrict lies in the Low Subarctic Ecoclimatic Region. The region has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature is approximately -2.5°C. The average length of the growing season is 145 days with about 1010 growing degree-days.

The average annual precipitation, which can vary greatly from year to year, is about 690 mm. About one-third falls as snow. Precipitation is highest during the growing season. The average yearly moisture deficit is about 20 mm.

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

There are no climate stations in the ecodistrict.

Physiography and Drainage

In Manitoba, the Winisk River Lowland ranges in elevation from about 150 masl along its southern margin to about 30 masl near the coastal lowland to the north. This flat, wetland-dominated plain borders in the south and west on the Severn and Kazan Uplands.

Permafrost is widespread and associated with bog peatlands. Fen peatlands generally lack permafrost. Thermokarsting is widespread and is evident from collapse edges and collapse areas in the centres of peat plateaus.

The relief of this ecodistrict has been considerably affected by post-glacial marine submergence and isostatic rebound of the land surface. Locally, raised beaches present a pattern of successive ridges covered with black spruce alternating with fens and bogs. However, most of the ecodistrict is a complex of peat plateau and string bogs, and horizontal and northern ribbed fens.

Numerous small to very small, largely unconnected lakes and ponds are characteristic of the ecodistrict. The Nelson, Hayes and Gods rivers are the primary drainage ways that traverse the ecodistrict, but most of it is drained by the many creeks and small rivers flowing through, and originating in the ecodistrict.

Soils

The dominant soils are Organic Cryosols and deep Mesisols and Fibrisols overlying clayey and silty glaciolacustrine and marine sediments. The Organic Cryosols are found on peat plateau bogs, and are comprised mainly of fibric sphagnum peat overlying mesic fen and forest peat. The Mesisolic and Fibrisolic Organic soils are associated with horizontal fens and northern ribbed fens and string bogs.

Local areas of mineral soils are dominantly well to imperfectly drained Eluviated Eutric Brunisols which are commonly found on raised marine beaches and fluvioglacial deposits.

The severe climatic constraints prevent the use of the ecodistrict for forestry or agriculture. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Limited ability to hold water and nutrients are severe constraints to the use of mineral soils.

Vegetation

The vegetation in the ecodistrict is characterized by the open stunted black spruce forest found on the bogs. Associated vegetation consists of Labrador tea, other ericaceous shrubs, mosses and lichens. The fens have vegetation dominated by sedges and brown mosses with varying amounts of dwarf birch, willow and stunted tamarack. Mineral soils support denser and taller black spruce stands with an understory of alder or willow and a ground cover of ericaceous shrubs, mosses and lichens.

Water

Numerous small lakes and ponds and the Nelson, Hayes and Gods rivers, and the many creeks that traverse the ecodistrict are the principal sources of water in the Manitoba portion.

Land use

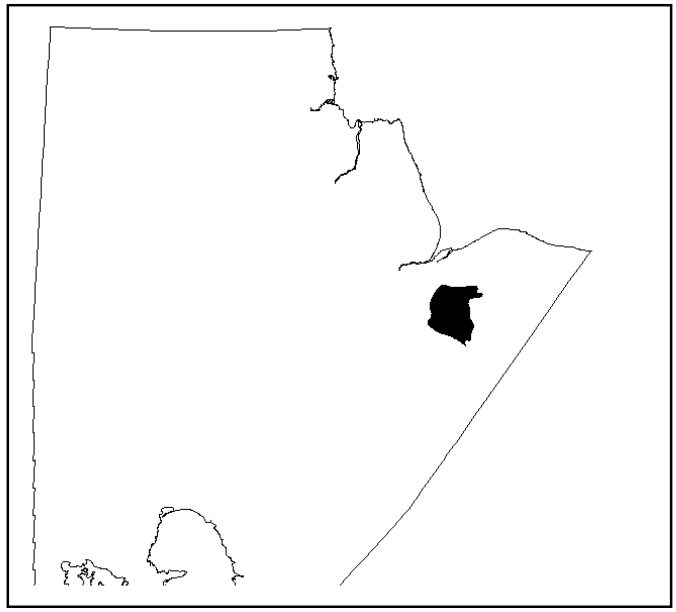
The Fox Lake First Nation and Sundance are the only settlements in the Manitoba portion of the ecodistrict. They are located in the extreme western sector. Fishing, trapping and hunting are the dominant land uses.

Moose

Moose are the largest ungulates in Canada. The moose uses a variety of habitats, including mixed forest, wetlands and burn-overs. Moose are found in most of the forested areas of Manitoba, but numbers vary depending on habitat quality and hunting pressure.

1025. French Creek Ecodistrict (4370 km^2)

The French Creek Ecodistrict lies wholly within Manitoba and is surrounded by the Winisk River Lowland Ecodistrict.



Climate

The ecodistrict lies in the High Subarctic Ecoclimatic Region and has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature is approximately -4.4^{o}C. The average growing season is 127 days, with about 850 growing degree-days.

The annual precipitation can vary greatly from year to year, but averages around 615 mm, of which about one-third is snow. Precipitation is highest during the growing season. The average yearly moisture deficit is about 40 mm.

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

The ecodistrict has no climate stations.

Physiography and Drainage

The French Creek Ecodistrict is a somewhat higher, mostly peat-covered subdued deposit of till with relic marine beaches. It is surrounded by the Winisk River Lowland Ecodistrict. It ranges in elevation from about 125 to 60 masl. Beach ridges have moderately long slopes of about 10 to 15 percent incline.

The relief of this ecodistrict has been considerably affected by post-glacial marine submergence and isostatic rebound of the land surface. Locally, raised beaches present a pattern of successive black spruce ridges alternating with peat plateau and veneer bogs and shallow fens. Numerous very small unconnected lakes, ponds and small to medium-sized drained lakes are characteristic. Gods River and its tributaries drain the area northward toward Hudson Bay over terrain that falls at about 0.5 m per km.

Permafrost is associated with the bog peatlands and is widespread.

Soils

The dominant soils are shallow and deep Organic Cryosols, and Fibrisolic and Mesisolic Organic soils comprised mainly of forest, sphagnum and sedge peat that overlie calcareous loamy till and clayey marine sediments. Significant areas of Eluviated Eutric Brunisols are found on sandy to loamy calcareous till, raised marine beaches and fluvioglacial deposits.

The severe climatic conditions prevent the use of the ecodistrict for forestry or agriculture. In addition, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Limited water holding capacity and nutrient retention are additional severe constraints to the use of mineral soils.

Vegetation

The organic soils generally support vegetation typical of veneer bogs, that is, stunted black spruce with varying amounts of dwarf birch, willow, Labrador tea, other ericaceous shrubs, mosses and lichens. The fens are dominated by sedges, brown mosses and varying amounts of dwarf birch, willow and tamarack. The mineral upland soils support fairly good stands of black spruce and birch and on warmer sites, trembling aspen, with an admixture of shrubs, herbs and mosses.

Water

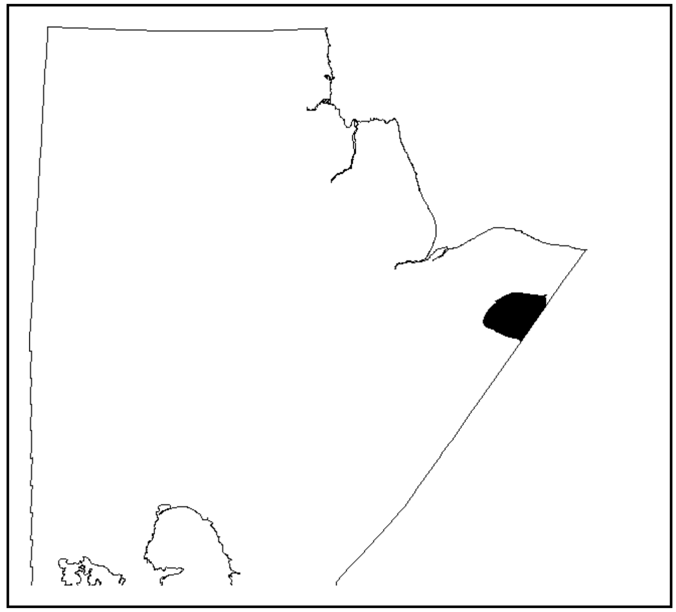
Principal sources of water are Gods River, small lakes, ponds, tributaries of the Gods River and other rivers and creeks flowing directly into Hudson Bay.

Land use

Shamatawa First Nation is the only community in the ecodistrict. It is located on the banks of the Gods River and straddles the border with Ecodistrict 1024.

Trapping and hunting are the dominant, but limited, uses of land in this ecodistrict.

1026. Sombert Lake Ecodistrict (4214 km^2)



This ecodistrict straddles the Manitoba-Ontario border, with about half of it within Manitoba. It is surrounded by the Winisk River Lowland Ecodistrict.

Climate

The ecodistrict is in part in the High Subarctic Ecoclimatic Region and has a climate marked by short, cool summers and long, very cold winters. The mean annual air temperature is about -2.8^{o}C. The average growing season is 142 days with about 980 growing degree-days.

The average annual precipitation is about 490 mm and can vary greatly from year to year. About one-third falls as snow. Precipitation is highest during the growing season. The yearly moisture deficit averages nearly 25 mm.

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

There are no climate stations in the ecodistrict.

Physiography and Drainage

This ecodistrict is a somewhat raised, drumlinized, mostly shallow peat-covered subdued till upland. Elevations range from about 125 to 60 masl. Local relief ranges from about 5 to 20 m, slopes are about 5 to 15 percent and moderately long. The relief has also been considerably affected by post-glacial marine submergence and isostatic rebound. Locally, raised beaches present a pattern of successive ridges covered with black spruce, alternating with peat plateau and veneer bogs. Numerous very small unconnected lakes, ponds and small to medium-sized drained lakes are characteristic. Tributaries of Gods and Kaskattama rivers drain the area northward toward Hudson Bay over terrain that falls at about 0.5 m per km.

Permafrost is associated with bog peatlands and is widespread.

Soils

The dominant soils are shallow Organic Cryosols and Terric Mesisols and Fibrisols on veneer bogs comprised of mesic and fibric forest peat. The peaty material in turn overlies calcareous loamy till and clayey marine sediments.

Significant areas of mineral soils are dominantly well to imperfectly drained Eluviated Eutric Brunisols on calcareous till, raised marine beaches and fluvioglacial deposits.

Climatic constraints, poor natural drainage and slow heat conductance properties limit the usefulness of organic soils. Stoniness, and on sandy to gravelly beach and fluvioglacial deposits and limited water-holding capacity and nutrient retention are additional several constraints to the use of mineral soils.

Vegetation

The organic soils generally support vegetation typical of veneer bogs - stunted black spruce with varying amounts of dwarf birch, willow, Labrador tea, other ericaceous shrubs, mosses and lichens. The fens are dominated by sedges, brown mosses, and have varying amounts of dwarf birch, willow and tamarack. The mineral upland soils support fairly good stands of black spruce and birch and on warmer sites, trembling aspen, with an admixture of shrubs, herbs and mosses.

Water

Principal sources of water are the numerous unconnected very small lakes, undrained ponds and tributaries of the Gods and Kaskattama rivers.

Land use

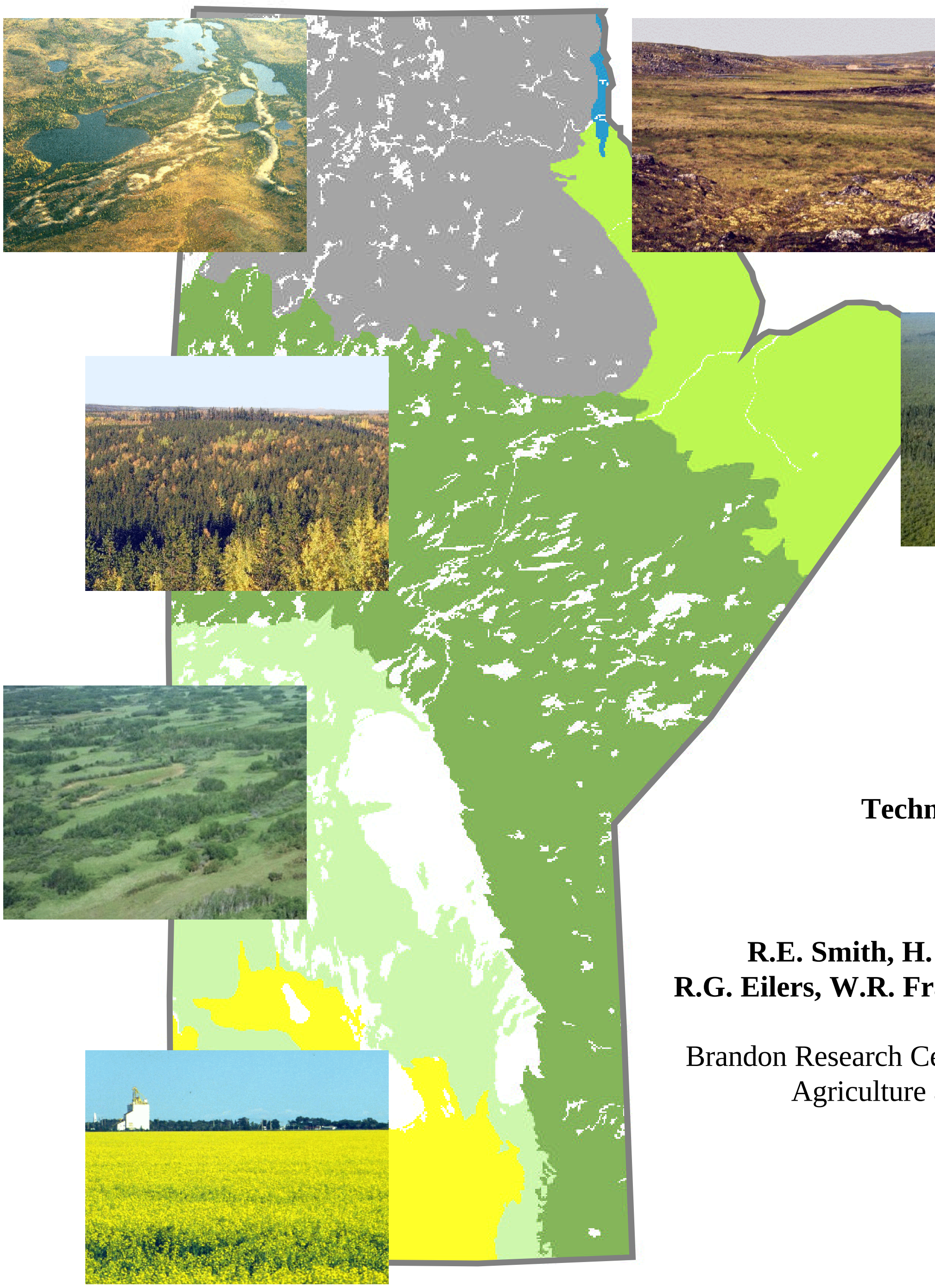
There are no communities in this ecodistrict.

Fishing, trapping and hunting are the dominant, but limited, land uses.

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Terrestrial Ecozones, Ecoregions, and Ecodistricts of Manitoba

An Ecological Stratification of Manitoba's Natural Landscapes



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Appendices

Appendix A: References and Sources of Information

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Appendix B: Glossary of Soil and Landform terms

Acid soil - A soil having a pH less than 7. See pH and Reaction, soil.

Active layer - The top layer of ground in areas underlain by permafrost which is subject to annual thawing and freezing.

Alkaline soil - A soil having a pH greater than 7. See Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams. Usually refers to recent deposits.

Apron - A relatively gentle slope at the foot of a steeper slope and formed by materials from the steeper, upper slope.

Arable soil - Soil suitable for plowing and cultivation.

1/3 Atmosphere moisture - The moisture percentage on a dry weight basis of a soil sample that has been air dried, screened, saturated and subjected to a soil moisture tension of 345 cm of water through a permeable membrane for a period of 48 hours. It approximates the soil moisture retention capacity.

Available soil moisture - The portion of water in a soil that can be readily absorbed by plant roots: generally considered to be that water held in the soil up to approximately 15 atmospheres pressure.

Bedrock - The solid rock that underlies soil and regolith or that is exposed at the surface.

Blanket - A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but still conforming to the general underlying topography.

Bog - see section under Wetland Classification.

Boulders - Stones which are larger than 60 cm in diameter.

Brunisol, Brunisolic soil - see section under Soil Classification.

Calcareous soil - Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with hydrochloric acid.

Calcium Carbonate Equivalent - Refers to the percent of carbonates in the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate contents of soils are:

noncalcareous. . . . .<1%
weakly calcareous. 1-5%
moderately calcareous. 6-15%
strongly calcareous. 16-25%
v. strongly calcareous 26-40%
extremely calcareous . . . . . . >40%

Chernozem, Chernozemic soil - See section under Soil Classification.

Clay - As a soil separate, the mineral soil particles less than 0.002 mm in diameter: usually consisting largely of clay minerals. As a soil textural class, soil materials that contain 40 or more percent clay, less than 45 percent sand and less than 40 percent silt.

Cobbles - Rock fragments 8 to 25 cm in diameter.

Colluvial - Mineral deposits that have reached their present position in the landscape by direct, gravity-induced movement. The materials are usually moderately to well stratified, non to poorly sorted with any range of particle sizes from clay to boulders and blocks.

Colour - Soil colours are compared with a Munsell colour chart. The Munsell system specifies the relative degrees of the three simple variables of colour: hue, value and chroma. For example: 10YR 6/4 means a hue of 10YR, a value of 6, and a chroma of 4, and is described as light yellowish brown.

Contour - An imaginary line connecting points of equal elevation on the land surface.

Cover - This term generally has one of the following meanings:

1. Vegetation or other material providing protection
2. In forestry, low growing shrubs and herbaceous plants under trees (i.e., ground cover vs. tree cover)
3. Any vegetation producing a protective mat on or just above the soil surface.

Creep (soil) - Slow mass movement of soil and soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and by alternate freezing and thawing.

Cryosol, Cryosolic soil - see section under Soil Classification

Degree-day - This is a measure of the departure of temperature for a day from some reference temperature. For example to obtain the growing degree-days over 5°C for a single day the mean temperature for that day is calculated by adding together the maximum and minimum temperature and dividing the total by 2. The mean is then subtracted from the selected reference temperature, in this case 5°C, such that each degree Celsius above 5°C is counted as 1 degree-day.

Delta - A fluvial or glaciofluvial fan shaped deposit at the mouth of a river that empties into a lake or sea.

Deltaic deposit - Surficial material originially deposited by a river emptying into a lake or sea.

Drainage (soil) - (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

Drainage in soil reports is described on the basis of actual moisture content in excess of field capacity and length of the saturation period within the plant root zone. The terms are as follows:

Very rapidly drained - Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm) within the control section and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Rapidly drained - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section, and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Well drained - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equalled by losses. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth. Soil horizons are usually bright colored.

Moderately well drained - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have an intermediate to high water storage capacity (5-6cm) within the control section and are usually medium to fine in texture. Soils are commonly mottled in the 50 to 100 cm depth. Colors are dull brown in the subsoil with stains and mottles.

Imperfectly drained - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is in major supply. If subsurface water or groundwater, or both, is the main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as the available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups. These soils generally have mottling below the surface layers and generally have duller colours with depth, generally brownish gray with mottles of yellow and gray.

Poorly drained - Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Poorly drained soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. These soils have a wide range in available water storage capacity, texture, and depth, and are either Gleysolic or Organic.

Dryland farming - The practice of crop production in low rainfall areas without irrigation.

Eluvial horizon - A horizon from which material has been removed in solution or in water suspension.

Eolian - Mineral sediments that have been transported and deposited by wind action. The materials generally consist of medium to fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive.

Erosion - The wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind or other geological processes.

Evapotranspiration - The combined loss of water from a given area, and during a specific period of time, by evaporation from the soil surface and transpiration from plants.

Fan - A fan-shaped form similar to the segment of a cone and having a perceptible gradient from the apex to the toe.

Fen - see section under Wetland Classification.

Fibric - The least decomposed of all organic materials; there is a large amount of well preserved fibre that is readily identifiable as to botanical origin. Fibres retain, for the most part, their character upon rubbing.

Flood plain - The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Fluvial - All sediments past and present, deposited by flowing water, including glaciofluvial deposits. Sediments generally consist of gravel and sand with a minor fraction of silt and clay. The gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification, but massive, nonsorted fluvial gravels do occur. Finer textured Fluvial deposits of modern rivers are termed Alluvium.

Frost heave -.The raising of the surface caused by ice in the subsoil.

Frost heaved stones - Stones that have been moved to the soil surface through frost action.

Glaciofluvial - Mineral materials moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

Glaciolacustrine - Lacustrine materials deposited in lakes that were in contact with glacial ice.

Glaciomarine - Materials of glacial origin laid down in a marine environment, as a result of settling from melting, floating ice and ice shelves.

Gleyed soil - An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have lower chromas or more prominent mottling or both in some horizons than the associated well-drained soil.

Gleysol, Gleysolic soil - see section under Soil Classification.

Gravel - Rock fragments 2 mm to 7.5 cm in diameter.

Ground moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till; most till is thought to have accumulated under the ice by lodgment, but some till has been let down from the upper surface of the ice by ablation. Resorting and modification may have taken place to some extent by wave action of glacial melt waters. The topography is commonly in the form of undulating plains with gently sloping hills and enclosed depressions, but steeper sloping hummocks or hillocks are also widespread.

Groundwater - Water beneath the soil surface, usually under conditions where the voids are completely filled with water (saturation).

Horizon (soil) - A layer in the soil profile, usually approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes.

Humic - Highly decomposed organic material; small amounts of fibre may be present that can be identified as to their botanical origin. Fibres can be easily destroyed by rubbing.

Hummocky - A very complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally between 9-70% (5-35 degrees).

Illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

Impeded drainage - A condition that hinders the movement of water by gravity through the soils.

Inclined - A sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 2-70% (1-35 degrees). The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Infiltration - The downward entry of water into the soil.

Irrigation - The artificial application of water to the soil for the benefit of growing crops.

Lacustrine - Mineral sediments that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action. The sediments generally consist of either stratified or varved (layered annual deposits) fine sand, silt, and clay deposited on the lake bed; or moderately well sorted and stratified sand and coarser materials that are beach and other near-shore sediments transported and deposited by wave action.

Landscape - All the natural features such as fields, hills, forest, water, etc., which distinguish one part of the earth's surface from another part.

Leaching - The removal from the soil of materials in solution.

Level - A flat or very gentle sloping , unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 2% (1 degree).

Luvisol, Luvisolic soil - see section under Soil Classification.

Marine - Mineral materials that have settled from suspension in salt or brackish water bodies or have accumulated at their margins through shoreline processes such as wave action and longshore drift. These materials generally consist of unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well stratified to moderately stratified (in some places containing shells).

Marsh - see section under Wetland Classification.

masl - metres above mean sea level.

Mesic - Organic material in an intermediate stage of decomposition; intermediate amounts of fibre are present that can be identified as to their botanical origin.

Mesophyte - A plant that grows under intermediate moisture conditions.

Microrelief - Small scale, local differences in relief including mounds, swales or hollows.

Morainal - Mineral deposits that been transported beneath, beside, on, within and in front of a glacier and were not modified by any intermediate agent. The sediments generally consist of well compacted materials that are nonstratified and contain a heterogeneous mixture of particle sizes, from clay to boulders.

Mottles - Irregularly marked spots or streaks, usually yellow or orange but sometimes blue. They are described in order of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottles in soils indicate poor aeration and lack of good drainage.

Organic carbon - Carbon derived from plant and animal residues.

Organic material - The soil material that occurs as peat deposits or as thin organic mats on the soil surface and contains >30% organic matter by weight.

Organic matter - The fraction of the soil which consists of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is determined on soils that have been sieved through a 2.0 mm sieve. It is estimated by multiplying the organic carbon by a factor of 1.72.

Organic soil - see section under Soil Classification.

Outwash - Sediments "washed out" beyond the glacier by flowing water and laid down in thin beds or strata. Particle size may range from boulders to silt.

Parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Particle size, soil - The grain size distribution of the whole soil including the coarse fraction. It differs from texture, which refers to the fine earth (less than 2mm) fraction only.

The particle-size classes are as follows:

Fragmental - Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal - Particles coarser than 2 mm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle size class.

Loamy-skeletal - Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loamy particle-size class.

Clayey-skeletal - Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle size class.

Sandy - The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm- 25 cm occupy less than 35% by volume.

Loamy - The texture of the fine earth includes loamy very fine sand, very fine sand, and finer textures with less than 35% clay; particles 2 mm-25 cm occupy less than 35% by volume.

Coarse-loamy - A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-loamy - A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Coarse-silty - A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-silty - A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Clayey - The fine earth contains 35% or more clay by weight and particles 2mm-25 cm occupy less than 35% by volume.

Fine-clayey - A clayey particle size that has 35-60% clay in the fine earth fraction.

Very-fine-clayey - A clayey particle size that has 60% or more clay in the fine earth fraction.

Ped - An individual soil aggregate such as a granule, prism or block formed by natural processes (in contrast with a clod which is formed artificially).

Pedology - Those aspects of soil science involving constitution, distribution, genesis and classification of soils.

Pedon - It is the smallest, three-dimensional unit at the surface of the earth that is considered as a soil.

Percolation - The downward movement of water through soil; specifically, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of 1.0 or less.

Permafrost - The condition of ground (soil and/or rock) in which it remains at or below 0°C for at least two years. Permafrost is usually associated with frozen ground water in the form of ice crystals, vein ice and/or ice lenses.

Permafrost table - The upper boundary of permafrost, usually coincident with the lower limit of seasonal thaw (active layer).

Permeability - The ease with which water and air pass through the soil to all parts of the profile. See hydraulic conductivity.

pH - The intensity of acidity and alkalinity, expressed as the negative logarithm of the hydrogen ion concentration. A pH of 7 is neutral, lower values indicate acidity and higher values alkalinity (see Reaction, soil).

Potential Evapotranspiration (PE) - The maximum quantity of water capable of being lost as water vapour, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water.

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

Reaction, soil - The acidity or alkalinity of a soil.Soil reaction classes are characterized as follows:

extremely acid	pH<4.5
very strongly acid	4.5 to 5.0
strongly acid	5.1 to 5.5
medium acid	5.6 to 6.0
slightly acid	6.1 to 6.5
neutral	6.6 to 7.3
mildly alkaline	7.4 to 7.8
mod. alkaline	7.9 to 8.4
strongly alkaline	8.5 to 9.0
very strongly alkaline	>9.0

Regolith - The unconsolidated mantle of weathered rock and soil material on the earth's surface.

Regosol, Regosolic soil - see section under Soil Classification.

Relief - The elevation of inequalities of the land surface when considered collectively.

Ridged - A long, narrow elevation of the surface, usually sharp crested with steep sides. The ridges may be parallel, subparallel, or intersecting.

Rolling - A very regular sequence of moderate slopes extending from rounded, sometimes confined concave depressions to broad, rounded convexities producing a wavelike pattern of moderate relief. Slope length is often 1.6 km or greater and gradients are greater than 5% (3 degrees).

Runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

Saline Soil - A nonalkaline soil containing soluble salts in such quantities that they interfere with the growth of most crop plants.

Salt-Affected Soil - Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or of soluble salts. It includes soils having an excess of salts, or an excess of exchangeable sodium or both.

Sand - A soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

Seepage -
1. The escape of water downward through the soil.
2. The emergence of water from the soil along an extensive line of surface in contrast to a spring where water emerges from a local spot.

Shallow Water - see section under Wetland Classification.

Soil, Series - see section under Soil Classification.

Soil - The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and microorganisms, and topography, all acting over a period of time.

Soil Classification - The Canadian System of Soil Classification is a hierarchical one in which the classes are conceptual, based on the generalization of properties of real bodies of soil. The categories in the system are Order, Great Group, Subgroup, Family, and Series, with the Pedon as basic unit of soil. Abridged definitions for a number of Orders and Great Groups are presented below. For more detailed information consult: Soil Classification Working Group. 1998. The Canadian System of Soil Classification. Agric. and Agri-Food Can. Publ. 1646 (revised). 187 pp.

<u>Brunisolic Order</u> - Soils of the Brunisolic order have sufficient development to exclude the soils from the Regosolic order, but lack the degrees or kinds of horizon development specified for soils of the other orders. The central concept of the order is that of soils formed under forest and having brownish coloured Bm horizons, but the order also includes soils of various colours with both Ae horizons and B horizons having slight accumulations of either clay, or amorphous Al and Fe compounds, or both.

<u>Eutric Brunisol</u> - These are Brunisolic soils that have a relatively high degree of base saturation as indicated by their pH and lack a well-developed mineral-organic surface horizon. They occur mainly on parent material of high base status under forest or shrub vegetation in a wide range of climates.

<u>Dystric Brunisol</u> - These are acid Brunisols that lack a well developed mineral-organic surface horizon. They occur widely, usually on parent materials of low base status and typically under forest vegetation.

<u>Chernozemic Order</u> - The general concept of the Chernozemic order is that of well to imperfectly drained soils having surface horizons darkened by the accumulation of organic matter from the decomposition of xerophytic or mesophytic grasses and forbs representative of grassland communities or of grassland-forest communities with associated shrubs and forbs.

<u>Black Chernozem</u> - These Chernozemic soils have A horizons dark in colour and commonly thick. Black Chernozems usually occur in association with a native vegetation of mesophytic grasses and forbs or with mixed grass, forb, and tree cover. The soil climate of this great group is typically cold, and subhumid.

<u>Dark Gray Chernozem</u> - These soils have chernozemic A horizons with characteristics indicative of eluviation associated with soils developed under forest vegetation. Dark Gray Chernozems usually occur under mixed native vegetation of trees, shrubs, forbs, and grasses in forest-grassland transition zones in areas of cold, subhumid soil climate.

<u>Cryosolic Order</u> - Soils of the Cryoslic order are formed in either mineral or organic materials that have permafrost either within 1 m of the surface or within 2 m if the pedon has been strongly cryoturbated laterally within the active layer, as indicated by disrupted, mixed, or broken horizons. They have a mean annual temperature of less than or equal to 0^0C.

<u>Turbic Cryosol</u> - Turbic Cryosols are mineral soils that have permafrost within 2 m of the surface and show marked evidence of cryoturbation laterally within the active layer, as indicated by disrupted or mixed or broken horizons, or displaced material or a combination of both.

<u>Static Cryosol</u> - These Cryosolic soils have permafrost within 1 m of the surface but show little or no evidence of cryoturbation or features that indicate cryoturbation.

<u>Organic Cryosol</u> - These Cryosols have developed primarily from organic material and are underlain by permafrost within 1 m of the surface.

Gleysolic Order - An order of soils developed under wet conditions and permanent or periodic reduction. They occur under a wide range of climatic conditions.

Luvic Gleysol - These Gleysolic soils have an eluvial A horizon and a silicate clay enriched (illuvial) B horizon. They may have up to 40 cm of mixed peat or 60 cm of fibric moss peat on the surface.

Humic Gleysol - These Gleysolic soils have a dark-coloured (organic enriched) A horizon. They may have up to 40 cm of mixed peat or 60 cm of fibric moss peat on the surface.

Gleysol - These Gleysolic soils may or may not have a thin Ah horizon over mottled gray or brownish gleyed material. They may have up to 40 cm of mixed peat or 60 cm of fibric moss peat on the surface.

Luvisolic Order - Soils of the Luvisolic order generally have light-coloured, eluvial horizons and have illuvial B horizons in which silicate clay has been accumulated. These soils develop characteristically in well to imperfectly drained sites, in sandy loam to clay, base saturated parent material under forest vegetation in subhumid to humid, mild to very cold climates.

Gray Luvisol - These Luvisolic soils usually have L, F, and H horizons (duff layer) and may or may not have a degraded, organic enriched A horizon. They occur typically under boreal or mixed forest vegetation and in forest-grassland transition zones under a wide range of climatic conditions.

Organic Order - Soils of the Organic order are composed largely of organic materials. They include, most of the soils commonly known as peat, muck, or bog and fen soils. Most organic soils are saturated with water for prolonged periods. These soils occur widely in poorly and very poorly drained depressions and level areas in regions of subhumid to perhumid climate and are derived from vegetation that grows in such sites.

Fibrisol - These are Organic soils that are composed largely of relatively undecomposed fibric organic material. They occur extensively in peat deposits dominated by *Sphagnum* mosses.

Mesisol - These are Organic soils that are at a stage of decomposition intermediate between Fibrisols and Humisols. They occur on all types of peatland but are especially widespread in fens.

Humisol - These are Organic soils that are at the most advanced stage of decomposition. They are not widespread and most are associated with swamp peatlands.

Regosolic Order - Regosolic soils have such weak pedogenic development that they have no diagnostic B or A horizon, nor do they have strong gleying, or permafrost within 1 or 2 m from the surface. They are often associated with recent alluvium, and active eolian deposits.

Solonetzic Order - Soils of the Solonetzic order have B horizons that are very hard when dry and swell to a sticky mass of very low permeability when wet. They occur on saline parent materials. Most have a native cover of grasses and forbs.

Vertisolic Order - Soils of the Vertisolic order occur in heavy textured materials and have shrink-swell characteristics. The central concept of the order is that of soils in which cracking, argillipedoturbation, and mass movement, as evidenced by the presence of slickensides and severe disruption within the control section, are the dominant soil-forming processes.

Humic Vertisol - These vertisolic soils have a dark coloured A horizon. They occur under native vegetation of mesophytic grasses and forbs or mixed grass, forb and tree cover.

Soil Survey - The systematic examination, description, classification, and mapping of soil in an area.

Soil texture - The relative proportions of the fine earth (less than 2 mm.) fraction of a soil. The size range of the constituent primary particles are as follows:

	Diameter (mm)
Very coarse sand	2.0-1.0
Coarse sand	1.0-0.5
Medium sand	0.5-0.25
Fine sand	0.25-0.10
Very fine sand	0.10-0.05
Silt	0.05-0.002
Clay	< 0.002
Fine clay	< 0.0002

Solum - The upper horizons of a soil above the parent material and in which the processes of soil formation are active. It usually comprises the A and B horizons.

Steep - Erosional slopes greater than 70% (35 degrees), on both consolidated and unconsolidated materials. The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of the origin of the underlying material.

Stones - Rock fragments greater than 25 cm in diameter.

Stoniness - The percentage of land surface occupied by stones.

Stratified materials - Unconsolidated sand, silt and clay arranged in strata or layers. In stratified materials, a bed is a unit layer distinctly separable from other layers and is one or more cm thick but a lamina is a similar layer less than 1 cm thick.

Structure - The combination or arrangement of primary soil particles into aggregates of secondary soil particles, units or peds, which are separated from each other by surfaces of weakness. Structure is expressed in terms of distinctness of the aggregate, size, and shape.

Swamp - See section under Wetland Classification.

Terraced - Scarp face and the horizontal or gently inclined surface (tread) above it.

Till, glacial - Unstratified glacial deposits consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Topography - Refers to the percent slope and the pattern or frequency of slopes in different directions. A set of 10 slope classes are used to denote the dominant but not necessarily most abundant slopes within a mapping unit.

Slope Class	Slope Name	Percent slope	Approx. degrees
1	level	0.0-0.5	0
2	nearly level	0.5-2.5	0.3-1.5
3	very gentle	2-5	1-3
4	gentle	6-9	3.5-5
5	moderate	10-15	6-8.5
6	strong	16-30	9-17
7	very strong	31-45	17-24
8	extreme	46-70	25-35
9	steep	71-100	35-45
10	very steep	>100	>45

Underground runoff - (or seepage) Water flowing towards stream channels after infiltration into the ground.

Undulating - A very regular sequence of gentle slopes that extends from rounded, sometimes confined concavities to broad rounded convexities producing a wavelike pattern of low local relief. Slope length is generally less than 0.8 km and the dominant gradient of slopes is 2-5% (1-3 degrees).

Varve - A distinct band representing the annual deposit in sedimentary materials regardless of origin and usually consisting of two layers, one thick light coloured layer of silt and fine sand laid down in the spring and summer, and the other a thin, dark coloured layer of clay laid down in the fall and winter.

Veneer - Unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface. A veneer will range from 10 cm to 1 m in thickness and will possess no form typical of the material's genesis.

Water-holding capacity - The ability of a soil to hold water against the force of gravity in a freely drained soil.

Weathering - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

Wetland Classification - The Canadian Wetland Classification System contains three hierarchical levels: (1) class, (2) form, and (3) type. Five classes are recognized on the basis of the overall genetic origin of wetland ecosystems. Forms are differentiated on the basis of surface morphology, surface pattern, water type, and morphology of underlying mineral soil. Types are classified according to vegetation physiognomy. (National Wetlands Working Group [NWWG), 1997).

Below are given the class definitions and descriptions for the five wetland classes, and definitions and descriptions for selected wetland forms for each class. The definitions and descriptions are abridged versions from the ones published by NWWG (1997).

Bog Wetland Class- A bog is a peat landform which is characterized by a variety of shapes and sizes. The bog surface, which is raised or level with the surrounding terrain, is virtually unaffected by runoff waters or groundwaters from the surrounding mineral soils. Generally the water table is at or slightly below the bog surface. As the bog surface is raised, so is the bog water table relative to the elevation of the water table at the edges of the bog. Precipitation, fog and snowmelt are the primary sources and thus, all bog are ombrogenous. Given that precipitation does not contain dissolved minerals and is mildly acidic, the surface bog waters are consequently low in dissolved minerals and acidic. Bog water acidity, usually between pH 4.0 and 4.8 is enhanced due to the organic acids that form during decomposition of the peat and the acids present within *Sphagnum* leaves.

Bogs may be treed or treeless, and they are usually covered with Sphagnum spp. and ericaceous shrubs. The driest bogs, especially in permafrost terrain, may be covered by dwarf shrubs and lichens. The dominant peat materials are poorly to moderately decomposed *Sphagnum* and woody peat, possibly with some sedge peat mixed throughout, especially in the deepest parts of the bog. The soils are mainly Fibrisols, Mesisols, and Organic Cryosols (permafrost soils).

Basin Bog - Basin bogs are situated in basins with a flat surface across the entire peatland. There are no surface feeder streams. Water is received from precipitation (rain and snowmelt) and runoff from the immediate surroundings of the basin. The thickest accumulation of peat is generally in the centre of the basin.

Blanket Bog - Blanket bogs are expansive and widespread peatlands that cover gentle slopes around valleys and on hillsides. The surface is uniform and lacks pools. Peat depths seldom exceed 2 m.

Collapse Scar Bog - Collapse scar bogs are circular or oval-shaped wet depressions in perennially frozen peatland. They originated as perennially frozen peatland and subsequently the permafrost thawed which caused the surface to subside. Surface waters are poor in dissolved minerals because they are not affected by mineral-rich waters in adjacent fens.

Domed Bog - Domed bogs are usually at least 500 m in diameter, with a convex surface which can be several metres higher than the edges of the wetland and surrounding terrain. Drainage radiates outwards from the centre, the highest part of the bog. Peat depth is usually in excess of 3 m.

Flat Bog - Flat bogs are not confined by a discreet basin and, therefore, occur in broad, poorly defined lowland areas. These bogs are not found on sloping terrain. The surface is more or less uniform and featureless and the depth of the peat is generally uniform across the entire peatland.

Northern Plateau Bog - Northern plateau bogs are raised bogs elevated 0.5-1 m higher than the surrounding fen. The surface is more or less flat and contains numerous small shallow pools. The bog may be teardrop-shaped in northern regions with the pointed end oriented in the downslope direction.

Palsa Bog - Palsa bogs are mounds of perennially peat and mineral soil, up to 5 m high, with a maximum diameter of 100 m. The surface is convex in shape and highly uneven. Collapse scar bogs may be found in association with palsa bogs. Fens commonly occur around palsa bogs.

Peat Plateau Bog - Peat plateau bogs are composed of perennially frozen peat and are sharply defined. The surface sits about 1 m higher than unfrozen fen that surrounds it. The surface is relatively flat, even and covers large areas. Peat plateau bogs appear to have developed under non-permafrost conditions and which subsequently became elevated and permanently frozen. Collapse scar bogs are commonly found with peat plateau bogs. These bogs are common in areas of discontinuous permafrost.

Polygonal Peat Plateau Bog - Polygonal peat plateau bogs are frozen bogs, rising about 1 m above the surrounding fen. The surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges. The permafrost and ice wedges developed in peat originally deposited in a non-permafrost environment.

String Bog - String bogs have a pattern of narrow (2 to 3 m wide), low (less than 1 m high) ridges of peat oriented at right angles to the direction of drainage. Wet depressions or pools occur between the ridges. The water and peat are low in dissolved minerals because the water originated in other ombrotrophic wetlands. Peat thickness exceeds 1 m.

Veneer Bog - Veneer bogs occur on gentle slopes that are underlain by discontinuous permafrost. Although drainage is predominantly below the bog surface, surface flow may occur in poorly defined drainage ways during peak runoff. Peat thickness is usually less than 1.5 m.

Fen Wetland Class - A fen is a peatland with a fluctuating water table. The waters in fens are rich in dissolved minerals and, therefore, are minerotrophic. Groundwater and surface water movement is a common characteristic of fens. Surface flow may be directed through channels, pools, and other open water bodies that can form characteristic surface patterns. The dominant materials are moderately decomposed sedge and brown moss peats of variable thickness.

The soils are mainly Mesisols, Humisols, and Organic Cryosols. The vegetation consists predominantly of sedges, grasses, reeds, and brown mosses with some shrubs and, at times, a sparse tree layer.

Basin Fen - Basins fens are topographically confined to basins. The basins may be entirely isolated and closed to both surface inflow or outflow feeder streams, or they may lack only inflowing streams but will have surface outflow. Most of the water is derived from any combination of sources from precipitation falling directly on the fen, surface runoff from the surrounding slopes and groundwater. The chemistry of the fen surface water, therefore, reflects the origin of the water entering the fen and the flow characteristics within the fen. The surface of the fen can be flat or slightly concave. The thickness of the peat is variable, most often in excess of 2 m, and consists mainly of mesic peat. Some basins originate as open water wetlands which later fill in and become grown over by fen vegetation.

Collapse Scar Fen - Collapse scar fens are small peatlands that originated through the subsidence of a part of a frozen peatland. Melting of the permafrost in frozen peatlands causes the peatland surface to subside to the same level or below the water table around the frozen peatland. The collapse scars are often circular or oval in outline, usually occur at the edge of the frozen peatland. Dead trees leaning in all directions ("drunken forest") and other drowned vegetation are characteristic. The peat is deep, usually in excess of 2 m, and consists of the peat of the collapsed section and debris from the drowned vegetation. Collapse scars are wet.

Horizontal Fen - Horizontal fens occupy broad, ill defined depressions. They occur on gentle slopes and are characterized by featureless surfaces. They are usually uniformly vegetated by graminoid, shrub or tree species. Some patterns, such as water tracks or somewhat drier treed "islands" may be present. Peat thickness varies from 2 to 3 m, depending on the topography of the underlying mineral substrate. Fibric peat is commonly found over mesic peat.

String Fen - String fens develop on sloping terrain and are characterized by narrow, peaty ridges ("strings") that enclose open water pools or depressions of open water ("flarks") or wet surfaces. The strings develop at right angles to the direction of surface flow. These strings act as small dams which impede water flow. The configuration and spacing of the strings appear to relate to the slope gradient: the strings are more closely spaced on steep slopes, and farther apart and more poorly defined on gentler gradients. String fens display four distinctive subforms based on peat thickness, surface configuration and drainage conditions. Two are presented below:

Net Fen - These fens display a broad pattern of low, interconnected peat ridges, often resembling a polygonal pattern, although permafrost is not present. The ridges enclose wet hollows or shallow pools. The fen surface is almost flat. The peat is usually deep (less than 3 m), consisting mainly of moderately decomposed peat.

Northern Ribbed Fen - These fens have subparallel, low peat ridges ("strings") which enclose elongated wet hollows or shallow pools. The ridges and hollows are oriented perpendicular to the direction to surface flow. The thickness of peat generally exceeds 2 m, and it is composed of moderately decomposed sedge and moss remains. Trees often grow on the ridges.

Marsh Wetland Class - A marsh is a wetland that has shallow water, and has levels that usually fluctuate daily, seasonally or annually due to tides, flooding, evapotranspiration, groundwater recharge, or seepage losses. Marshes may experience water level drawdowns which will result in portions drying up and exposing the sediments. Marshes receive their water from the surrounding catchment as surface runoff, stream inflow, precipitation, storm surges, groundwater discharge, longshore currents and tidal action. Marshes dependent upon surface runoff usually retain less permanent water than sites supplied by groundwater. The water table usually remains at or below the soil surface, but soil water remains within the rooting zone for most of the growing season, except in years of extreme drought.

A marsh is a minerotrophic and usually eutrophic wetland. Nutrients are derived from the substrate through periodic aeration. High nutrient levels give rise to the characteristic high productivity of vascular plants and high decomposition rates of plant material at the end of the growing season.

Soils and substrates encountered in marsh wetlands typically range from mineral soils such as Humic and Rego Gleysols to organic soils such as Humisols and Mesisols. Normally, marsh sediment is a mixture of unconsolidated organic and inorganic material.

Basin Marsh - Basin marshes are situated in well-defined basins and depressions in inland regions outside the influence of sea waters and sea spray. They receive waters from groundwater discharge, surface runoff and stream and river flow. The three subforms are presented below:

Discharge Basin Marsh - These marshes occupy flat areas, depressions, basins, kettles or sinkholes below the groundwater table. The basins are usually much larger and deeper than isolated basin marshes. The marsh receives most of its water as groundwater discharge that is cold and usually high in dissolved minerals.

Isolated Basin Marsh - These marshes occupy topographically-defined basins formed by glacial erosional and depositional processes, slumping, solution or ablation of unconsolidated deposits and bedrock. There are no surface inlets or outlets. The marsh receives water from rain, snowmelt, surface runoff, and groundwater discharge. The length of time that the marsh retains water is dependent upon water exchanges with the groundwater table, the permeability of geological substrates, and water losses by evaporation.

Linked Basin Marsh - These marshes occupy defined depressions that have channelized inlets and outlets operating during periods of abundant surface flow. The linked basin marsh is subject to intermittent surface and groundwater inflow, primarily from the local watershed, but may receive regional inflow from beyond the local catchment. This marsh usually occupies intermediate topographic positions and intermittently contains water.

Coastal High Marsh - A marsh influenced by brackish or saline waters of tidal marine origin. It is located above the mean high water level and is inundated only by flood tides. It occurs on marine terraces, flats, embayments, or lagoons.

Coastal Low Marsh - A marsh influenced by brackish or saline waters of tidal origin. It is located below the mean high water level and is inundated daily. It occurs on marine terraces, flats, embayments, or lagoons.

Estuarine Marsh - Estuarine marshes are confined to intertidal and supratidal zones of estuaries. Water levels are subjected to tidal changes but water levels do not change greatly as in other tidal marshes. There is a major input of freshwater into these marshes which makes estuarine marshes brackish to fresh. Vegetation develops in zones in response to variations in slope, water depth and salinity gradient. There are four subforms of estuarine marshes recognized: Estuarine Bay Marsh, Estuarine Delta Marsh, Estuarine Lagoon Marsh, and Estuarine Shore Marsh.

Floodplain Marsh - A marsh occurring on fluvial floodplains adjacent to river channels. The marsh is subject to annual flooding and sedimentation for various lengths of time., with possibly some water impounded on the marsh following flooding.

Kettle Marsh - A marsh usually occupying well-defined elliptical catch basins located in moraines and glaciofluvial or glaciolacustrine landscapes. The kettles are moderately deep bowls with moderately to steeply sloping sides. The water sources are chiefly surface runoff from local catchment areas and some interbasin flow or groundwater inflow.

Lacustrine Marsh - Lacustrine marshes occur along the shores of permanent inland, open water bodies and lakes. Water sources are a combination of input from adjacent lakes, rivers and streams flowing into the lake, surface runoff from adjacent catchment, and groundwater discharge. Such marshes have freshwater. Three subforms are recognized: Lacustrine Bay Marsh, Lacustrine Lagoon Marsh, and Lacustrine Shore Marsh.

Shallow Basin Marsh - A marsh occurring in a uniformly shallow depression or swale, having a gradual gradient from the edge to the deepest portion. The marsh edge may be poorly defined due to rapidly receding water levels.

Riparian Marsh - Riparian marshes occupy riparian zones of streams and rivers. They may receive waters from precipitation, groundwater discharge, and surface runoff, but are most closely linked to water quality in an adjacent stream or river. Four subforms of Riparian Marsh are recognized: Riparian Delta Marsh, Riparian Floodplain Marsh, Riparian Meltwater Marsh, and Riparian Stream Marsh.

Tidal Marsh - Tidal marshes develop along beaches, bars, reefs, or inlets of sea coasts, protected from wave action and storm surges. Development is on coarse to fine-grained sediments in intertidal zones and some supratidal zones influenced by salt spray. Tidal marsh is flooded regularly by tidal saltwater with no major influence from freshwater. Water is saline or brackish. Vegetation community development is in response to duration of exposure, slope gradients, distribution of tidal channels and basins, and salinity. Four Tidal Marsh subforms are recognized: Tidal Basin Marsh, Tidal Bay Marsh, Tidal Channel Marsh, and Tidal Lagoon Marsh.

Swamp Wetland Class - Swamps are treed or tall shrub dominated wetlands that are influenced by minerotrophic groundwater, either on mineral or organic soils. The essential features of the swamp class are the dominance of tall woody vegetation, generally over 30% cover, and the wood-rich peat laid down by this vegetation.

The water table is below the major portion of the ground surface, and the dominant ground surface is a hummocky ground surface that is 20 cm or more above the average summer ground water level. It is the aerated (or partly aerated) zone of substrates above the water that is available for root growth of trees and/or tall shrubs. Swamps occur on mineral soils as well as on peat. The texture of the underlying mineral soils is variable, ranging from clays to sands, and they frequently are Gleysols. When organic soils develop, they are Mesisols or Humisols that are rich in woody peat, at least in the surface layers.

Flat Swamp - Flat swamps develop in topographically defined basins, kettle holes or bedrock where the water is derived by surface runoff, groundwater or precipitation and occasionally by small inflowing surface streams. Flat swamps may also occupy poorly defined basins such as those in broad, shallow depressions in glacial lake beds and outwash plains. Peat depths may be more than 0.5 m to more than 2 m in the centre. Three Flat Swamp subforms are recognized of which two are defined below:

Basin Swamp - These swamps are topographically defined in glacial features on ablation till plains. The edges are well defined by the sides of the basin and the surrounding mineral uplands,

Unconfirmed Flat Swamp - These swamps are not topographically defined, often occurring in glacial lakebeds or areas of glacial outwash. These swamps lack obvious edges and well-defined banks. They commonly occur as a broad swamp in other kinds of wetlands.

Shallow Water Wetland Class - Shallow water wetlands are distinct wetlands transitional between those wetlands that are saturated or seasonally wet (i.e. bog, fen, marsh or swamp) and permanent, deep water bodies (i.e. lakes) usually with a developed profundal zone.

Delta Water - Shallow ponds occurring on deltas that have been impounded by the shifting of river channels and the deposition of sediments. Periodic flooding in the delta usually inundates the delta water body.

Shallow Basin Water - Shallow ponds located in gently sloping depressions, receiving water from the catchment area. The basin edges are usually poorly defined. Surplus water is drained by open outlets or by seepage.

Thermokarst Water - Shallow water body in a basin formed by the thawing and subsidence of ice-rich permafrost. The banks may be unstable due to continuing thermal erosion.

Tundra Pool Water - Uniformly shallow water body formed in lowlands covered by thin peat. The shores are formed by steep, but low (less than 0.3 m) banks of perennially frozen peat. Permafrost usually occurs under the water bodies.

Slope Swamp - Slope swamps have surfaces that slope downward. They occupy glacial lakebeds and outwash areas, or can be associated with other kinds of wetland. They may occur in sloping drainage ways, on mineral or peaty soils. Channels may be absent, but small channels with intermittent flow or small, partially buried channels may be present. Four Slope Swamp subforms are recognized of which two are presented below:

Lagg Swamp - These swamps occur in the zone between upland mineral terrain and a peatland (swamp, fen or bog). The lagg swamp is a wetland distinctly enriched by runoff from the upland. Surface water movement is parallel to the upland.

Peat Margin Swamp - These swamps have sloping topography and are situated between peatland and upland mineral terrain. Hydrology is such that paludification allows the swamp to spread outwards to adjacent upland.

Xerophyte - A plant capable of surviving periods of prolonged moisture deficiency.

Appendix C: Glossary of Plant Species

Trees

Ash, green - Fraxinus pennsylvanica
Ash, black - Fraxinus nigra
Aspen, trembling - Populus tremuloides
Basswood - Tilia americana
Birch, white - Betula papyrifera
Cedar, white - Thuja occidentalis
Elm, white - Ulmus americana
Fir, balsam - Abies balsamea
Oak, bur - Quercus macrocarpa
Pine, jack - Pinus banksiana
Poplar, balsam - Populus balsamifera
Spruce, black - Picea mariana
Spruce, white - Picea glauca

Shrubs (High, medium and low)

Alder, green - Alnus crispa
Alder, speckled - Alnus rugosa
Bear berry - Arctostaphylos uva-ursi
Bilberry, alpine - Vaccinium uligonosum

Bog-Laurel - Kalmia polifolia
Bog-Rosemary - Andromeda glaucophylla
Cherry, Pin - Prunus pensylvanica
Cherry, choke - Prunus virginiana
Cranberry, small - Oxycoccus microcarpus and O. quadripetalus
Cranberry, highbush - Viburnum trilobum
Dogwood, red-osier - Cornus stolonifera
Ericaceous shrubs - Ericaceae
these include, but are not restricted to:
bearberry, small cranberry, leather-leaf, bog-Rosemary, bog laurel, Labrador-tea, sour-top-blueberry, low-sweet-blueberry, alpine bilberry, rock-cranberry.
Hazel, beaked - Corylus cornuta
Juniper, common - Juniperus communis
Juniper, creeping - Juniperus horizontalis
Leather-leaf - Chamaedaphne calyculata
Low-sweet-blueberry - Vaccinium angustifolium
Raspberry - Rubus idaeus
Rock-cranberry - Vaccinium vitis-idaea
Rose - Rosa spp.
Saskatoon - Amelanchier alnifolia
Silverberry - Elaeagnus commutata
Snowberry - Symphoricarpos albus
Sour-top-blueberry - Vacinium myrtilloides
Willow - Salix spp.

Forbs, Herbs and Grasses

Anemone, wood - Anemone canadensis