Science and Research Technical Report TR-26

The Ecosystems of Ontario, Part 2: Ecodistricts

Ministry of Natural Resources and Forestry

Ontario

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Abstract

Effective management of Ontario’s vast and diverse landscapes and waterscapes requires an ecologically meaningful spatial framework. Long term sustainability of biodiversity and ecological functions and services requires a robust and organized ecological framework to help achieve the goals of ecosystem-based planning, management, and monitoring.

Ontario’s ecological land classification (ELC) has been developed at multiple organizational levels within a spatial framework. From broad ecological zones to site scale, the ELC is used to identify and describe ecosystem conditions and offers a comprehensive and flexible foundation for resource planning and management.

In the upper levels of the ELC hierarchy, ecodistricts represent landscape-scale patterns of productivity and trends in landform and soil development. They are defined by physiographic features including bedrock, surficial geology, and topography that, along with climate, help to determine patterns of species association. Ecodistricts are used as the basis for many provincial planning processes as well as for assessing biodiversity, defining seed zones, and mapping ecosystems to identify and set natural heritage objectives. The use of ecodistricts promotes a coordinated, integrated, and comprehensive approach to natural resource management across administrative boundaries.

Outlined in this report are the history, development, and application of this scale of the ELC. Comprehensive summaries of the 71 ecodistricts are provided along with discussions of notable ecological features and values. Included are descriptions of key features such as geology, landscape attributes, parent materials and soils, vegetation patterns, and aspects of current land use.

This report complements a previous report, The Ecosystems of Ontario: Part 1: Ecozones and Ecoregions (Crins et al. 2009), which describes the characteristic features of the ecozones and ecoregions in Ontario.

Résumé

Les écosystèmes de l’Ontario – Partie 2 : Écodistricts

La gestion efficace des paysages terrestres et de plans d’eau de l'Ontario – des paysages vastes et diversifiés – exige un cadre spatial utile sur le plan écologique. La pérennité de la biodiversité et des fonctions et services écologiques exige un cadre écologique robuste et organisé pour favoriser l’atteinte des objectifs des activités de planification, de gestion et de surveillance axées sur les écosystèmes.

Le Programme provincial de classification écologique des terres (CET) est articulé autour d’un cadre spatial comprenant plusieurs niveaux organisationnels. Qu'il s'agisse de vastes zones écologiques ou d'un seul site, la CET sert à déterminer et à décrire l'état d’un écosystème et offre un outil de base complet et flexible pour la planification et la gestion des ressources.

Les écodistricts se situent aux niveaux supérieurs de la hiérarchie de la CET. Ils représentent les schémas de productivité à l'échelle du paysage et les tendances observées dans le développement des sols et de la forme du relief terrestre. Ils sont définis par des caractéristiques physiographiques, dont le substratum rocheux, la géologie de surface et la topographie qui, avec le climat, aident à déterminer les modèles d'association des espèces. Les écodistricts servent de base à de nombreux processus de planification provinciaux ainsi qu'à l'évaluation de la biodiversité, à la définition des zones semencières et au relevé cartographique des écosystèmes, pour établir les objectifs relatifs au patrimoine naturel. L'utilisation des écodistricts favorise une démarche coordonnée, intégrée et globale pour la gestion des ressources naturelles au-delà des frontières administratives.

Le présent rapport décrit l'historique, l'élaboration et l'application de cette échelle de la CET. On y trouve une description détaillée des 71 écodistricts ainsi qu’un exposé des caractéristiques et ressources écologiques notables. On y trouve en outre une description des principales caractéristiques étudiées (géologie, attributs du paysage, matériaux et sols d'origine, régimes de végétation, aspects de l'utilisation actuelle des sols, etc.).

Le présent rapport apporte un complément au rapport précédent (*The Ecosystems of Ontario: Part 1*, *Crins et autres, 2009*) où sont décrites les caractéristiques des écozones et des écorégions de l'Ontario.

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Contents

Introduction

The Ministry of Natural Resources and Forestry (MNRF) is responsible for the protection and sustainable management of Ontario's diverse natural landscapes and waterscapes (OMNRF 2015c). Through legislation, policies, and programs, the ministry and partners work to provide a healthy, ecologically managed environment that supports economic prosperity, ecological sustainability, and a high quality of life. Ontario's biodiversity plan (OMNR 2012a), Far North planning strategy (OMNR 2013a), and the Provincial Policy Statement (PPS) (OMMAH 2014), are used with management directives in support of renewed and enhanced efforts to plan for and sustainably manage natural assets at appropriate scales. Together with similar national and international efforts, a growing focus on a well informed ecological approach has emerged to address complex global issues such as connectivity among natural heritage systems, climate change (Colombo et al. 2007, 2015; McKenney et al. 2010; Gleeson et al. 2011; McDermid et al. 2015a, b), and long-term protection of natural areas (Wiersma et al. 2005; Lemieux et al. 2008, 2010, 2011).

Waterfall in the Wunnummin Lake Ecodistrict. Sam Brinker, MNRF.

Long term sustainability of natural resources results from the maintenance and enhancement of ecosystem function, including biodiversity. Ecological sustainability requires that practitioners understand, manage, and plan for the effects of human activities within the potentials and constraints of Ontario's natural systems. Planning is best addressed using an ecological spatial framework rather than by political or administrative boundaries (Bailey 2014).

Ecosystems occur at various geographic scales and are differentiated on the basis of key ecological attributes and processes. Within a robust and consistent framework that represents ecosystem organization and potential function, an efficient and effective ecosystem-based planning and monitoring approach can be achieved (Bailey and Hogg 1986, Uhlig and Jordan

1996, CEC 1997, Klijn and de Haes 1994, Silbernagel 2005, Bailey 2009, Fisher et al. 2009, Bailey 2014).

The units in Ontario’s ecological land classification (ELC) have been developed at multiple scales within a hierarchical and spatial framework. Each level provides a spatial context that supports areas of conservation and resource decision making such as defining wildlife habitat, managing forests, and identifying protected areas. The broad scales of the ELC are important for strategic provincial, international, and national objective setting and assessments. Finer-scale units (ecosites, vegetation and soil types) are particularly relevant to specific resources and municipal planning and are frequently used for the design of monitoring and sampling networks, detailed resource inventory, decision support, and applications (Crins 2007). For detailed information about Ontario’s ELC hierarchy including characteristics, primary application, and common map scale consult Crins et al. (2009).

Ecodistricts

Ecosystem classification delineates areas of similar ecology at different scales, typically in a nested or hierarchical framework so that the lower levels of the hierarchy are recognized and set in the context of the larger system (Bailey 2014). Ecodistricts are nested in an ecoregion that in turn is nested within an ecozone (Figure 1). Ecodistricts are defined as follows (for ecozone and ecoregion definitions, see Crins et al. 2009):

> **Ecodistrict**: an area of land and water, contained within an ecoregion, which is defined by a characteristic set of physiographic features, including bedrock and/or surficial geology and topography. These physiographic features determine successional pathways, patterns of species association, and the habitats that may develop. Local climatic patterns, such as lake effect snowfall areas, may also characterize ecodistricts.

Ecodistricts are, by nature, large and complex. They have been defined as explicitly as possible using the multiple criteria relevant at this scale of ecological organization (i.e., surficial geology, topography, local climate patterns) and using the best available data. They represent landscape-scale patterns of productivity and trends in landform and soil development.

The delineation and mapping of ecodistrict boundaries cannot adequately portray all of the variability within or among ecodistricts. On the ground, mapped boundaries are not observed as sharp lines but as transition areas. Ecotones of varying width as well as outliers from adjacent areas must be anticipated (Hustich 1953, Bailey 2004, DeYoung and Troughton 2010).

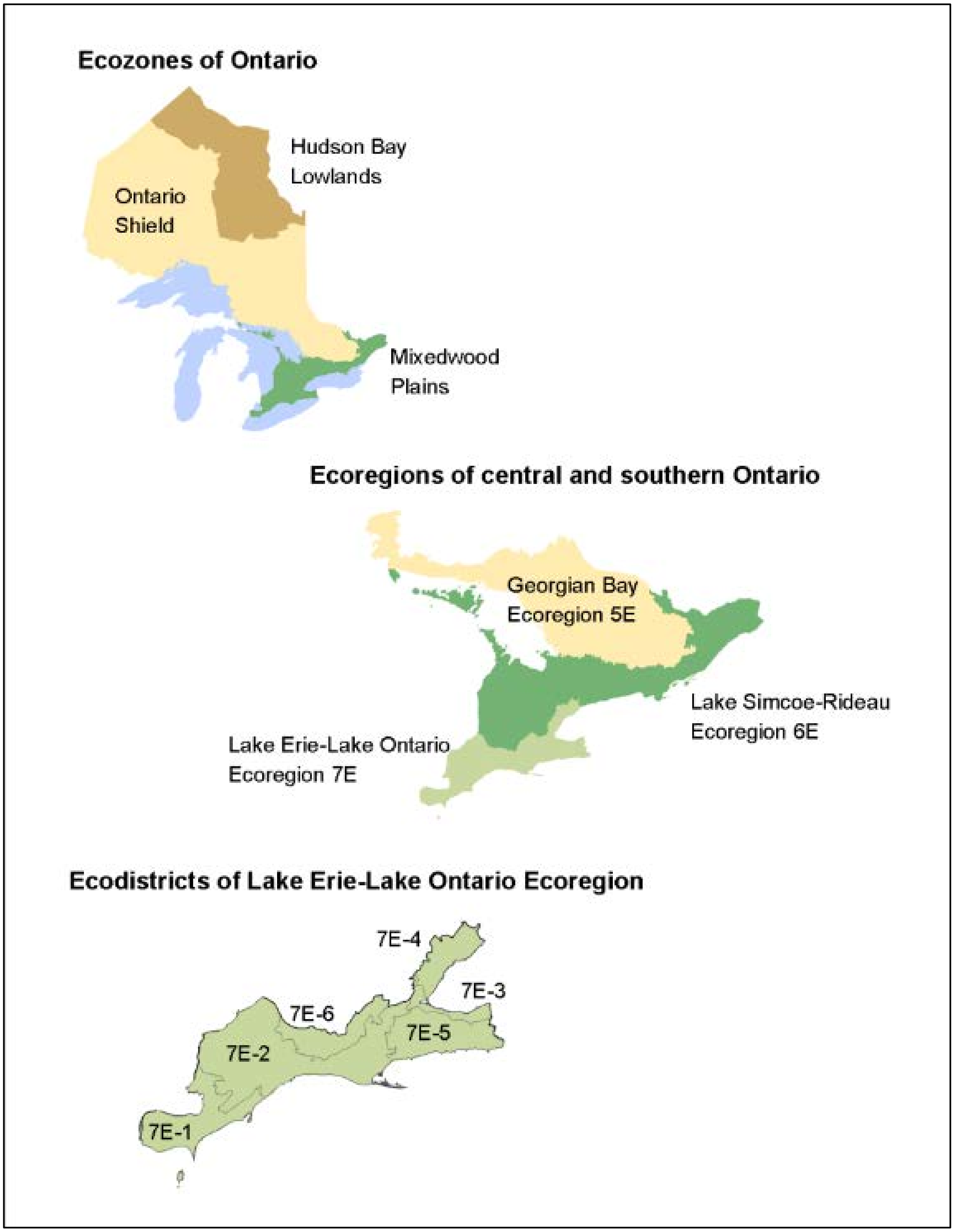


Figure 1. Nested ecozones, ecoregions, and ecodistricts in Ontario's ecological land classification.

Section 1

Development of Ontario's ecological land classification (ELC) ecodistricts and rationale for revisions

Boundary delineation and refinement

Ecosystems and the important factors (drivers) that lead to their establishment and function exist at many scales. Ecological land classifications are designed to help practitioners classify and summarize ecosystems at multiple scales. In Ontario, Angus Hills developed the first multi-scale, hierarchical ELC for the province (Hills 1959). As new information became available, Hills (1961, 1964) revised the system and demonstrated how it could be used to provide a broad-scale ecological context for a variety of resource management and planning activities.

Hills' (1959) system contained two broad levels, site regions and site districts, with the latter nested within the former. Site regions were characterized by broad climatic patterns (mainly temperature, precipitation, and functions thereof). Site districts within each site region were characterized by physiographic similarities, and by the successional trends exhibited by the predominant vegetation types on those physiographic features. Boundaries were further delineated with data from soil surveys, forest surveys, aerial photographs, and several years of field data collection and validation. In 1978, site regions and site districts were formally adopted by Ontario Parks (OMNR 1978), a decision reaffirmed in 1992 (OMNR 1992).

For some time following the development of Hills' classification, little work was undertaken to revise the upper levels of the hierarchy for the province. A review and boundary adjustment of several site districts in Site Region 6E was initiated by Cuddy (Jalava et al. 1997) and, in 1993, Burger proposed revisions to some site region boundaries. Burger's most significant changes included the recognition of Site Region 0E along the Hudson Bay coast, the elimination of Site Region 5S in the Kenora-Lake of the Woods region, and altered junction points for site regions 3S, 3W, 4S, and 4W (Burger 1993). The latter site regions were redesigned to meet at a single point, reflecting Burger's re-interpretation of climatic trends and variation and emphasis on vegetation successional patterns on similar physiographic sites, akin to Hills (1959).

Over the years, it became apparent that revisions were needed to the boundaries of the ecological units at higher levels of the ELC hierarchy. Transcription errors had led to the incorrect placement of boundaries on successive versions of maps, in some cases leading to the removal of most of the features for which a site district was originally delineated. In the 1990s and 2000s, an explicit ecological framework, including ecoregions (previously called site regions) and/or ecodistricts (previously, site districts), was integrated into policies, directives, and projects, increasing the need to interpret ecological boundaries for resource management purposes. For example, Ontario's Living Legacy Land Use Strategy (OMNR 1999a), the Forest Management Planning Manual (OMNR 2004a), Ontario's Old Growth policy (OMNR 2003c), the Forest Resources of Ontario (Watkins 2011), State of Ontario's Forests (OMNR 2012b), and Integrated Science Action Plan (OMNRF 2015a) use an ecosystem framework, requiring a consistent, interpretable ELC at top levels of the hierarchy.

During this time, new digital data sources and analytical tools had become available for use in the delineation and interpretation of these broad ecological units. These include improved geological and soils maps, remotely sensed land cover, and climate models.

In 1997, Jalava et al. proposed revisions to the site district boundaries in Site Regions 6E and 7E. The site district boundaries in these southernmost site regions were adapted to tie explicitly to physiographic features, using the maps accompanying Chapman and Putnam's (1984) monograph [scale 1:253,440], providing direct rationale for characterizing and differentiating the site districts. The revised boundaries rectified the original mapping transcription errors, simplified representation analysis by reducing the number of physiographic features in a site district, and provided a consistent approach to site district delineation in site regions 6E and 7E (Jalava et al. 1997).

Also recognized was the need for revisions to the remaining site district boundaries in the province (Riley 1993, Uhlig and Baker 1994, Uhlig and Jordan 1996) and more explicit links to national (Ecological Stratification Working Group 1995) and continental (CEC 1997, Cleland et al. 1997, Bailey 1998) ELCs. Despite the differences among systems, these classifications are broadly similar to Hills' (1959, 1961, 1964) system for Ontario, and are based on similar premises. At this time a decision was made to align ecosystem class terminology with other jurisdictions to permit broader understanding and communication. Terms emerging from the Ecological Stratification Working Group (1995) were adopted. Due to their conceptual similarity and consistency, Hills' terms of site region and site district were replaced with the nationally recognized ecoregion and ecodistrict.

Refinement of the boundaries of Ontario's ecoregions and ecodistricts is a step in the evolution of continental and national ELCs, using the best information appropriate for each hierarchical level. The level of ecozone, previously not recognized in Ontario, was added to the provincial ELC in 2000 (Crins 2000, Crins and Uhlig 2000, Crins et al. 2009). This addition, with small refinements to the boundaries of the ecozones in the national ELC, aligned Ontario's ELC with the broader hierarchical national and continental systems (ecozone in the Canadian ELC; Level I and II Ecological Regions in the North American ELC).

Ecodistrict rationalization process

At the outset of the ELC rationalization process, a premise was that the overall philosophy and approach used by Hills (1959, 1961, 1964) would be preserved in the revised classification due to the strength of the approach and proven utility to legislation and planning. Where evidence weighed strongly in support of boundary changes, and merging or splitting of ecoregions or ecodistricts, these have been made. However, the general framework developed by Hills has stood the test of time, and the revisions described here focus on refinements, rather than generating a new classification.

In general, physiographic units, dominant landforms, and geological features have been used to refine the delineation of ecodistricts (formerly known as site districts). Major climatic and bedrock geology zonation, parameters relevant at higher levels in the hierarchy (i.e., ecozones and ecoregions; formerly site regions) have been maintained.

Physiographic and geological data sets formed the basis for Hills' (1959) and subsequent concepts of site districts. In recent years, rapid improvement in the digital availability of these thematic surveys has replaced earlier reliance on very coarse coverage of bedrock and surficial geology. Where finer-scaled provincial coverage was not available, an amalgamation of the best available information has been used.

The Ontario Land Inventory (OLI) (OMNR 1977) data set has been used to characterize and support the definition of ecodistricts from Lake Erie to approximately 51°N (roughly including ecoregions 3S, 3W, and 3E south to ecoregions 6E and 7E; Pierpoint and Uhlig 1985). The OLI coverage represents an interpretation of landscape units, at a scale of 1:250,000. This data set integrates surficial geology, topographic variation (ruggedness of terrain), major and minor overburdens, and to some extent, bedrock geology. Polygons could be selected that correspond to broad patterns observed in the coarse-scale provincial coverage, and in many cases fine-scale patterns were identified and also incorporated into ecodistrict boundaries. Revisions to site district boundaries for site regions 6E and 7E (Jalava et al. 1997) were used and rationalized with OLI-derived lines. Where the OLI polygons and the work completed by Jalava et al. (1997) differed, the data set that best reflects the area was used. North of the OLI coverage, other typically coarser-scaled, geological digital information sources including bedrock and surficial geology maps (e.g., OGS 1991a, b, c) and aerial photography have been used to derive the revised lines with the final boundaries merged with the OLI coverage.

Understanding gained from OLI was supplemented by numerous bedrock geology and surficial geology surveys and reports together with literature synopses of glacial history, major landform trends, materials, and soil landscapes (e.g., Zoltai 1965a; Boissonneau 1966, 1968; Burger 1972a, b). A review and consultation of historic and contemporary zonation approaches (e.g., Ahti 1964; Ahti et al. 1968; Tuhkanen 1980, 1984; Burger 1993; Brandt 2009; Sánchez-Mata and Rivas-Martinez 2012) was also undertaken. Supplemental documentation is cited where necessary to corroborate individual ecodistrict descriptions and boundary delineation decisions.

Polygon data derived from versions of the Soil Landscapes of Canada (recently summarized by Schut et al. 2011) were used to assess broad scale patterns of soil development and prevalence. A full range of published soil survey maps and reports were also used to establish soil occurrence and pattern. For areas where agricultural soil surveys were not available, scientific and technical literature was consulted to provide background on major trends in soil physical and chemical characteristics, occurrence, and patterns of development. Examples include Evans and Cameron (1984), Protz et al. (1984, 1988), Riley and Michaud (1989), and Riley (1994).

Concurrent with the improvements in physical geographic themes, a considerable volume of work has been completed in the area of climate data compilation. More recent data syntheses (e.g., Watson and MacIver 1995; Mackey et al. 1996a, b; McKenney et al. 2001, 2006, 2007) were used directly in the assessment of meso-climatic trends to refine the understanding of climatic patterns within ecological regions. The Ontario Climate model (1960–1991; OMNR 2000) together with improved digital elevation models for the province (Mackey et al. 1994) were used to refine the understanding of climatic variations at the meso-scale and as influenced by subregional variations in topography and landform. Subregional patterns of precipitation, temperature, seasonal minimums and maximums, growing season length and quality were used and found significant for some ecodistricts.

Where additional expert knowledge was available it was incorporated into the revised ecodistrict boundaries presented here. In some cases, this knowledge was available only in non-digital form. Where appropriate, boundary modifications were digitized to reflect this knowledge. Consultations were held with several experts to obtain the best available advice and interpretation of relevant physiographic, geological, climatic, and biological data sets bearing on the delineation of ecological boundaries.

The use and synthesis of data sets and knowledge to reflect boundaries of ecological units has been effective, particularly at the ecodistrict level. Given the available information, emphasis was placed on defining the ecodistrict boundaries as accurately as possible since this is the scale at which much of Ontario’s landscape modelling and resource management planning is conducted, and at which many resource management targets are set. Some of these refinements may change as new environmental data become available or ecosystem dynamics change (e.g., under the influence of climate change; Colombo et al. 2007, McKenney et al. 2010, McDermid et al. 2015a). However, it is hoped that these refinements to the upper levels of Ontario’s ELC will make the classification more easily interpretable and help ensure that it serves as a useful tool for resource planners and managers.

Organization and presentation of the ecodistrict fact sheets

The main content of this report is organized into ecoregional chapters each beginning with a regional synopsis derived from The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions (Crins et al. 2009), followed by ecodistrict fact sheets appropriate to each region. In general, provincial data sets were used to characterize each ecodistrict. Specific data and information for each ecodistrict were obtained from a variety of sources, which are cited on each fact sheet. Similar ecological domains may occur in adjacent provinces or countries, however, the ecodistrict names and descriptions provided here apply only to Ontario.

Each ecodistrict fact sheet begins with a **general description** of where the ecodistrict is located (including a map). The size (area and percent) is based on terrestrial area only as determined by ArcGIS analysis of the ecodistrict layer (OMNR 2003b). Maximum and minimum elevations were determined using the Ontario Radar Digital Surface Model (ORDSM) (OMNR 2010). A representative photograph of the area is provided. This is followed by a **key features** section that provides an overview of the dominant vegetation and mode of deposition, and at least one distinguishing feature of the ecodistrict.

Three-flowered avens, Manitoulin Island. Monique Wester, MNRF.

Geology and substrate features provides a brief glacial history of the area that explains the relevant modes of deposition in the ecodistrict. Representative soil orders as defined according to the Canadian System of Soil Classification are also included. Accompanying pie charts for the modes of deposition and soil orders are provided. Types that occupy more than 5% of the ecodistrict are represented in the pie chart while those covering less than 5% are included in the *other* category. Percentages were determined through the ArcGIS analysis of Soil Landscapes of Canada (SLC) (v 3.1.1, AAFC 2007) overlain on ecodistrict boundary maps. Polygons defined as bedrock in SLC typically refer to areas that contain a mix of undefined substrates that support vegetation and bedrock outcrops. When large areas of bedrock were identified in the SLC, literature sources, field surveys, and expert input were used to better quantify the extent of bedrock and depth of the overlying mineral material. Bedrock geology was largely derived from the seamless coverage provided by the Ontario Geological Survey (OGS 2006). Primary sources for quaternary geology include Northern

Ontario Engineering Geology Terrain Study (NOEGTS, OMNDM 2005) and physiography of southern Ontario (Chapman and Putnam 1984, OMNDM 2007). Additional maps (e.g., bedrock, quaternary geology, surficial geology, and physiography) and reference documents were also consulted to ensure all categories of modes of depositions and soil orders were adequately captured.

Land cover and vegetation attributes include associated vegetation zones (Baldwin et al. 2018), forest sections defined by Rowe (1972), and characteristic land cover types. Land cover types were determined through ArcGIS analysis of the Provincial Land Cover 2000 (LC 2000, OMNR 1999b) layer (0E-5S) or re-examination of the gap analysis conducted for the Great Lakes Conservation Blueprint for Terrestrial Biodiversity report (Henson et al*.* 2005, Henson and Brodribb 2005). Only terrestrial areas have been captured. The rationalization of classes in LC 2000 and blueprint data was required to facilitate the comparison of similar types across the province. For example, open and treed fens have been amalgamated into fen complexes and deciduous forests include deciduous swamps. Land cover types with less than 5% coverage were lumped into *other* for anthropogenic (e.g., pit, quarry, or settlement) or *other natural* for non-anthropogenic land types. Only alvar and grassland ecosystems as reevaluated in 2014 through the Natural Heritage Information Centre (NHIC) rare plant community digitization project (Bakowsky and Henson 2014b) are referenced.

Characteristic tree species for each ecodistrict are primarily derived from Trees in Canada (Farrar 1995), Forest Regions of Canada (Rowe 1972), forest resource inventories (FRI), and park reports specific to the area. Additional information (e.g., fire regime, climatic influences on vegetation) are discussed when significant. Specific descriptions of broad-scale vegetation variability and the patterns of occurrence of rare flora or communities were derived from the literature and life science inventories or from expert knowledge. Examples of notable vegetation species at or near their geographic ranges are provided. Detailed lists of common species and vegetation associations are beyond the scope of this report and are best addressed at the ecosite and vegetation type scale. Old growth areas were identified using parks reports, applicable FRI databases, and the significant ecological area layer (OMNR 2009b), available through Land Information Ontario (LIO).

A map of the ecodistrict highlighting features such as larger lakes, rivers, natural heritage areas, roads, and select communities is provided. The map is presented for illustrative purposes to provide a general orientation to the ecodistrict. Map size limited the selection of features shown. Shape files used to produce the maps were obtained from LIO. These include official names (OMNR 2014b), national parks (OMNR 2008b), provincial parks (OMNR 2008d), conservation reserves (OMNR 2008a), and Indigenous communities (OMNR 2008c). For a detailed list of natural heritage areas, consult Gray et al. (2009). A list of general **land use** is provided. Mineral exploration information was obtained from the Ontario Ministry of Northern Development and Mines (OMNDM 2016). Layers obtained from LIO were used to determine the locations of aggregate extraction (OMNR 2006), hydroelectric generation (OMNR 2001e), wind turbines (OMNR Unpublished), and petroleum wells

(OMNRF 2016b). The mining operations map (OPA 2018) was used to determine if mining occurs in an ecodistrict. The percentage of protected areas in each ecodistrict was determined through ArcGIS analysis. Included in the calculation were protected areas with the regulation status of regulated, legally designated, and gazetted. The percentage is based on the terrestrial area of each ecodistrict only. The portions of Lake Superior National Marine Conservation Area and Fathom Five National Marine Park that are water only are reported separately on applicable fact sheets. Protected areas include provincial parks, conservation areas, wilderness areas, national parks, and regulated dedicated protected areas.

The final section, **ecodistrict boundary delineation**, describes the characteristics that help distinguish adjacent ecodistricts and where appropriate, differences between ecoregions. Only major changes to ecodistrict boundaries with respect to Hills (1959) site district classification are outlined. A detailed discussion on the rationale and resources used to refine ecodistrict boundaries is provided at the beginning of this section.

For select ecodistricts, a unique feature (e.g., geological, historical, natural heritage) is highlighted with additional pictures and text.

A glossary of scientific terms and a list of common and scientific names for flora and fauna species mentioned in this report are in appendices 1 and 2, respectively. Scientific and common names are consistent with NHIC naming conventions (OMNRF 2016a).

Section 2

A summary of the 14 ecoregions (for a detailed description of each ecoregion, see Crins et al. 2009) and characteristic features of the 71 ecodistricts of Ontario (Figure 2) are presented in the following order:

Ecoregion 0E: **Hudson Bay Coast Ecoregion**

- Ecodistrict 0E-1 - Wood Creek Ecodistrict

Ecoregion 1E: Northern Taiga Ecoregion

- Ecodistrict 1E-2 - Dickey River Ecodistrict
- Ecodistrict 1E-3 - Winisk River Ecodistrict

Ecoregion 2E: James Bay Ecoregion

- Ecodistrict 2E-1 - Albany Ecodistrict
- Ecodistrict 2E-2 - Moose River Ecodistrict
- Ecodistrict 2E-4 - Lower Kenogami River Ecodistrict

Ecoregion 2W: Big Trout Lake Ecoregion

- Ecodistrict 2W-1 - Sandy Lake Ecodistrict
- Ecodistrict 2W-2 - Kasabonika Lake Ecodistrict
- Ecodistrict 2W-3 - Wunnummin Lake Ecodistrict

Ecoregion 3E: Lake Abitibi Ecoregion

- Ecodistrict 3E-1 - Clay Belt Ecodistrict
- Ecodistrict 3E-2 - Hornepayne Ecodistrict
- Ecodistrict 3E-4 - Tip Top Mountain Ecodistrict
- Ecodistrict 3E-5 - Foleyet Ecodistrict
- Ecodistrict 3E-6 - Kirkland Lake Ecodistrict
- Ecodistrict 3E-7 - Kesagami Ecodistrict

Ecoregion 3S: Lake St. Joseph Ecoregion

- Ecodistrict 3S-1 - Berens River Bedrock Plateau Ecodistrict
- Ecodistrict 3S-2 - Throat River Plain Ecodistrict
- Ecodistrict 3S-3 - Agutua Moraine (Windigo Lobe) Ecodistrict
- Ecodistrict 3S-4 - Pickle Lake Drumlin Field Ecodistrict
- Ecodistrict 3S-5 - St. Raphael Lake Ecodistrict

Ecoregion 3W: Lake Nipigon Ecoregion

- Ecodistrict 3W-1 - Whitewater Lake Ecodistrict
- Ecodistrict 3W-2 - Savanne Ecodistrict
- Ecodistrict 3W-3 - Black Sturgeon Ecodistrict
- Ecodistrict 3W-4 - Geraldton Ecodistrict
- Ecodistrict 3W-5 - Schreiber Ecodistrict

Ecoregion 4E: Lake Temagami Ecoregion

- Ecodistrict 4E-1 - Michipicoten Ecodistrict
- Ecodistrict 4E-3 - Mississagi Ecodistrict
- Ecodistrict 4E-4 - Temagami Ecodistrict
- Ecodistrict 4E-5 - New Liskeard Ecodistrict

Ecoregion 4S: Lake Wabigoon Ecoregion

- Ecodistrict 4S-1 - Sydney Lake Ecodistrict
- Ecodistrict 4S-2 - Lac Seul Ecodistrict
- Ecodistrict 4S-3 - English River Ecodistrict
- Ecodistrict 4S-4 - Dryden Ecodistrict
- Ecodistrict 4S-5 - Manitou Ecodistrict
- Ecodistrict 4S-6 - Sioux Narrows Ecodistrict

Ecoregion 4W: Pigeon River Ecoregion

- Ecodistrict 4W-1 - Quetico Ecodistrict
- Ecodistrict 4W-2 - Kakabeka Ecodistrict

Ecoregion 5E: Georgian Bay Ecoregion

- Ecodistrict 5E-1 - Thessalon Ecodistrict
- Ecodistrict 5E-3 - La Cloche Ecodistrict
- Ecodistrict 5E-4 - Sudbury Ecodistrict
- Ecodistrict 5E-5 - North Bay Ecodistrict
- Ecodistrict 5E-6 - Tomiko Ecodistrict
- Ecodistrict 5E-7 - Parry Sound Ecodistrict
- Ecodistrict 5E-8 - Huntsville Ecodistrict
- Ecodistrict 5E-9 - Algonquin Park Ecodistrict
- Ecodistrict 5E-10 - Brent Ecodistrict

- Ecodistrict 5E-11 - Bancroft Ecodistrict
- Ecodistrict 5E-13 - Batchawana Ecodistrict

Ecoregion 5S: Agassiz Clay Plain Ecoregion

- Ecodistrict 5S-2 - Rainy River Ecodistrict

Ecoregion 6E: Lake Simcoe-Rideau Ecoregion

- Ecodistrict 6E-1 - Stratford Ecodistrict
- Ecodistrict 6E-2 - Kincardine Ecodistrict
- Ecodistrict 6E-4 - Meaford Ecodistrict
- Ecodistrict 6E-5 - Mount Forest Ecodistrict
- Ecodistrict 6E-6 - Barrie Ecodistrict
- Ecodistrict 6E-7 - Oak Ridges Ecodistrict
- Ecodistrict 6E-8 - Peterborough Ecodistrict
- Ecodistrict 6E-9 - Havelock Ecodistrict
- Ecodistrict 6E-10 - Charleston Lake Ecodistrict
- Ecodistrict 6E-11 - Smiths Falls Ecodistrict
- Ecodistrict 6E-12 - Kemptville Ecodistrict
- Ecodistrict 6E-13 - Oshawa-Cobourg Ecodistrict
- Ecodistrict 6E-14 - Tobermory Ecodistrict
- Ecodistrict 6E-15 - Picton Ecodistrict
- Ecodistrict 6E-16 - Pembroke Ecodistrict
- Ecodistrict 6E-17 - Manitoulin Ecodistrict

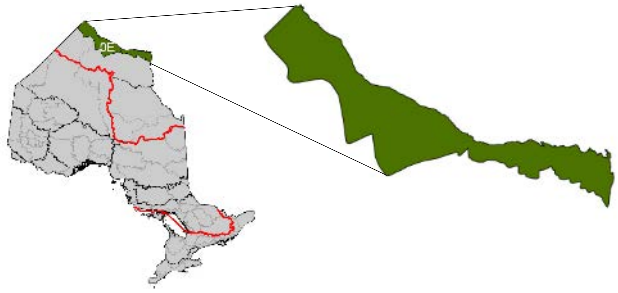
Ecoregion 7E: Lake Erie-Lake Ontario Ecoregion

- Ecodistrict 7E-1 - Essex Ecodistrict
- Ecodistrict 7E-2 - St. Thomas Ecodistrict
- Ecodistrict 7E-3 - Grimsby Ecodistrict
- Ecodistrict 7E-4 - Toronto Ecodistrict
- Ecodistrict 7E-5 - Niagara Ecodistrict
- Ecodistrict 7E-6 - London Ecodistrict

Figure 2. The ecozones, ecoregions, and ecodistricts of Ontario (Crins et al. 2009).

Ecoregion 0E

Hudson Bay Coast Ecoregion



The most northerly ecoregion in Ontario extends 8 to 35 km south of the Hudson Bay coast from the Manitoba border east to Cape Henrietta Maria. Located in the Hudson Bay Lowlands Ecozone, it encompasses 2,827,893 ha or 2.9% of the province. It includes one ecodistrict — 0E-1: Wood Creek.

Extensive shallow lakes, ponds, and peatlands are found throughout the ecoregion resulting in a landscape of variable wetland types including fen complexes, palsas, bog complexes, and open water (Figure 3). Closer to the coast, on drier sites, tundra heath and sparse woodlands prevail.

Short cool summers, long cold winters, and the presence of continuous permafrost control substrate formation. The underlying bedrock, typically Paleozoic dolomite, limestone, and sandstone, is initially covered by calcareous glaciomarine deposits with an accumulation of deep organic (Fibrisols and Organic Cryosols) materials at the surface. Small amounts of exposed mineral material, typically glaciomarine (Eutric Brunisols and Regosols) occur on well drained sites or along the coast.

Subarctic and boreal plant species occur in the ecoregion. Characteristic subarctic species include Arctic willow and alpine chickweed. Black spruce and bog birch are common boreal species. Salt marshes have developed along the coast. On elevated sites farther inland, tundra heath dominated by low ericaceous plants including lapland azalea and northern Labrador tea have developed. Black spruce, white spruce, and American larch can be found on river banks and sheltered beach ridges.

The fauna is also a mixture of subarctic and boreal species. Subarctic species include Arctic fox and red-throated loon. Boreal species include woodland caribou and fox sparrow. The ecoregion is an important area for denning and summering polar bears, and breeding shorebirds such as dunlin, Hudsonian godwit, and semipalmated plover. Ecoregion 0E is the only ecoregion in Ontario that contains Arctic char habitat.

Many small lakes have formed in response to the flat topography and poor drainage. Important river systems include the Black Duck, Severn, Winisk, Sutton, Brant, and Kinushseo rivers that drain through the Hudson Bay Watershed.

Fort Severn is the primary community, where hunting, trapping, and fishing are culturally important.

Figure 3. Wetlands of the Hudson Bay Coast Ecoregion. Ed Morris, Ontario Parks.

Six types of natural heritage areas occur in Ecoregion 0E (Gray et al. 2009), including Polar Bear Provincial Park, Ontario’s largest provincial park.

Continuous permafrost, shorter growing season, and lower summer temperatures distinguish this ecoregion from Ecoregion 1E to the south. The coast of Hudson Bay forms the northern boundary, James Bay the eastern boundary, and the Manitoba-Ontario border marks the western boundary.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 0E-1

Wood Creek Ecodistrict

The Wood Creek Ecodistrict is the northernmost ecodistrict in Ontario. Located along Hudson Bay, it encompasses 2,827,893 ha and is the only ecodistrict in the Hudson Bay Coast Ecoregion (2.9% of the province). The ecodistrict extends from the border with Manitoba east to James Bay, and from Hudson Bay south for a distance of 8 to 35 km. The elevation increases from sea level on the coast to 136 m above sea level near the southern boundary close to Beavertrap Creek.

Figure 4. Wetland area and treed beach ridges in the Wood Creek Ecodistrict. Gerry Racey, MNRF.

Key features

- Wetlands (fen and bog complexes; Figure 4) and open water occupy more than three-quarters of the ecodistrict.
- Shallow to deep organic deposits dominate.
- Parallel relict beach ridges extend many kilometres inland.
- Substrates exhibit continuous permafrost.
- Coastline continues to emerge from Hudson Bay due to isostatic rebound.

Geology and substrates

Ecodistrict 0E-1 contains the only area of continuous permafrost in Ontario. Nearly all of the ecodistrict is dominated by organic materials (Figure 5) overlying calcareous glaciomarine deposits. Approximately 7,600 years ago (Dyke 2004) the Tyrrell Sea, the precursor to Hudson Bay, inundated the area, depositing fine-textured mineral material on the underlying Paleozoic bedrock. Through time, deep organic layers have developed on the poorly drained, flat landscape. Isostatic rebound and periodic storms have produced a series of relict beach ridges parallel to the emerging shore. Found throughout the ecodistrict, relict beach ridges are more prevalent west of the Winisk River and south of Cape Henrietta Maria. Exposed glaciomarine deposits occur on the beach ridges near the coast, where the local relief and time since emergence have prevented the accumulation of organic material. Better drained glaciomarine deposits also occur near the Severn, Shagamu, and Sutton rivers (Barnett et al. 2012a, b, c; 2016a, b). Marine and aeolian sediment occurs along the Hudson Bay shoreline and limited glaciofluvial and alluvial deposits are located along the Severn, Winisk, and Niskibi rivers (Barnett et al. 2012h; 2016a, e).

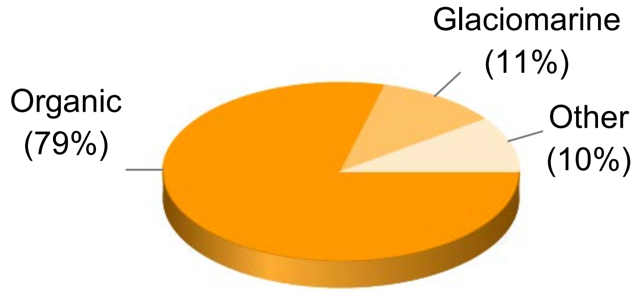


Figure 5. Modes of deposition in Ecodistrict 0E-1.

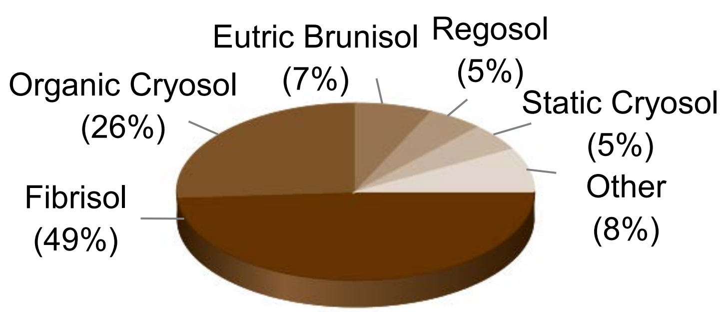


Figure 6. Substrate types in Ecodistrict 0E-1.

The cold climate and young age of the parent material limits mineral substrate development. The dominant substrate type found in this ecodistrict is Fibrisols (Figure 6). Organic Cryosols occur in the south-central portion, often associated with bog complexes. Inland, Eutric Brunisols are common in better drained glaciomarine deposits, while the coast and larger rivers are characterized by Regosols. Static Cryosols have developed in coarse-textured mineral material where permafrost is evident within 1 m of the surface. In poorly drained areas where deep organic deposits have not accumulated, Gleysols may occur. In the northwest, Mesisols can be found mainly in fens dominated by sedges.

Land cover and vegetation

The Wood Creek Ecodistrict is associated with the Subarctic Woodland-Tundra Vegetation Zone (Baldwin et al. 2018) and the Forest-Tundra (B.32) and Hudson Bay Lowlands (B.5) sections of the Boreal Forest Region (Rowe 1972).The coastal climate results in a cold, harsh environment that controls plant establishment and growth. The cooler climate and poorly drained landscape limit fires, relative to adjacent ecodistricts.

Fen and bog complexes (e.g., treed and open fens and bogs) dominate (Figure 7). Treed fens, characterized by black spruce and American larch, are typically located inland, with open fens more prevalent near the coast and in the eastern part of the ecodistrict. Bog complexes, including palsas, can be found farther inland. Tundra heath, dominated by prostrate ericaceous shrubs, is prevalent on relict beach ridges and adjacent to rivers (Riley 2011). Sparse, coniferous, and mixed forests occur inland among the bogs and fens, particularly on river banks with better drainage. These river banks support forests of white spruce, black spruce, American larch, and balsam poplar. Inland beach ridges are dominated by low treed spruce woodlands with a diverse range of lichen species (Figure 8). Extensive saline-influenced mudflats and marshes form a continuous shoreline along Hudson Bay and the northern portion of James Bay.

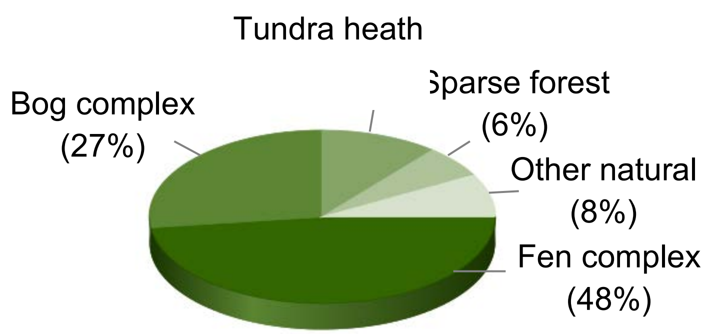


Figure 7. Land cover types in Ecodistrict 0E-1.

Figure 8. Hudson Bay coast relict beach ridges. Gerry Racey, MNRF.

The modifying effects of Hudson Bay and the close proximity to salt water support notable plant species. Cooler temperatures influenced by the proximity to the water sustain the growth of subarctic species including short-capsuled willow and gravel sedge (Riley 2011). Halophytic plants including tundra alkaligrass and horned sea-blite occur along the coast.

Land use

The community of Fort Severn is located in Ecodistrict 0E-1. Settlement and infrastructure related to this community represent less than 1% of the area (Figure 9). Major land uses include hunting, fishing, trapping, aggregate extraction, and services associated with resource-based activities. Polar Bear Provincial Park, the only protected area in the ecodistrict, covers nearly 51.4% of the area.

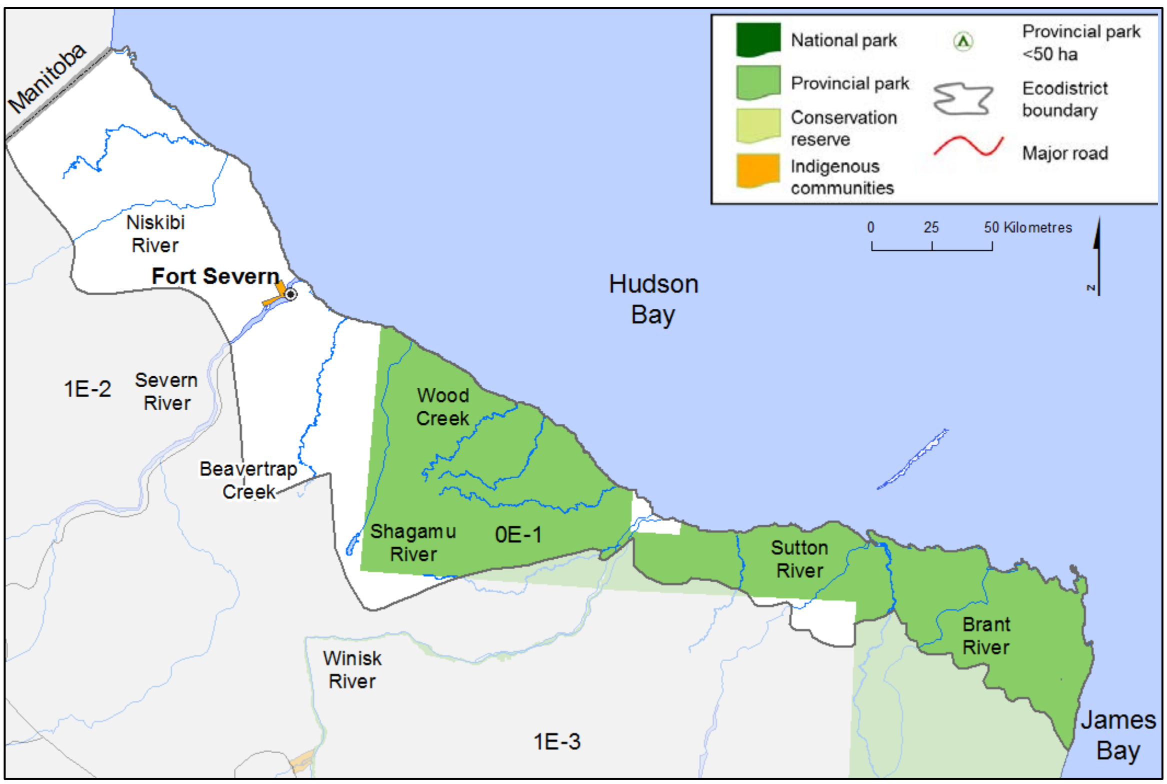


Figure 9. Select community, natural heritage area, rivers, and creeks in Ecodistrict 0E-1.

Ecodistrict boundary delineation

Earlier work by Hills (1959) classified the Wood Creek Ecodistrict as Site Districts 1E-1 and 1E-4 along with portions of 1E-2 and 1E-3. First proposed by Burger (1993), the southern boundary of Ecodistrict 0E-1 has been redefined using satellite imagery interpretation to recognize the transition from continuous permafrost in Ecoregion 0E to discontinuous permafrost in 1E (Brown 1973), supplemented by observed vegetation patterns. The coast of Hudson Bay and the extreme northwestern portion of James Bay form the northern and eastern boundaries, and the western boundary abuts the province of Manitoba.

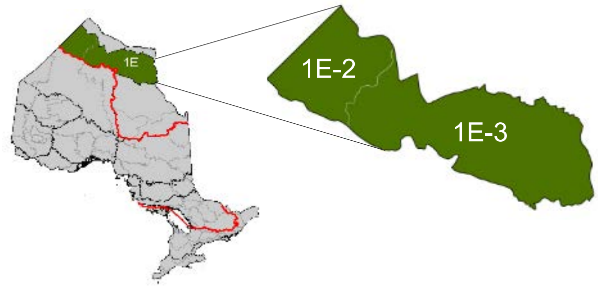
Hudson Bay coast

Following deglaciation, the modern landscape of the Hudson Bay coast continues to emerge from the sea. Exposed mineral material has been reshaped by wind, waves, and storms, creating thousands of parallel beach ridges (Figure 10) and successions of salt water to fresh water wetlands as distance from the coast increases. The beach ridges and wetland areas are important habitat for a variety of plants and animals including polar bears, woodland caribou, shorebirds, and waterfowl.

Figure 10. Coastal beach ridges, Hudson Bay. Ed Morris, Ontario Parks.

Ecoregion 1E

Northern Taiga Ecoregion



Located in the Hudson Bay Lowlands Ecozone, Ecoregion 1E extends from the province of Manitoba eastward to the shore of James Bay. Covering an area of 9,482,319 ha or 9.6% of the province, it includes two ecodistricts (Table 1).

Table 1. Ecodistricts in Ecoregion 1E.

Ecodistrict	Ecodistrict name
1E-2	Dickey River
1E-3	Winisk River

Short cool summers and long cold winters have contributed to the development of deep organic materials (typically Fibrisols and Organic Cryosols) over calcareous glaciomarine deposits. The underlying bedrock is primarily Paleozoic sandstone, shale, and limestone. Precambrian bedrock inliers, including the Sutton Ridges, are found in the eastern portion of the ecoregion.

Small lakes and wetlands dot the landscape, the result of flat topography and poor drainage. Bog and fen complexes have formed over more than half of the landscape, which is underlain by extensive, discontinuous permafrost.

Contained within the Hudson Bay Watershed, portions of several large river systems, including the Severn, Winisk, Sutton, and Ekwan rivers, traverse this ecoregion along with Sutton, Hawley, and Aquatuk lakes, which are associated with the Sutton Ridges.

Vegetation is dominated by low treed spruce-lichen woodlands, fen complexes (Figure 11), and bog complexes inhabited by boreal plant species. Open to closed treed areas can be found near streams and rivers with better drainage. Similar to Ecoregion 0E, salt marshes have formed along the James Bay coast. Subarctic species are less common in this ecoregion compared with Ecoregion 0E.

Open wetlands host breeding sandhill cranes and yellow rails, while treed areas support species such as blackpoll and western palm warblers. Woodland caribou and snowshoe hare occur on the landscape, with brook stickleback and spoonhead sculpin inhabiting rivers and lakes.

Peawanuck, along the Winisk River, is the primary community. Fishing, hunting, and trapping are important activities in this northern community.

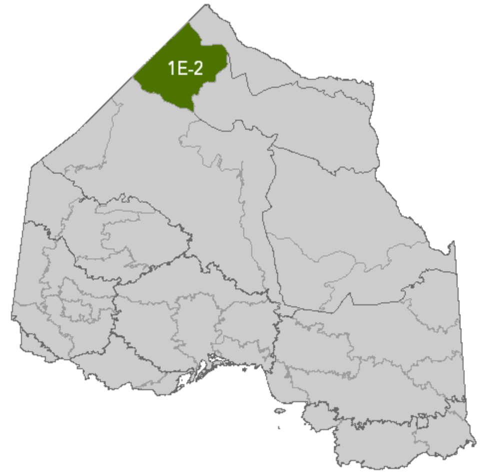
Figure 11. Fen complex in Ecoregion 1E. Sam Brinker, MNRF.

Seven types of natural heritage areas occur in Ecoregion 1E (Gray et al. 2009), including the Winisk River Provincial Park, featuring rapids and river-etched limestone cliffs.

The Northern Taiga Ecoregion was differentiated from Ecoregion 0E due to a longer growing season and higher summer temperatures. Satellite imagery depicting differences in land cover patterns associated with discontinuous permafrost in Ecoregion 1E and continuous permafrost in Ecoregion 0E was also used. In the southwest, this ecoregion transitions from Paleozoic to Precambrian bedrock and in the southeast lower mean annual temperature, shorter growing season, and more prevalent coastal effects distinguish it from Ecoregion 2E.

Ecodistrict 1E-2

Dickey River Ecodistrict



The Dickey River Ecodistrict is located along the Ontario-Manitoba border and extends to the Severn River in the east and from the Black Duck River south to Agusk Lake. The ecodistrict encompasses 2,777,072 ha (29.3% of the ecoregion, 2.8% of the province). The elevation across the relatively flat landscape ranges from 9 m above sea level in the northeast near the Severn River to 186 m above sea level north of Hosea Lake near the Ontario-Manitoba border.

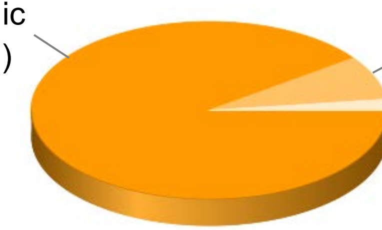
Figure 12. Wetland system along the Severn River. Gerry Racey, MNRF.

Key features

- Over half of the land base is represented by fen and bog complexes (Figure 12).
- Area is dominated by organic material underlain by deep, fine-textured, calcareous mineral material.
- Discontinuous permafrost occurs across the ecodistrict.

Geology and substrates

Hills (1959) described the Dickey River Ecodistrict as a nearly level landscape of deep, calcareous mineral material, overlying Paleozoic bedrock. Extensive areas of poorly drained organic material



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have developed (Figure 13) over fine-textured glaciomarine deposits, remnants from the Tyrrell Sea that covered the area nearly 7,600 years ago (Dyke 2004). Discontinuous permafrost is widespread (Smith and Burgess 2004), typically occurring in the west and central portions of the ecodistrict.

Pockets of morainal deposits can be found from the Manitoba border near Hosea Lake east to the Niskibi River (Barnett et al. 2016d, f) and near the ecodistrict boundary with 2W-3. Limited glaciofluvial and alluvial deposits have formed along the larger river systems including the Severn, Niskibi, and Black Duck rivers (Barnett et al. 2016b, c, f). Exposed glaciomarine deposits are scattered across the northern and central portions of the ecodistrict. Sizable deposits occur adjacent to the Severn River and west of the Black Duck River (Barnett et al. 2016b, c).

Organic Cryosols are the most common substrate type (Figure 14), dominating the western and central portions of the ecodistrict. Fibrisols can be found along the northern ecodistrict boundary and in the east near the Severn River. In the south, Gray Luvisols occur in better drained coarse-textured morainal material and Eutric Brunisols dominate areas near the southern boundary. Regosols are restricted to larger river systems.

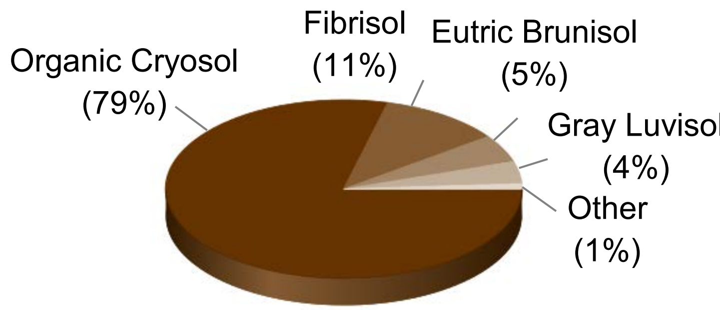


Figure 14. Substrate types in Ecodistrict 1E-2.

Land cover and vegetation

The Dickey River Ecodistrict is associated with the Northern Boreal Woodland Vegetation Zone (Baldwin et al. 2018) and the Hudson Bay Lowlands (B.5) and Northern Coniferous (B.22a) sections of the Boreal Forest Region (Rowe 1972). It is characterized by bog and fen complexes, which cover more than half of the land base (Figure 15). Bog complexes dominated by black spruce are more prevalent in the northern and western portions of the ecodistrict, whereras fen complexes comprising black spruce and American larch are more typical in the northeast and south. Low treed, sparse forests (Figure 16) occur in the northwestern and southeastern portions of the ecodistrict. Coniferous forests of black spruce, white spruce, and American larch grow where better drainage

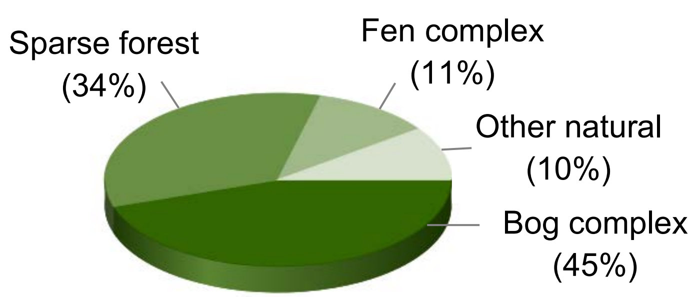


Figure 15. Land cover types in Ecodistrict 1E-2.

occurs including river banks and areas with local relief. Mixed and deciduous forests containing trembling aspen and paper birch are limited, typically occurring in the south. Balsam poplar is more common. Recent fires and old burns (i.e., regenerating depletion) are infrequent due to the poorly drained landscape. Relative to Ecodistrict 1E-3, fires are more abundant due to the greater proportion of upland environments and drier climatic regime.

Plant species more common in subarctic regions, including sparrow's-egg lady's-slipper and narrow-leaved arnica, occur in the Dickey Ecodistrict due to the cool climate. American milk-vetch and little-tree willow reach their eastern extent in Ontario near the boundary between 1E-2 and 1E-3 (Argus et al. 1982-1987), and jack pine reaches its northwestern extent. Throughout the area a dense covering of lichen species form a carpet on top of organic material on drier sites (Riley 2011).

Figure 16. Black spruce lichen woodland, south of the community of Fort Severn. Gerry Racey, MNRF.

Land use

Land uses include trapping, hunting, fishing, and services associated with resource-based activities. No permanent settlements or documented infrastructure are found in the area (Figure 17). No protected areas occur in the ecodistrict.

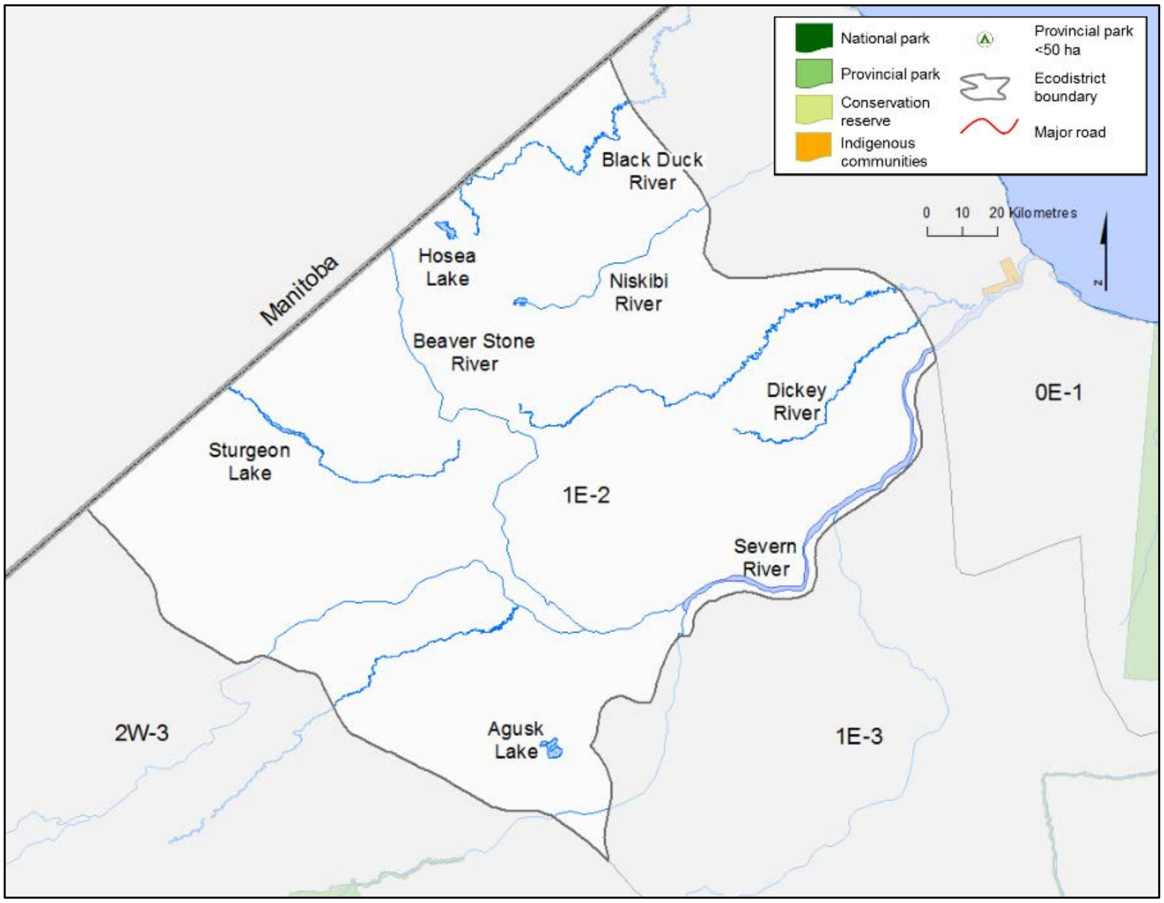


Figure 17. Select rivers and lakes in Ecodistrict 1E-2.

Ecodistrict boundary delineation

The northern boundary is defined by satellite imagery interpretation that reflects the transition between discontinuous permafrost of Ecodistrict 1E-2 and the continuous permafrost of 0E-1 (Brown 1973). Burger (1993) first proposed the changes to the northern boundary of Hills (1959) Site District 1E-2 incorporating satellite imagery along with vegetation pattern observations (e.g., denser treed landscape in 1E-2 compared with 0E-1). The southern boundary reflects ecoregional differences including bedrock and climatic variables. Ecoregion 1E is underlain with Paleozoic bedrock compared with Precambrian bedrock in 2W, and 1E has a colder climate and less precipitation. The northeastern boundary follows the Severn River, and in the southeast the boundary reflects the transition from morainal material in 1E-2 to organic accumulations in 1E-3. The western boundary of this ecodistrict is delineated by the Ontario-Manitoba border.

The Tyrrell Sea

Nearly 7,600 years ago as the glaciers retreated, sea water inundated the land around Hudson Bay and the Tyrrell Sea was formed (Dyke 2004). At its maximum extent the Tyrrell Sea covered parts of Québec, Ontario, and Manitoba (Figure 18). In northern Ontario, fine-textured mineral sediment with marine mollusc fossils occurs up to 300 km inland. With the weight of ice removed, isostatic rebound started to occur, resulting in the regression of the Tyrrell Sea to its present day form — Hudson Bay.

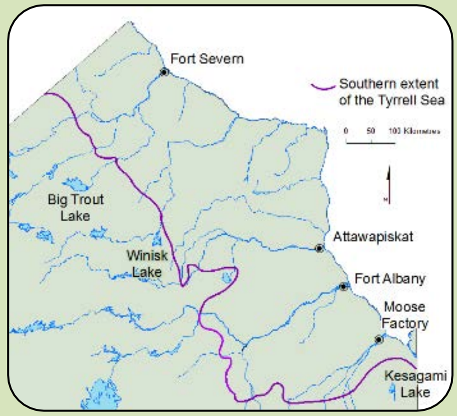
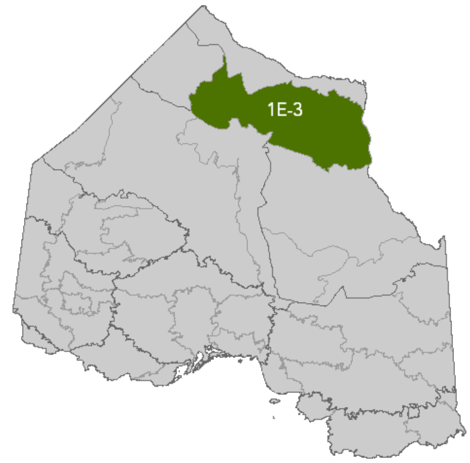


Figure 18. The southern extent of the Tyrrell Sea. Adapted from Barnett 1992.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 1E-3

Winisk River Ecodistrict



The Winisk River Ecodistrict extends from the Severn River in the west to James Bay in the east. The community of Peawanuck occurs at the northern boundary and south of the Ekwan River marks the southern limit. The ecodistrict encompasses 6,705,248 ha (70.7% of the ecoregion, 6.8% of the province). Elevation ranges from sea level on the James Bay coast to 251 m above sea level east of Sutton Lake.

Figure 19. Fen and bog complexes with upland black spruce lichen forests. Ed Morris, Ontario Parks.

Key features

- Fen and bog complexes (Figure 19) are present over three-quarters of the land base.
- The ecodistrict is generally level, overlain with organic substrates.
- Discontinuous permafrost exists throughout the area.
- The Sutton Ridges — Precambrian bedrock outcrops — occur in the east-central portion.

Geology and substrates

Approximately 7,600 years ago, the Tyrrell Sea covered the landscape (Dyke 2004), depositing a deep layer of calcareous, fine-textured, glaciomarine sediment across the underlying Paleozoic bedrock. Over time, poor drainage due to the flat topography and cold temperatures have contributed to the accumulation of organic materials that dominate the area (Figure 20). Widespread discontinuous permafrost occurs throughout the ecodistrict

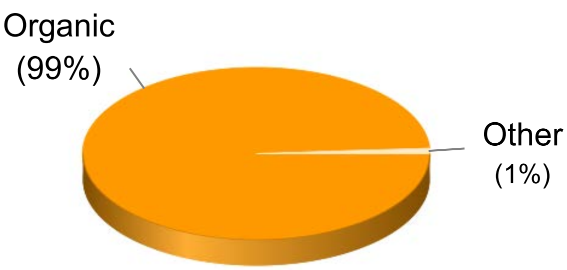


Figure 20. Modes of deposition in Ecodistrict 1E-3.

(Smith and Burgess 2004); however, large areas of permafrost can be found in the central portion stretching to the southeast. Exposed glaciomarine deposits occur in limited amounts north of Opinnagau, Nowashe, and North Washagami lakes (Barnett et al. 2012f), as well as along the boundary with Ecodistrict 2E-1, where organic matter has not accumulated due to local relief. A distinct, series of Precambrian bedrock inliers, forming the Sutton Ridges, occurs in the east-central portion of the ecodistrict near Sutton Lake (Barnett et al. 2012f). Morainal deposits are found along the Shamattawa and Sutton rivers (Barnett et al. 2012f) and in the southwestern corner of the ecodistrict. Glaciofluvial and alluvial materials are restricted to larger rivers (e.g., Winisk and Sutton rivers; Barnett et al. 2012f, g, h) and marine sediment occurs along the James Bay coast.

Nearly three-quarters of the ecodistrict is overlain by Fibrisols (Figure 21). Organic Cryosols occur in large contiguous patches in the central portion along Sutton Lake south to the Ekwan River. Limited areas of Grey Luvisols have developed in exposed mineral material in better drained locations and Regosols occur along the coast and adjacent to larger rivers. Bedrock, exposed at the surface or with a thin layer of mineral material, is limited to an area north and east of Sutton Lake, typically associated with the Sutton Ridges.

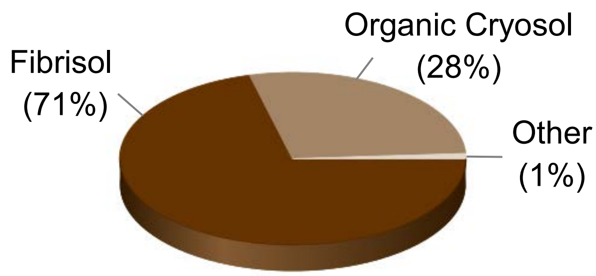


Figure 21. Substrate types in Ecodistrict 1E-3.

Land cover and vegetation

Dominated by bog and fen complexes, Ecodistrict 1E-3 is primarily associated with the Northern Boreal Woodland Vegetation Zone (Baldwin et al. 2018) and the Hudson Bay Lowlands Section (B.5) of the Boreal Forest Region (Rowe 1972). A small portion of the Northern Coniferous Section (B.22a) occurs in the southwest (Rowe 1972). Bog complexes occur over half of the landscape (Figure 22), typically in the western and central portions. Fen complexes (Figure 23) have formed along the eastern and northeastern ecodistrict boundaries, and dominate the landscape in the southeastern corner. These fens are characterized by stunted black spruce and American larch. Sparse forests, typically low treed, occur in the western part of the ecodistrict and in the headwater area of Wachi Creek, north of North Washagami Lake.

Recent fires and old burns (i.e., regenerating depletion) are infrequent due to the cool climate, poor drainage, and in the east increased humidity near the coast. Better drained river banks and upland areas support forests of black spruce, white spruce, and American larch. These coniferous forests are particularly evident along the Fawn, Winisk, and Ekwan rivers. Balsam poplar may be found in mixed and deciduous forests. Trembling aspen and paper birch are limited, occurring on better drained mineral material including islands along the Winisk River (Abraham 2017, MNRF, pers. comm.). Land cover types restricted to the coast of James Bay include salt marshes and mudflats.

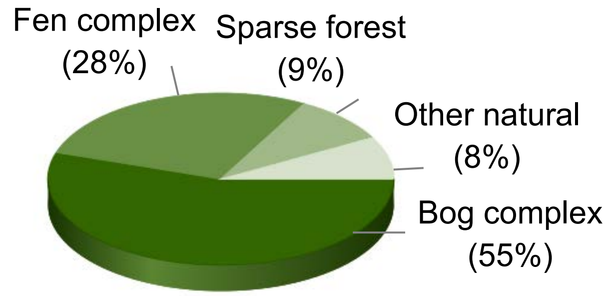


Figure 22. Land cover types in Ecodistrict 1E-3.

Specialized groups of plants including halophytic and subarctic species occur in the Winisk River Ecodistrict. The proximity to salt water along the James Bay coast facilitates the growth of halophytic plants (e.g., alkali bulrush and Greenland silverweed), and subarctic species tolerant of cold temperatures including northern bog rosemary and lapland azalea also occur. On drier sites, the organic substrate frequently supports a diverse range of lichen species (Riley 2011).

Figure 23. Wetland mosaic. Ed Morris, Ontario Parks.

Land use

The major land uses in Ecodistrict 1E-3 are hunting, trapping, fishing, mineral exploration, and services associated with resource-based activities. Settlement and associated infrastructure, including the community of Peawanuck, account for less than 1% of the area (Figure 24). Protected areas encompass approximately 13.2% of the ecodistrict.

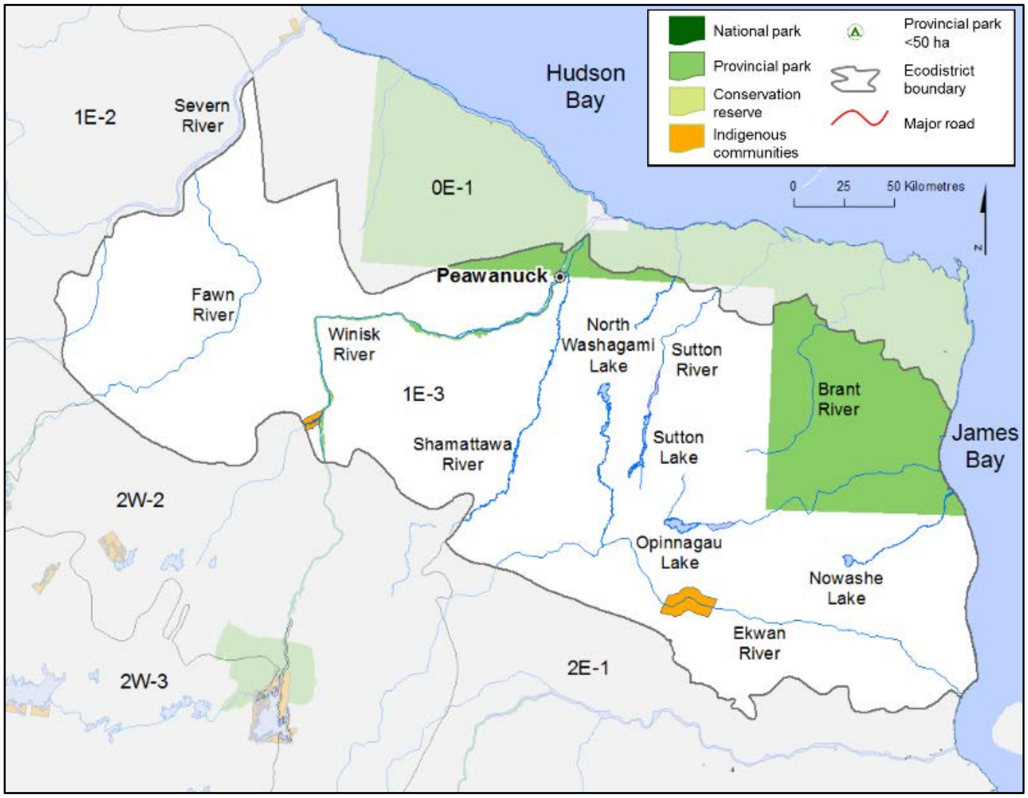


Figure 24. Select community, natural heritage areas, rivers, and lakes in Ecodistrict 1E-3.

Ecodistrict boundary delineation

Site District 1E-3, as initially proposed by Hills (1959), extended to the Hudson Bay coast in the east, but did not encompass the James Bay coast. Modifications to the northern and eastern boundaries of Ecodistrict 1E-3, first proposed by Burger (1993), combined satellite imagery showing the limit of discontinuous permafrost in Ecoregion 1E and continuous permafrost in 0E (Brown 1973) with vegetation patterns. The eastern boundary occurs along the coast of James Bay. In the southeast, the boundary is defined by Organic Cryosols in 1E-3 and Fibrisols in 2E-1 as well as ecoregional differences (e.g., Ecoregion 1E is colder and drier). The southwestern limit with 2W-2 also reflects ecoregional attributes including variations in bedrock, with 1E on Paleozoic bedrock and 2W on Precambrian bedrock. The boundary with 1E-2 follows the edge of the Severn River in the north and the transition from organic deposits in 1E-3 to morainal material in 1E-2 in the south.

Figure 25. Sutton Ridges.
Sam Brinker, MNRF.

Sutton Ridges

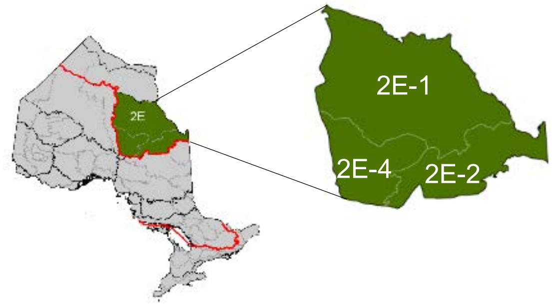
Located in a southeast trending band from North Washagami Lake to Nowashe Lake, the Sutton Ridges (Figure 25) are unique Precambrian bedrock inliers in an otherwise flat, Paleozoic bedrock landscape. The upper portion of the ridges was formed nearly 1,900 million years ago (Stott and Buse 2009), 1,500 million years before the surrounding Paleozoic bedrock.

Home to provincially rare plants, such as the Arctic bellflower (Figure 26) and lapland diapensia (Oldham and Brinker 2011), the Sutton Ridges are also culturally significant to local Indigenous communities.

Figure 26. Arctic bellflower.
Sam Brinker, MNRF.

Ecoregion 2E

James Bay Ecoregion



The James Bay Ecoregion extends from north of the Attawapiskat River, south along and inland from James Bay to the Québec border. It is bound on the west and south by the Paleozoic-Precambrian bedrock transition zone. Located in the Hudson Bay Lowlands Ecozone, it encompasses 12,494,468 ha, or 12.7% of the province and is divided into three ecodistricts (Table 2).

Table 2. Ecodistricts in Ecoregion 2E.

Ecodistrict	Ecodistrict name
2E-1	Albany
2E-2	Moose River
2E-4	Lower Kenogami River

Ecoregion 2E is relatively flat and poorly drained with numerous shallow ponds interspersed among peatlands, typically fen and bog complexes. Coniferous forests grow on better drained sites.

Organic substrates, typically Fibrisols, have developed over deep calcareous glaciomarine deposits. Permafrost can occasionally be found but it is patchy and discontinuous. The underlying bedrock is primarily Paleozoic. Limestone, sandstone, and shale are common.

As part of the Hudson Bay Watershed, several large river systems, including the Attawapiskat, Albany, Abitibi, and Moose rivers traverse the ecoregion. These rivers drain directly into James Bay. Lakes in the ecoregion include Jog, Missisa, and Kapiskau.

Across the landscape, stunted black spruce, white spruce, and American larch are interspersed with open fens and bogs. Coniferous and mixed boreal forests grow adjacent to streams and rivers and in sheltered valleys on well drained sites. The James Bay coast is characterized by salt and brackish marshes (Figure 27), estuaries, and coastal beach ridges.

Important for staging shorebirds and waterfowl during the fall migration, the James Bay tidal flats host large numbers of species including red knot and semipalmated sandpiper. Boreal bird species such as yellow rail and Connecticut warbler are found farther inland, along with woodland caribou, Canada lynx, and southern red-backed vole. Characteristic amphibians and reptiles include American toad, boreal chorus frog, and eastern gartersnake, and fish species include burbot, johnny darter, and logperch.

Several Indigenous communities are established in the James Bay Ecoregion, including Attawapiskat, Fort Albany, Kashechewan, Moose Cree, and Moose Factory. Hunting, trapping, and guiding along with mining and mineral exploration are important activities.

Figure 27. James Bay marsh complex. Sam Brinker, MNRF.

The James Bay Ecoregion plays a significant role during bird migration, providing critical staging and molting habitat. In recognition of this, several Important Bird Areas have been designated. In addition, two areas along James Bay have been designated as Migratory Bird Sanctuaries. In total, 13 types of natural heritage areas are established in Ecoregion 2E (Gray et al. 2009).

To the west and south, a change from Paleozoic to Precambrian bedrock differentiates Ecoregion 2E from 2W and 3E. The northern boundary is delineated by a higher mean annual temperature and longer growing season than those in Ecoregion 1E. The coast of James Bay and the province of Québec mark the eastern edge of the ecoregion.

Ecodistrict 2E-1

Albany Ecodistrict

The Albany Ecodistrict extends north from Jaab Lake to south of the Ekwan River, and east from the edge of the Precambrian shield near Streatfeild Lake to the James Bay coast. The ecodistrict encompasses 7,408,698 ha (59.3% of the ecoregion, 7.5% of the province). Elevation ranges from sea level at the coast to 231 m above sea level east of Streatfeild Lake.

Figure 28. Wetland complex near James Bay. Bill Crins, MNRF.

Key features

- Fen and bog complexes (Figure 28) dominate the land base.
- Typically is a level landscape of organic material over calcareous fine-textured deposits.
- Estuaries occur at coastal outlets of large river systems.

Geology and substrates

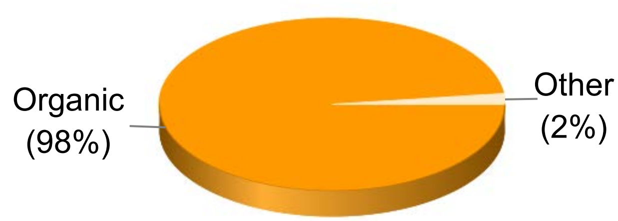


Figure 29. Modes of deposition in Ecodistrict 2E-1.

A level landscape, poor drainage, and cold temperatures have contributed to the predominance of organic materials (Figure 29) in the Albany Ecodistrict. Underneath the organic material is a deep layer of fine-textured mineral material. Laid down by the Tyrrell Sea, which inundated the area approximately 7,600 years ago (Dyke 2004), the glaciomarine deposits are calcareous reflecting the chemistry of the underlying Paleozoic bedrock. Small pockets of exposed mineral material occur throughout the ecodistrict. Glaciofluvial and alluvial deposits are limited to major rivers, including the Albany and Attawapiskat, and marine sediment occurs along the James Bay coast. Small, exposed glaciomarine deposits can be found between the Missisa River and the James Bay coast, and east of Jaab Lake (Pala et al. 1991). These deposits are often associated with relict beaches. Morainal materials are also restricted, occurring around Missisa Lake and in the west near the border with Ecodistrict 2W-2 (Barnett et al. 2013a, c, e). Limestone cliffs can be found adjacent to some rivers (e.g., Attawapiskat River; Cowell 1983). The ecodistrict also includes areas of sporadic discontinuous permafrost (Smith and Burgess 2004).

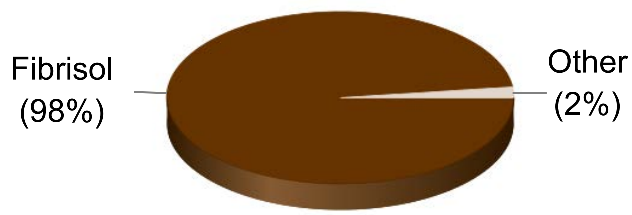


Figure 30. Substrate types in Ecodistrict 2E-1.

The Albany Ecodistrict is almost entirely covered by Fibrisols (Figure 30). Gleysols have developed in mineral material with poor drainage and Regosols are limited to better drained mineral material, including small deposits along the Albany River and the James Bay coast.

Land cover and vegetation

Hills (1959) described Ecodistrict 2E-1 as an area of stunted spruce, broken occasionally by spruce-poplar forests along stream banks and ridges. Associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Hudson Bay Lowlands Section (B.5) of the Boreal Forest Region (Rowe 1972), this ecodistrict is characterized by flat topography and poor drainage with bog and fen complexes occurring over most of the land base (Figure 31). Bog complexes occur throughout the ecodistrict (Figure 32), with open bogs more prevalent in the southeast and along portions of the Albany River. Fen complexes dominate the eastern portion of the ecodistrict along the coast as well as areas adjacent to the Attawapiskat River and south of the Albany River.

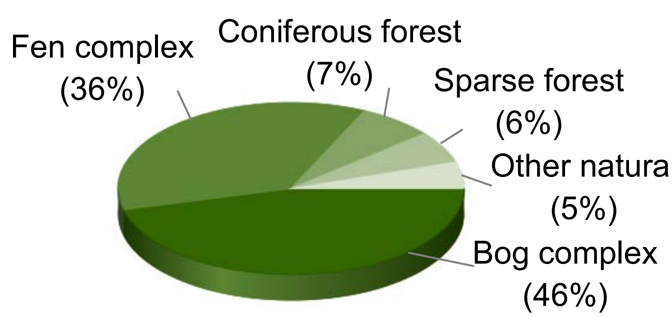


Figure 31. Land cover types in Ecodistrict 2E-1.

Coniferous forests characterized by black spruce, American larch, white spruce, and balsam fir occur in better drained areas, often intermixed with treed fens. In the southwest, sparse forests grow as a transition between coniferous forests and treed fens. Mixed and deciduous forests growing paper birch, trembling aspen, and balsam poplar occur on river banks and on upland sites. Recent fires and old burns (i.e., regenerating depletion) are limited due to the cool, humid climate (Hills 1976) and poorly drained landscape. Marshes occur along the coast and adjacent to larger rivers. Fires are infrequent and small due to the moist climate and poor drainage.

The Albany Ecodistrict supports several notable ecosystems. Along the coast, plant species (e.g., estuary sedge and estuary beggarticks; Riley 2011) occur that are adapted to the changing, nutrient rich estuarine habitats where fresh and salt water mix. Where the water has a higher concentration of salt, halophytic plants (e.g., saltmarsh bulrush and horned sea-blite) thrive. Due to the cold climate, subarctic species including net-veined willow and showy pussytoes occur and eastern white cedar reaches its northern limit. Limestone karst wetlands, featuring disappearing lakes and streams, occur north and south of the Attawapiskat River (Riley 2011). On drier ridges, an array of lichen frequently covers organic matter (Riley 2011).

Figure 32. Black spruce bog island surrounded by fens. Gerry Racey, MNRF.

Land use

Settlements, including Attawapiskat, Kashechewan, and Fort Albany, and their associated infrastructure cover less than 1% of the area (Figure 33). Mining, mineral exploration, aggregate extraction, trapping, hunting, fishing, and the provision of services associated with resource-based activities occur across the land base. Approximately 0.2% of the ecodistrict is designated as protected areas.

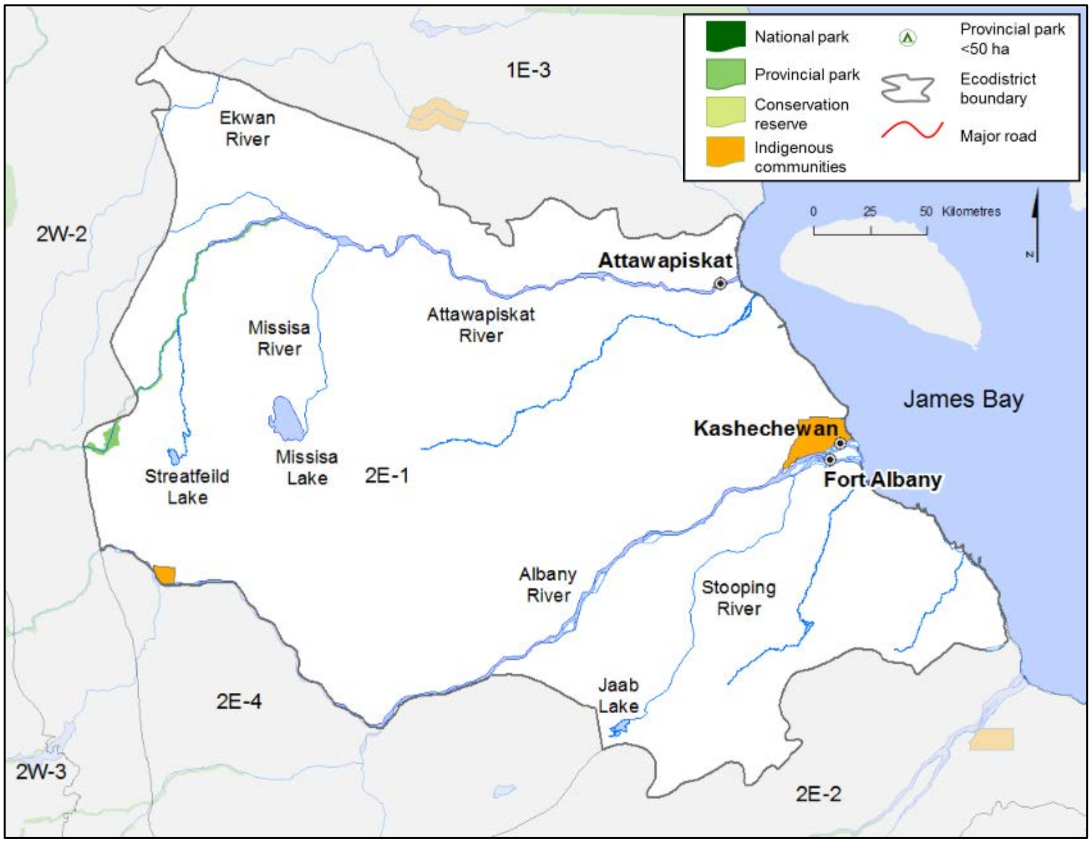


Figure 33. Select communities, natural heritage areas, rivers, and lakes in Ecodistrict 2E-1.

Ecodistrict boundary delineation

In Hills' (1959) original site district classification, Site District 2E-1 covered an area from Ecodistrict 1E-3 in the north to 3E-1 in the south. The current southern boundary of Ecodistrict 2E-1, aligned with the western part of the Albany River, is based on the recognized differences in hydrology and vegetation north (2E-1) and south (2E-4) of the river. In 2E-1, larger areas of surface water occur and the predominant land cover types are bog and fen complexes. In contrast, the surface water in 2E-4 is more confined to streams, rivers, and smaller lakes and coniferous forests are more prevalent. These features also distinguish 2E-1 from 2E-2. The western boundary with Ecoregion 2W is defined by ecoregional traits including differences in climatic variables (e.g., 2E is warmer and wetter) and the transition from Paleozoic bedrock in 2E to Precambrian bedrock in 2W. In addition, compared with 2E-1, Ecodistrict 2W-2 has a more abrupt elevational gradient over a shorter distance. The predominance of Fibrisols along with a warmer, wetter climate in 2E-1 separate it from the Organic Cryosols in 1E-3. The James Bay coastline forms the eastern boundary.

Important Bird Areas

Along the coasts of James and Hudson bays, sites important for the breeding and staging of a variety of bird species have been identified. Referred to as Important Bird Areas (IBA), they contain essential habitat for many species of birds, species at risk, or areas with large concentrations of birds (Gray et al. 2009). In Ecodistrict 2E-1, the Albany River Estuary and Associated Coastline IBA is recognized as an important staging areas for thousands of migrating geese, waterfowl, and shorebirds, including snow geese (Figure 34) and Hudsonian godwit (Figure 35) (IBA Canada 2015).

Figure 34. Snow geese. Mike Oldham, MNRF.

Figure 35. Hudsonian godwit. Ken Abraham, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 2E-2

Moose River Ecodistrict

Encompassing 2,759,542 ha (22.1% of the ecoregion, 2.8% of the province), the Moose River Ecodistrict lies in the southeastern portion of Ecoregion 2E. It stretches from the Kabinakagami River in the south and west to the James Bay coast and the province of Québec in the east, and the Kwetabohigan River in the north. The typically level landscape varies in elevation from sea level in the east to 214 m above sea level west of the Kabinakagami River.

Figure 36. Fen and bog complexes with upland coniferous forests in Ecodistrict 2E-2. Sam Brinker, MNRF.

Key features

- Bog and fen complexes occupy approximately two-thirds of the area (Figure 36).
- Area is dominated by organic material over calcareous fine-textured mineral deposits.
- Tidal estuaries are present at coastal outlets of large rivers.
- Includes areas of karst topography.

Geology and substrates

Ecodistrict 2E-2 is dominated by organic accumulations that have developed on mineral material overlying Paleozoic bedrock (Figure 37). The organic deposits are a result of the subdued topography, cooler climate, and poor drainage. They are dissected by many streams in the west and low ridges of shallow morainal material in the east (Hills 1959). The underlying mineral material is generally fine-textured and calcareous, consisting of glaciomarine sediments from the Tyrrell Sea that covered the landscape nearly 7,600 years ago (Dyke 2004). Exposed glaciomarine deposits occur along rivers and streams (e.g., Moose and Missinaibi rivers; Barnett et al. 2011e, g; 2012d, e). Glaciofluvial and alluvial deposits occur along the shores and at the mouths of larger river systems including the Moose and Harricanaw rivers (Barnett et al. 2011a, g). Morainal deposits are more common west of the Missinaibi River (Barnett et al. 2012d, e) and in the south as limited extensions of similar deposits in adjacent Ecodistrict 3E-1. In the east, between the Abitibi and North French rivers, Paleozoic bedrock is common, and typically covered by a shallow layer of mineral material (Barnett et al. 2011a). The bedrock features a range of karst characteristics (White 1994). Areas of localized discontinuous permafrost may occur in the north (Smith and Burgess 2004).

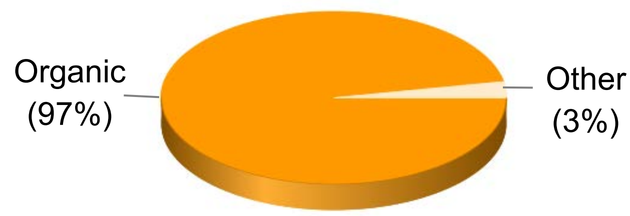


Figure 37. Modes of deposition in Ecodistrict 2E-2.

Organic substrates (Fibrisols and Mesisols) have developed over much of the land base (Figure 38). Mesisols are more prevalent in the west and east. Gleysols have developed in exposed mineral material in poorly drained areas. Regosols occur along the coast and at the mouth and upper portions of larger river systems where mineral material is actively being deposited.

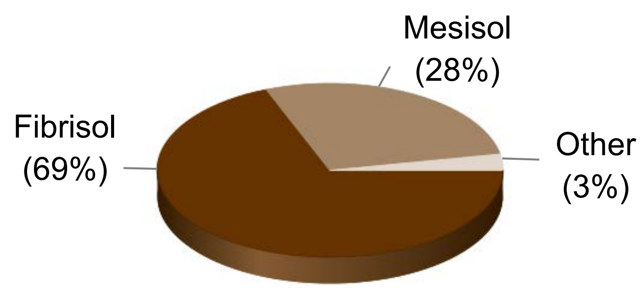


Figure 38. Substrate types in Ecodistrict 2E-2.

Land cover and vegetation

Ecodistrict 2E-2 is found in the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) placed the ecodistrict in the Hudson Bay Lowlands Section (B.5) of the Boreal Forest Region. Characterized by flat topography and poor drainage, the Moose River Ecodistrict is dominated by bog and fen complexes (Figure 39). Bog complexes (e.g., treed and open bogs) with stunted black spruce occur throughout the ecodistrict. Fen complexes are more prevalent in the east and in areas surrounding the Moose River. Coniferous forests of black spruce and American larch grow throughout the ecodistrict. Better drained areas, such as river banks, support coniferous forests of black spruce, American larch, white spruce, and balsam fir.

Sparse forests occur predominantly in the south. Mixed forests that include deciduous species such as trembling aspen, paper birch, and balsam poplar are most prominent in the extreme southwest corner on upland sites with better drainage. Marshes occur adjacent to rivers or along the coast (Figure 40). As they empty into James Bay, larger river systems support estuarine habitats. Fires are infrequent and small due to the moist climate and poor drainage.

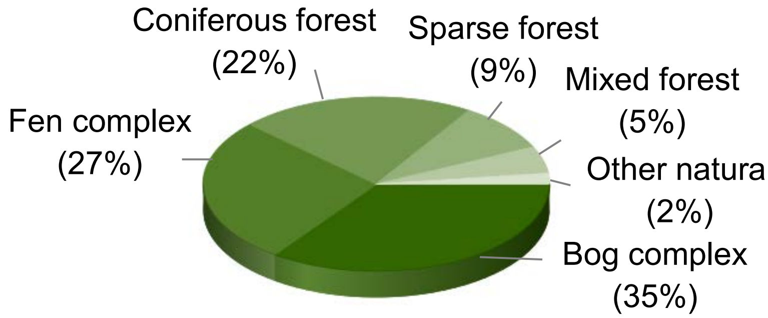


Figure 39. Land cover types in Ecodistrict 2E-2.

The biological diversity of the Moose River Ecodistrict is related to its climate and location. Jack pine and black ash reach their northeastern limits here, and the close proximity to James Bay provides a cool, wet climate that has resulted in the establishment of subarctic species (e.g., Arctic bluegrass and twisted draba). Halophytic species, including ditch-grass and alkali bulrush, occur along the coast. Estuarine habitats support American sloughgrass and chaffy sedge (Brunton 1983). Away from the coast, organic substrates frequently support a diverse, dense cover of lichens (Riley 2011).

Figure 40. Graminoid dominated coastal marsh. Wasyl Bakowsky, MNRF.

Land use

Less than 1% of the area is devoted to settlement (e.g., Moosonee and Moose Factory) and associated infrastructure, including railways (Figure 41). Land uses include hunting, fishing, trapping, mineral exploration, timber harvesting, hydroelectric generation, and the provision of services associated with resource-based activities. Protected areas cover 0.8% of the ecodistrict.

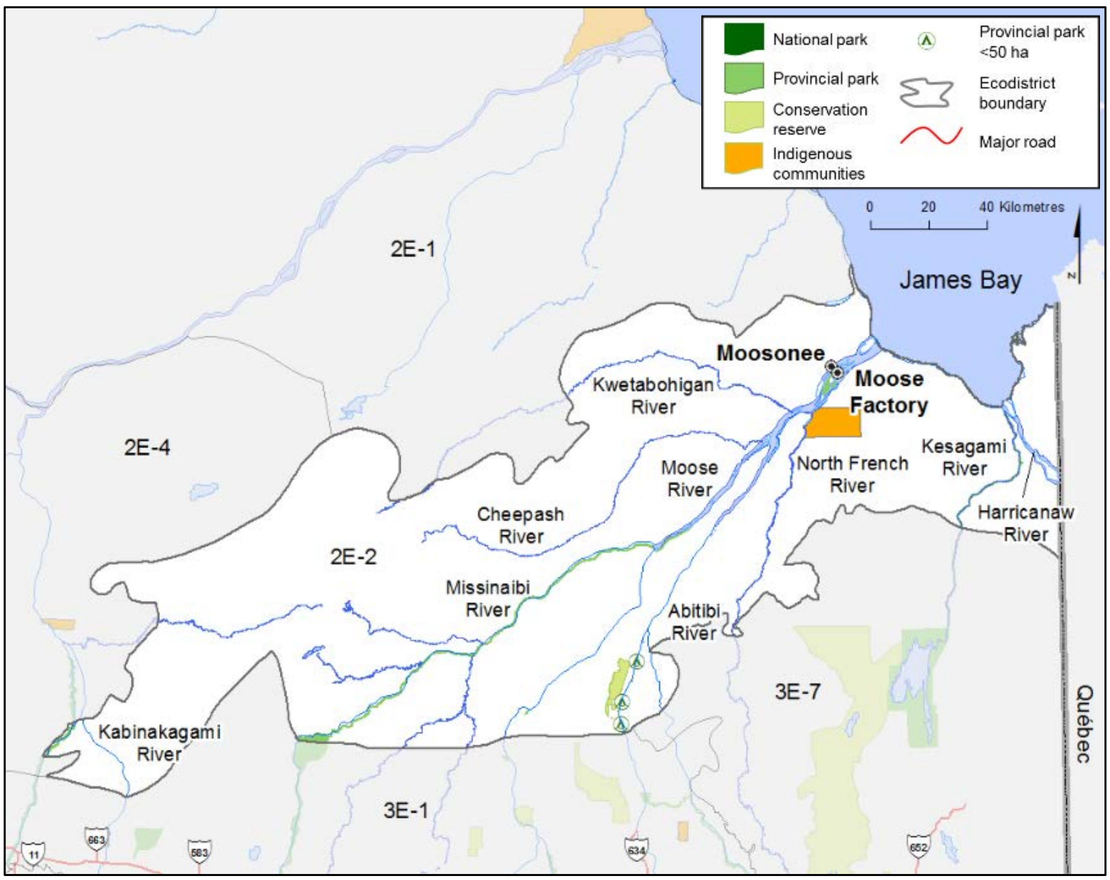


Figure 41. Select communities, natural heritage areas, and rivers in Ecodistrict 2E-2.

Ecodistrict boundary delineation

Hills (1959) originally described Ecodistrict 2E-2 as a part of Site District 2E-1. To the north, the boundary with Ecodistrict 2E-1 is defined by hydrological patterns and land cover composition. In the Moose River Ecodistrict, surface water is confined to water bodies such as streams, river, and small lakes, while in 2E-1 surface water areas are larger. Though bog and fen complexes dominate both 2E-2 and 2E-1, a higher proportion of dense coniferous forests occur in 2E-2 as a result of improved drainage associated with hydrological patterns. The northeastern boundary occurs along the James Bay coast and the eastern limit is defined by the border between Ontario and Québec. The transition from Paleozoic bedrock in Ecoregion 2E to Precambrian bedrock in 3E and a cooler, drier climate in 2E delineates the southern boundary. In addition, a transition from organic material in 2E-2 to organic and morainal deposits in 3E-7 help differentiate the two areas. The western boundary is primarily defined by the Mesisols of 2E-2 abutting the Fibrisols of adjacent 2E-4.

Gypsum Mountain

Gypsum Mountain is the best known example of gypsum karst topography in Ontario. Located approximately 70 km south-southwest of Moosonee, the ridge (Figure 42) is bisected by several streams that have eroded the easily weathered rock, creating a range of karst features including solution arches, fissures, caves, and sinkholes. The upland area supports jack pine, black spruce, trembling aspen, and balsam poplar, as well as several regionally significant plant species such as bristle-leaved sedge and great northern aster (White 1994).

Figure 42. Outcrop formation at Gypsum Mountain. Bill Crins, MNRF.

Ecodistrict 2E-4

Lower Kenogami River Ecodistrict

The Lower Kenogami River Ecodistrict encompasses the southwestern corner of Ecoregion 2E. The smallest ecodistrict in 2E, it covers an area of 2,326,229 ha (18.6% of the ecoregion, 2.4% of the province). Extending from Barber Lake in the west to approximately Pledger Lake in the east, and Feagan Lake in the south to the Albany River in the north, the landscape is nearly level with an elevation ranging from 71 m above sea level along the Albany River to 257 m above sea level southeast of Quantz Lake.

Figure 43. Fen complex and coniferous forests in Ecodistrict 2E-4. Sam Brinker, MNRF.

Key features

- Over half of the ecodistrict is fen and bog complexes (Figure 43).
- Area is dominated by organic material over calcareous fine-textured mineral material.
- Jog Lake, the only conservation reserve in Ecodistrict 2E-4, features a raised wetland complex with radial drainage (OMNR 2001c).

Geology and substrates

Organic deposits, underlain primarily by fine-textured calcareous material on Paleozoic bedrock dominate the Lower Kenogami River Ecodistrict (Figure 44). This ecodistrict has been affected by three major glacial events, glacial Lake Ojibway, the Cochrane readvance, and the Tyrrell Sea. Approximately 9,000 years ago (Dyke 2004) in northeastern Ontario, a glacial lake (i.e., glacial Lake Ojibway) formed in front of the ice sheet, growing and shrinking as the glacier advanced and retreated. A readvance of the ice sheet, the Cochrane readvance, deposited morainal material throughout the area. As the glaciers retreated for the last time, glacial Lake Ojibway followed the melting ice sheet north extending into Ecodistrict 2E-4 leaving behind lake bed sediment. The area was quickly inundated by the Tyrrell Sea from the north, reaching its southern limit here (Barnett 1992). All three events distributed weakly calcareous to calcareous mineral material to the surrounding area. The cool climate, level topography, and poor drainage has resulted in deep organic material accumulating over much of the landscape.

Figure 44. Modes of deposition in Ecodistrict 2E-4.

Exposed glaciomarine material deposited by the Tyrrell Sea can be found south of the Drowning River and in the southeast part of the ecodistrict. Morainal material is limited, occurring near Quantz Lake, along the Little Current River, and in the extreme southeastern corner. A small area of exposed glaciolacustrine sediment occurs in the southwest. Alluvial material with minor glaciofluvial deposits can be found along larger river systems including the Kenogami and Nagagami rivers. In the north, permafrost is restricted to localized pockets (Smith and Burgess 2004).

The poorly drained, level landscape is dominated by Fibrisols (Figure 45). Gleysols have developed in mineral material in wet areas with minimal organic accumulation, particularly in the south. Mesisols occur along the western and southern edges of the ecodistrict, and Gray Luvisols have developed in better drained mineral materials typically associated with morainal and glaciofluvial material. Regosols can be found along larger river systems.

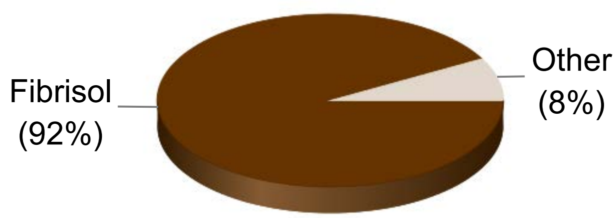


Figure 45. Substrate types in Ecodistrict 2E-4.

Land cover and vegetation

Associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Hudson Bay Lowlands (B.5) and Central Plateau (B.8) sections of the Boreal Forest Region (Rowe 1972), Ecodistrict 2E-4 is characterized by bog and fen complexes (Figure 46). Bog complexes are more frequent in the north, whereas fens are common in the south. Coniferous, sparse, and mixed forests (Figure 47) generally grow alongside the rivers and in the southwest. In particular, the Kenogami River is flanked by mixed forests, often fringed by coniferous forests or grading into bog and fen complexes. Tree species include black spruce, white spruce, American larch, balsam fir, jack pine, trembling aspen, balsam poplar, paper birch, and on river banks occasionally black ash and American elm. Deciduous forests are limited. A moist climate and poor drainage restrict forest fires.

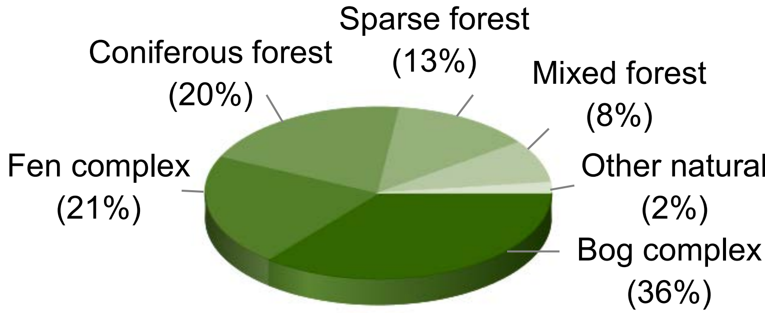


Figure 46. Land cover types in Ecodistrict 2E-4.

In the southwest, Jog Lake is an elevated feature on the landscape. Drainage from the lake occurs in a radial pattern, mainly through the organic substrate, following the gentle outward slope on each side of the lake. Unusual to the area is a deciduous swamp (OMNR 2001c). Species that reach their northern limits in Ecodistrict 2E-4 include American elm and American mountain-ash. Lichens, overlying a thin layer of organic material, often dominate on drier ridges (Riley 2011).

Figure 47. Mixed forests along the Drowning River. Sam Brinker, MNRF.

Land use

Major land uses include trapping, hunting, fishing, mineral exploration, and the provision of services associated with resource-based activities. The community of Ogoki and associated infrastructure cover less than 1% of the land base (Figure 48). Approximately 2.3% of the ecodistrict is protected.

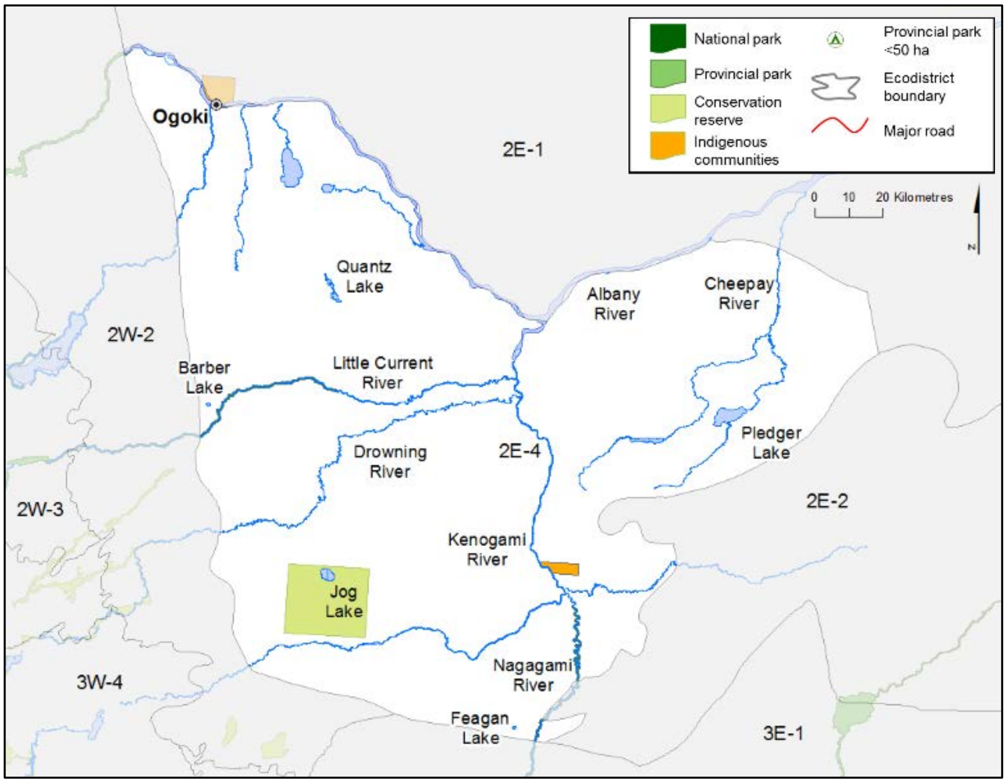


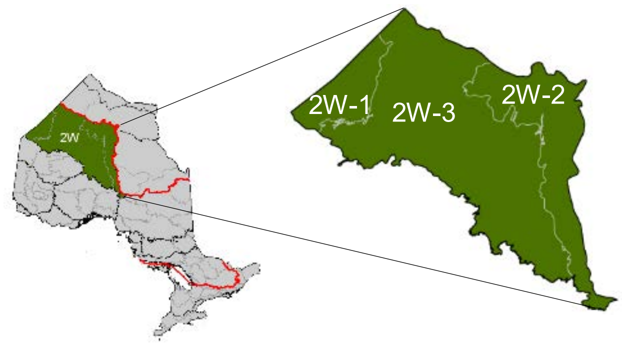
Figure 48. Select natural heritage areas, rivers, and lakes in Ecodistrict 2E-4.

Ecodistrict boundary delineation

Originally described as part of Site District 2E-1 by Hills (1959), Ecodistrict 2E-4 has been distinguished based on hydrological and vegetation patterns. The northern boundary with 2E-1 is aligned with the western part of the Albany River, separating an area with more extensive coniferous forests and water generally confined to streams, rivers, and smaller lakes to the south, from a landscape with larger areas of surface water and wetland vegetation types (e.g., bog and fen complexes) to the north. To the west and south, the transition from Paleozoic to Precambrian bedrock along with ecoregional climatic attributes (e.g., Ecoregion 2E is warmer and wetter than 2W, and cooler and drier than 3E) separates 2E-4 from 2W-2 and 3E-1. The eastern boundary reflects the change from Fibrisols in 2E-4 and Mesisols in adjacent 2E-2.

Ecoregion 2W

Big Trout Lake Ecoregion



Representing the transition from Precambrian to Paleozoic bedrock in the east and north, and Manitoba in the west, Ecoregion 2W extends south to Favourable Lake and the Albany River. It is the largest ecoregion in the Ontario Shield Ecozone with an area of 16,303,215 ha or 16.5% of the province. The area is divided into three ecodistricts (Table 3).

Table 3. Ecodistricts in Ecoregion 2W.

Ecodistrict	Ecodistrict name
2W-1	Sandy Lake
2W-2	Kasabonika Lake
2W-3	Wunnummin Lake

Located on the Precambrian Shield, the underlying bedrock is typically gneissic or granitic. Exposed bedrock, morainal deposits including several major moraines (e.g., Agutua-Windigo, Sachigo), and glaciolacustrine material from glacial Lake Agassiz cover a large area with a variable mixture of acidic to calcareous, fine-textured to coarse-textured deposits.

The subdued landscape is mixed with extensive peatlands in low-lying areas and low ridges of mineral material. Organic substrates including Mesisols, Organic Cryosols, and Fibrisols cover half of the ecoregion. Eutric and Dystric Brunisols have formed in mineral material on well drained sites. Permafrost is sporadically discontinuous to localized.

Sparse, coniferous, and mixed forests (Figure 49) blanket about half of the ecoregion. In addition, small pockets of deciduous forest grow in river valleys. Open water and bog complexes are the next most prevalent land cover classes. The percentage of area recently burned is higher than that in any other ecoregion in the province. While the susceptibility of burning is high, fires in this ecoregion are generally smaller than those that occur further south.

Situated in the Hudson Bay Watershed, several large rivers and lakes occur, including the Severn, Winisk, Albany, and Pipestone rivers and Sandy, Big Trout, and Wunnummin lakes.

The flora and fauna in Ecoregion 2W are typically boreal. On upland and lowland sites black spruce prevails. Associates of jack pine and paper birch occur with the black spruce on upland sites and mixed forests of white and black spruce, balsam fir, and poplar species occur on richer warmer-than-normal sites. Fen and bog complexes dominated by mosses, ericaceous shrubs, and graminoids have formed in low-lying areas.

Northern gray wolf, wolverine, woodland caribou, and American marten are a few of the mammals that inhabit the area. Bird species include bald eagle, gray jay, and white-throated sparrow. Amphibians and reptiles include mink frog, northern leopard frog, and eastern gartersnake. In the aquatic systems finescale dace, white sucker, and fathead minnow occur.

Figure 49. Boreal forests of the Big Trout Lake Ecoregion. Sam Brinker, MNRF.

Communities include Sandy Lake, Kitchenuhmaykoosib Inninuwug, and Kasabonika. Trapping, hunting, fishing, and services associated with resource-based tourism are important to the local economy. Mining occurs in the ecoregion along with widespread mineral exploration.

Five types of natural heritage areas occur in Ecoregion 2W, including the second largest provincial park, Wabakimi Provincial Park (Gray et al. 2009), which has an extensive network of canoe routes.

The northern and eastern boundaries are delineated by the transition from Precambrian bedrock in Ecoregion 2W to Paleozoic bedrock in 1E and 2E. Climatic and surficial geology variations differentiate Ecoregion 2W from 3S and 3W. The Big Trout Lake Ecoregion is cooler and typically drier. Large moraines define a significant portion of the boundary between Ecoregion 2W and areas to the south.

Ecodistrict 2W-1

Sandy Lake Ecodistrict

Stretching from the Manitoba-Ontario border in the west to the eastern boundary of Opasquia Provincial Park, the Sandy Lake Ecodistrict encompasses an area of 1,630,807 ha (10.0% of the ecoregion, 1.7% of the province). The north-south boundary extends from Stull Lake to Sandy Lake. The gently rolling landscape ranges in elevation from 182 m above sea level at the northern boundary to 408 m above sea level along the eastern portion of the Opasquia Moraine, north of Opasquia Lake.

Figure 50. Meandering river and black spruce forests of the Sandy Lake Ecodistrict. Sam Brinker, MNRF.

Key features

- Forests, typically sparse, coniferous, and mixed, dominate the ecodistrict (Figure 50).
- Relatively shallow glaciolacustrine and morainal materials occur over Precambrian bedrock.
- Includes the Opasquia and Sachigo moraines, two significant moraines found in northwestern Ontario.

Geology and substrates

The Sandy Lake Ecodistrict is characterized by a gently rolling landscape of bedrock ridges covered by a blanket of glaciolacustrine or morainal material of variable depth (Figure 51). In the northern part of the ecodistrict, the mineral material is generally deep and calcareous due to the deposition of Hudson Bay Lowlands materials by advancing glacial activity. The

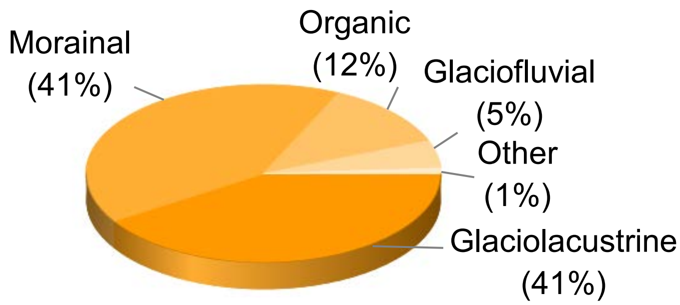


Figure 51. Modes of deposition in Ecodistrict 2W-1.

underlying Precambrian bedrock is typically acidic, but areas of base-rich bedrock occur south of Pierce Lake, near Ponask and Stull lakes, and in the southwest along the border with Manitoba. Numerous faults occur throughout the ecodistrict, often associated with rivers and long linear lakes such as Sandy and Ponask.

Approximately 8,000 years ago, most of Ecodistrict 2W-1 was inundated by glacial Lake Agassiz (Dyke 2004), a large ice-dammed lake that followed the retreat of the ice margin in northwestern Ontario, Manitoba, and Saskatchewan (Thorleifson 1996). At this time, glacial Lake Agassiz had combined with glacial Lake Ojibway forming a large lake that covered a significant portion of northern Ontario from Manitoba to the Québec border. Deep glaciolacustrine deposits, the remnants of glacial Lake Agassiz, occur north and east of Finger Lake and along the eastern boundary. Level, deep, morainal deposits occur in the northern part of the ecodistrict. Two significant moraines, the Opasquia Moraine, north of Opasquia Lake, and the Sachigo Moraine, occur along the eastern boundary. DeGeer moraines have been mapped near the Sachigo Moraine. The DeGeer moraines formed at the edge of the ice sheet as it contacted glacial Lake Agassiz (Harvey 1979). Modifications to the moraines have occurred through subsequent wave action in glacial Lake Agassiz, which reduced the original height of the moraines (Clark 1989), cut terraces, and left relict beaches (Harvey 1979). Glaciofluvial deposits are found along the northern boundary and at the eastern boundary generally mixed with glaciolacustrine materials. In addition, glaciofluvial esker-kettle deposits border the Opasquia and Sachigo moraines. Organic accumulations occur between glaciofluvial and glaciolacustrine deposits near the eastern boundary, as well as north of Sandy Lake and west of Angekum Lake. Exposed bedrock is limited. Sporadic discontinuous permafrost occurs in the north and localized pockets of permafrost can be found in the south (Smith and Burgess 2004).

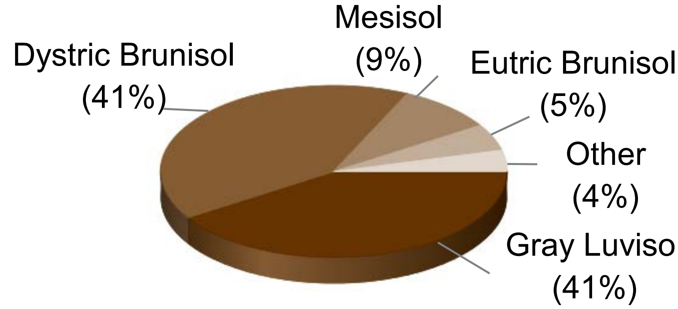


Figure 52. Substrate types in Ecodistrict 2W-1.

On better drained sites in the south, Gray Luvisols have developed (Figure 52). Dystric Brunisols occur in coarse-textured material in the central and western portion of the ecodistrict. A thin band has also formed along the eastern ecodistrict boundary. Mesisols have accumulated in low-lying areas and extend north of Sandy Lake along the eastern boundary to the north end of the ecodistrict.

Eutric Brunisols have developed in calcareous material in the north, and Organic Cryosols occur south of Ponask Lake and in the extreme southeastern corner of the ecodistrict just north of Sandy Lake on cool, poorly drained sites. Small pockets of exposed bedrock are scattered across the landscape.

Land cover and vegetation

Associated with the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous Section (B.22a) of the Boreal Forest Region (Rowe 1972), sparse forests grow over nearly one-third of the ecodistrict (Figure 53). Coniferous forests of black spruce and jack pine are common on upland sites. In poorly drained areas, American larch frequently occurs with black spruce. Mixed forests of black spruce, balsam fir, white spruce, trembling aspen, paper birch, and balsam poplar occur on warmer-than-normal sites, usually on the shores of lakes and large rivers (Rowe 1972). Jack pine and paper birch are scattered throughout the ecodistrict. These forests are heavily influenced by fire, which is a principal source of ecosystem renewal in the ecodistrict. High intensity surface fires or stand-replacing crown fires are generally frequent (Van Sleeuwen 2006) due to the drier climate (Hills 1976). Old burns supporting very sparse regenerating vegetation (i.e., regenerating depletion) and recent burns occur throughout the area. Fen complexes with American larch and black spruce are more common in the southeast, while bog complexes can be found in the north. Deciduous forests and bare bedrock are limited. Marshes may occur along the edges of rivers and lakes (Figure 54).

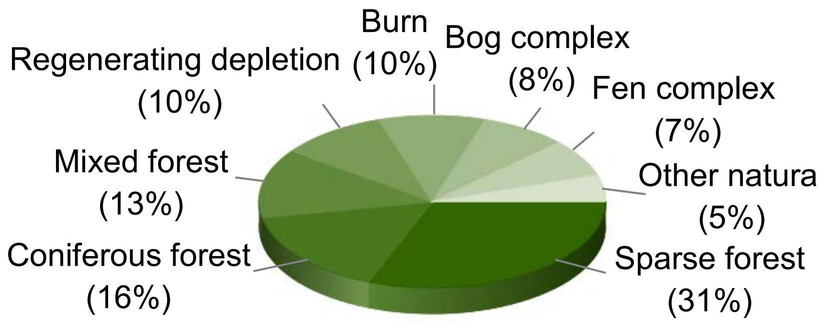


Figure 53. Land cover types in Ecodistrict 2W-1.

Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area. In the west, Alaska paper birch may occur. Plant species diversity may increase in areas of base-rich bedrock or calcareous mineral material where substrate nutrient availability is higher.

Land use

Less than 1% of the area has been devoted to settlement and associated infrastructure, including the community of Sandy Lake (Figure 55). Other land uses include mineral exploration, trapping, hunting, fishing, and the provision of services associated with resource-based tourism. Opasquia Provincial Park, which encompasses 28.4% of the ecodistrict, is the only protected area in the region.

Figure 54. Marsh and fen complex near Sandy Lake. Sam Brinker, MNRF.

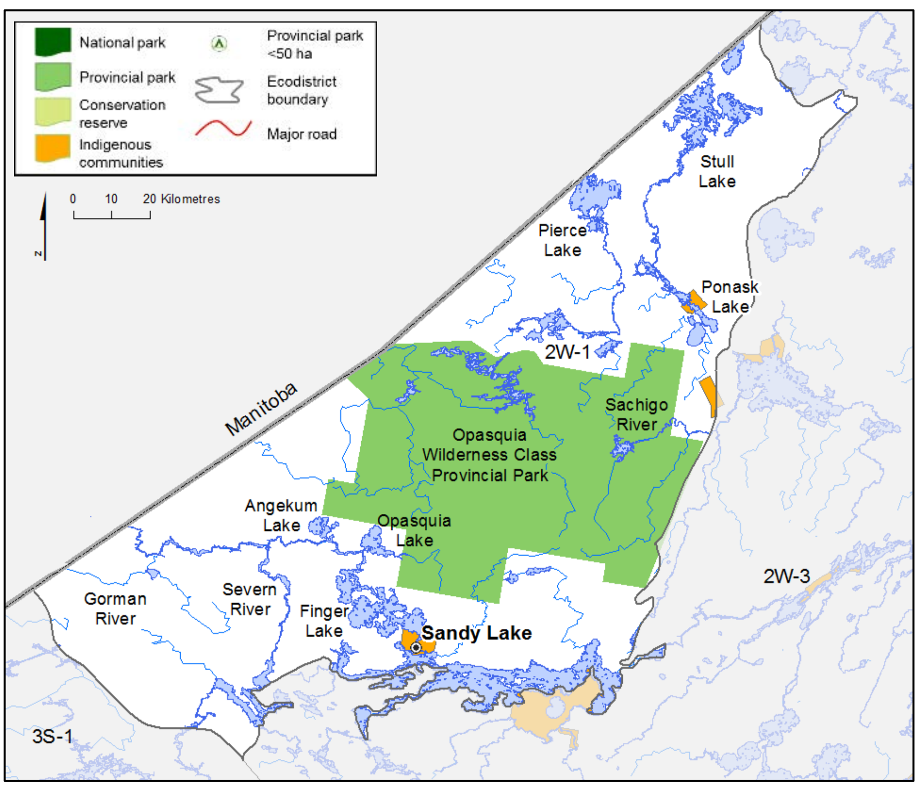


Figure 55. Select community, natural heritage area, lakes, and rivers in Ecodistrict 2W-1.

Ecodistrict boundary delineation

Site District 2W-1, as proposed by Hills (1959), in some areas extended approximately 100 km farther east. The provisional boundary as suggested by Burger (1983) based on work completed for the Ecoclimatic Region Map of Canada (Ecoregions Working Group 1989) is adopted here. The new northern and eastern boundary recognizes vegetation differences between Ecodistrict 2W-1 and 2W-3. Black spruce and jack pine occur in areas with average climate and soil moisture, with white spruce and balsam fir restricted to warmer-than-normal, moist areas in 2W-1 compared with black spruce, white spruce, and balsam fir on sites in 2W-3 with average climate and soil moisture. The eastern boundary now follows the Sachigo Moraine from Stull Lake in the north to Sandy Lake in the south. Associated with this moraine is a thin band of Dystric Brunisols. The southern boundary is defined by the transition from deep mineral material, typically Gray Luvisols and Dystric Brunisols in 2W-1 to very shallow mineral deposits in 3S-1 and an increase in temperature and precipitation in Ecoregion 3S compared with 2W. The western boundary abuts the province of Manitoba.

Sachigo and Opasquia moraines

In Ecodistrict 2W-1, two prominent moraines rise above the landscape. The Sachigo Moraine (Figure 56) is a north–south trending moraine approximately 240 km long, extending from Sandy Lake to Manitoba (Clarke 1989). North of Opasquia Lake, the Opasquia Moraine begins just west of the Sachigo Moraine and continues into Manitoba. Notable features on the moraines include crevassing along the top of the ridge caused by a series of kettles and heavy modification by glacial Lake Agassiz including a recurved spit on the Sachigo Moraine (Harvey 1979).

Figure 56. The Sachigo Moraine in Ecodistrict 2W-1. Sam Brinker, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 2W-2

Kasabonika Lake Ecodistrict

The Kasabonika Lake Ecodistrict covers a long linear area from the confluence of the Winisk and Asheweig rivers in the north to the Pagwachuan River, just north of Highway 11 in the south. The western boundary extends from the community of Wapekeka to Fishtrap Lake. It encompasses 4,003,604 ha (24.6% of the ecoregion, 4.1% of the province). The gently rolling landscape varies in elevation from 97 m above sea level in the north where the Asheweig and Winisk rivers enter the area to 316 m above sea level along the western boundary, north of the Drowning River.

Figure 57. Coniferous forests and fen complexes in the Kasabonika Lake Ecodistrict. Gerry Racey, MNRF.

Key features

- Bog and fen complexes dominate the north while coniferous forests grow in the south (Figure 57).
- The primary substrates are organic deposits overlying calcareous mineral material.
- Sporadic discontinuous permafrost occurs along the northeast boundary in cold wetlands.

Geology and substrates

Poor drainage and cool temperatures have contributed to the formation of deep organic deposits over much of the underlying mineral material and Precambrian bedrock in this ecodistrict (Figure 58). Along the western edge and to the south (Barnett and Yeung 2014a, b; Barnett et al. 2013b, d, f), the landscape is better drained and morainal material is present at the surface. The morainal deposits are typically calcareous, particularly in the north, and fine-textured, a result of the Cochrane readvance that brought Hudson Bay Lowlands materials to the area approximately 8,000 years ago (Dyke 2004). A set of low drumlins, part of the Winisk Drumlin Field, occurs west of the Winisk River near the border with Ecodistrict 2W-3 (Barnett 2008). Limited amounts of glaciolacustrine material occur in the extreme south. A result of sediment deposited in a large glacial lake, a merger of glacial Lake Agassiz in the west and glacial Lake Ojibway in the east, which expanded and contracted as the ice sheet advanced and retreated across the province. Glaciomarine deposits from the Tyrrell Sea that inundated the area from the north are restricted to small pockets in the north. Bedrock exposed at the surface or with a very shallow layer of mineral material can be found in the northwest. Acidic bedrock is common, however bands of base-rich bedrock occur throughout the ecodistrict including near the communities of Wapekeka and Kasabonika and along the Albany River. In the north, a network of faults adds relief to the landscape. Glaciofluvial esker-kettle deposits have formed near the Attawapiskat (Barnett et al. 2013e) and Albany (Barnett et al. 2013b) rivers and near Shibogama and Kasabonika lakes. Areas of sporadic discontinuous permafrost occur in the north, whereas permafrost is more localized in the south (Smith and Burgess 2004).

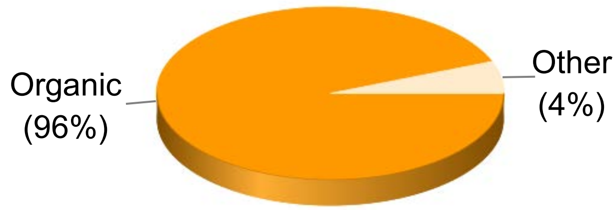


Figure 58. Modes of deposition in Ecodistrict 2W-2.

Fibrisols and Mesisols dominate the landscape (Figure 59). Fibrisols have formed in low-lying areas throughout the north and east, and Mesisols have formed in the south and west. Organic Cryosols have developed along the northeastern boundary in cold wetlands. Eutric Brunisols, typically in calcareous material, occur near Kasabonika and Shibogama lakes in the northwest and Gleysols blanket the extreme southern edge of the ecodistrict on poorly drained glaciolacustrine deposits.

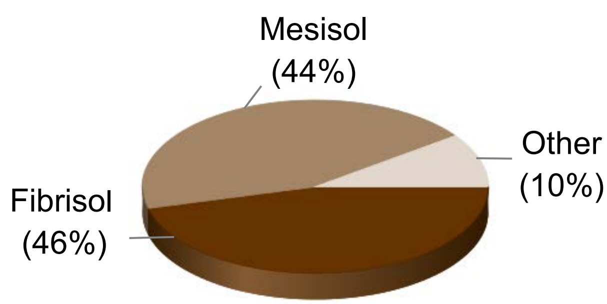


Figure 59. Substrate types in Ecodistrict 2W-2.

Land cover and vegetation

Ecodistrict 2W-2 is found in the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) classified the Kasabonika Lake Ecodistrict into three different sections of the Boreal Forest Region: the Northern Coniferous Section (B.22a) in the north, the Hudson Bay Lowlands Section (B.5) in the central portion, and the Central Plateau Section (B.8) in the southeast. The northeast portion is dominated by wetlands, primarily bog and fen complexes (Figure 60). The bogs are dominated by black spruce, whereas the fens typically include American larch.

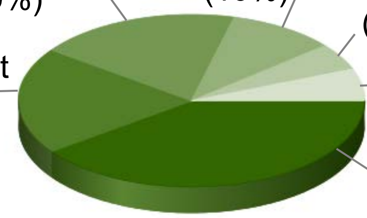


Figure 60. Land cover types in Ecodistrict 2W-2.

Sparse forests with visible ground cover occur in the northwest and black spruce dominated coniferous forests (Figure 61) are common in the south and west. On very shallow upland sites or areas affected by frequent fires, jack pine is a typical associate of black spruce (Rowe 1972). High intensity surface fires or stand-replacing crown fires are less common than in other parts of the ecoregion (Van Sleeuwen 2006). As a result, a mosaic of recent and old burns (i.e., regenerating depletion) with sparse vegetation are scattered throughout the ecodistrict. Mixed forests of black spruce, white spruce, balsam fir, paper birch, trembling aspen, and balsam poplar occur on sheltered or warmer-than-normal sites, usually on the shores of lakes and large rivers. Deciduous forests and bare bedrock are limited.

Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout. Eastern white cedar, American elm, and black ash reach their northern limits in Ecodistrict 2W-2. Areas of base-rich bedrock and calcareous mineral material where substrate nutrient availability is high may support increased plant species diversity.

Figure 61. Black spruce forest south of the Winisk River. Gerry Racey, MNRF.

Land use

The communities of Kasabonika and Wapekeka (Figure 62) occur in Ecodistrict 2W-2. The area occupied by these communities and associated infrastructure represents less than 1% of the total land base. Land uses include mineral exploration, trapping, hunting, fishing, timber harvesting, and the provision of services associated with resource-based tourism. Protected areas cover 3% of the ecodistrict.

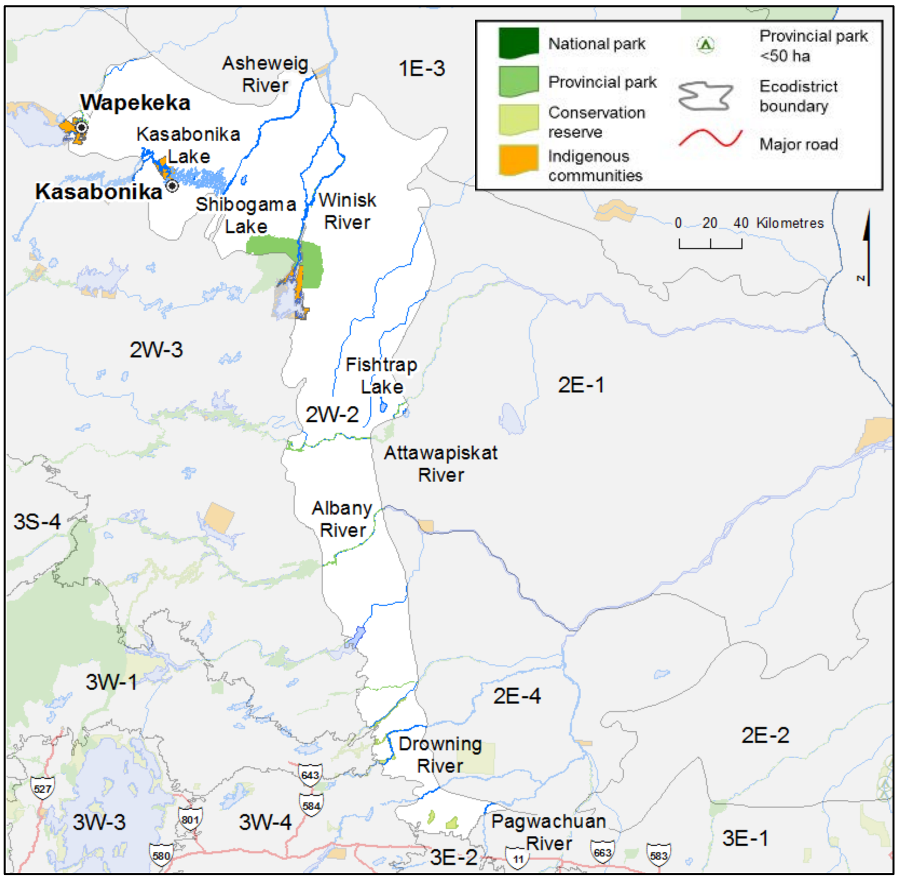


Figure 62. Select communities, natural heritage areas, rivers, and lakes in Ecodistrict 2W-2.

Ecodistrict boundary delineation

Hills' (1959) map of site districts showed Site District 2W-2 covering the northern part of Ecoregion 2W, stretching from the Manitoba border to the Paleozoic bedrock of Ecoregion 2E. As the amount of data available for the north has increased, the boundaries have been updated. The western boundary of Site District 2W-2 was shifted approximately 190 km east and 160 km south, to encompass deeper substrates of which more are organic, and to reflect that the elevation is lower than that of 2W-3.

The northern and eastern boundaries are primarily defined by the transition from Precambrian to Paleozoic bedrock but other ecoregional attributes (e.g., temperature and precipitation) have also been accounted for. Ecoregion 2W is warmer and moister than 1E to the north, and cooler and drier than 2E to the east. The western boundary with Ecodistrict 2W-3 is defined by the change from deeper, typically organic material in 2W-2 to shallow, mineral material in 2W-3. The deep, glaciolacustrine deposits in 2W-2 contrast with the morainal deposits in 3E-1 and 3W-4, and the very shallow, mineral material with bedrock knobs of 3E-2 and 3W-1. At ecoregional scale, Ecoregion 2W is cooler and drier than 3W and 3E.

Figure 63. Limestone cliffs along the Winisk River. Ontario Parks.

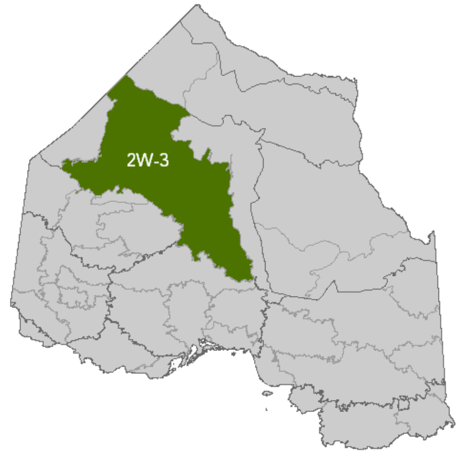
Figure 64. Winisk River rapids. Ontario Parks.

Winisk River Provincial Park

The Winisk River Provincial Park was established along 371 km of river and includes a large area of land that spans ecodistricts 2W-2 and 2W-3 near the community of Webequie. Limestone cliffs (Figure 63), rapids (Figure 64), drumlin fields, eskers, and extensive wetland complexes are also located in the park area (Geomatics International Inc. 1994).

Ecodistrict 2W-3

Wunnummin Lake Ecodistrict



The Wunnummin Lake Ecodistrict encompasses 10,668,805 ha (65.4% of the ecoregion, 10.8% of the province). The ecodistrict extends from the Ontario-Manitoba border in the north to the Little Current River in the south, and east from Sandy and Sachigo lakes to the Winisk River. The gently rolling landscape ranges in elevation from 109 m above sea level in the northwest to 463 m above sea level south of Windigo Lake.

Figure 65. Upland black spruce forest overlooking a meadow marsh. Sam Brinker, MNRF.

Key features

- Sparse and coniferous forests occur over half of the ecodistrict (Figure 65).
- Morainal material of variable depths dominates the area.
- Includes areas of sporadic discontinuous permafrost in the north.
- Three moraines — the Agutua-Windigo, Big Beaverhouse, and Miminiska — occur across the landscape.

Geology and substrates

Very shallow to deep morainal material overlying gently rolling Precambrian bedrock ridges dominate the ecodistrict (Figure 66). The blanket of morainal material is deepest in the east and north and generally more calcareous in the north due to the deposition of Hudson Bay

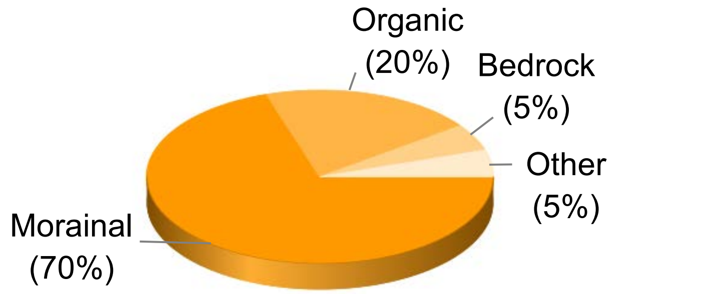


Figure 66. Modes of deposition in Ecodistrict 2W-3.

Lowlands materials by the advancing glacier. Ecodistrict 2W-3 contains the youngest moraine in northwestern Ontario. Created approximately 8,000 years ago, the Big Beaver House Moraine is a subdued, partially buried feature that runs from the northwest, east of Sachigo Lake, to the southeast (Dyke 2004). A prominent feature across the landscape, the Agutua-Windigo Moraine, occurs along the western boundary with Ecodistrict 3S-3 and 3S-4 arching towards Lake Nipigon. A third moraine, the Miminiska is found north of the Pineimuta River stretching to Attawapiskat Lake (Sado and Carswell 1987). West of the community of Webequie, the Winisk Drumlin Field is a collection of low, broad hills that dominate the landscape (Barnett 2008).

Organic deposits intermixed with glaciolacustrine materials occur throughout the ecodistrict. In the northwest, at approximately the same time as the deposition of the Beaver House Moraine, glacial Lake Agassiz followed the retreating ice sheet depositing glaciolacustrine sediment. In the east, glacial Lake Ojibway also followed the glacier north, eventually joining with glacial Lake Agassiz to form a sizable lake across a large portion of northern Ontario. Significant organic and glaciolacustrine deposits occur south and west of Wunnummin Lake and in the west. Coarse-textured glaciolacustrine beach deposits and bedrock with little to no mineral material are scattered throughout. The Precambrian bedrock is typically acidic but linear bands of base-rich bedrock occur near Big Trout Lake, the Windigo River, and Eabamet Lake. A series of faults occur across the landscape. The longest fault, the Stull Lake-Wunnummin Lake fault zone (Thurston 1991), spans approximately 400 km from the western boundary with 2W-1 north of Little Sachigo Lake through Wunnummin Lake to north of Attawapiskat Lake and the eastern boundary with 2E-1. Glaciofluvial materials are associated with larger moraines (i.e., Beaver House and Agutua-Windigo) or may exist as eskers, including a large deposit south of Eabamet Lake (Barnett and Yeung 2015). Aeolian features are limited; however, an extensive system occurs east of the Agutua-Windigo Moraine, north of the Pineimuta River (Ontario Parks 2002). Permafrost in Ecodistrict 2W-3 is sporadic in the north and more localized in the south (Smith and Burgess 2004).

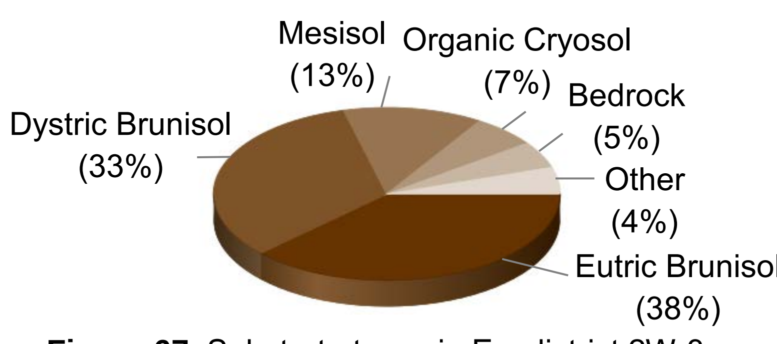


Figure 67. Substrate types in Ecodistrict 2W-3.

Eutric Brunisols have developed in calcareous material under forest or shrub conditions in the northeast (Figure 67). Dystric Brunisols occur primarily in the midwest, characterized by better drained areas typically in acidic substrates.

In low-lying areas north of the Windigo River and around the string of lakes from Windigo River south to North Caribou Lake, Mesisols have developed. Organic Cryosols occur sporadically in colder wetlands between Eabamet and Attawapiskat lakes, as well as along the northwestern boundary of the ecodistrict. Bedrock exposed to the surface or with a thin layer of mineral material is more common in the south. Gray Luvisols occur in small pockets of glaciolacustrine material at Big Trout Lake, Sachigo Lake, and north near Little Sachigo Lake. Limited amounts of Gleysols have developed in poorly drained areas south of Big Trout Lake and Humo-Ferric Podzols occur around North Caribou Lake.

Land cover and vegetation

The Wunnummin Lake Ecodistrict is associated with the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous (B.22a) and the Central Plateau (B.8) sections of the Boreal Forest Region (Rowe 1972). Sparse forests predominate in the northern half and coniferous forests grow in the south (Figure 68). Black spruce is the dominant species, occurring on shallow upland sites associated with jack pine, as well as on poorly drained lowlands with American larch (Rowe 1972). Mixed forests of black spruce, white spruce, balsam fir, trembling aspen, paper birch, and balsam poplar occur on richer, more sheltered or warmer-than-normal sites associated with lakes and rivers (Figure 69).

Fires are generally small but stand-replacing crown and high intensity ground fires do occur (Van Sleeuwen 2006). Small, frequent fires favour the development of jack pine forests, often associated with trembling aspen and paper birch. Approximately one-fifth of the ecodistrict represents either recent or old burns (i.e., regenerating depletion) with sparse vegetation cover. Bog and fen complexes have formed in poorly drained areas where organic material has accumulated. Adjacent to lakes and rivers, marsh ecosystems may occur. Warmer-than-normal sites support pockets of deciduous forests, including black ash (Shuter et al., no date), and bedrock is limited.

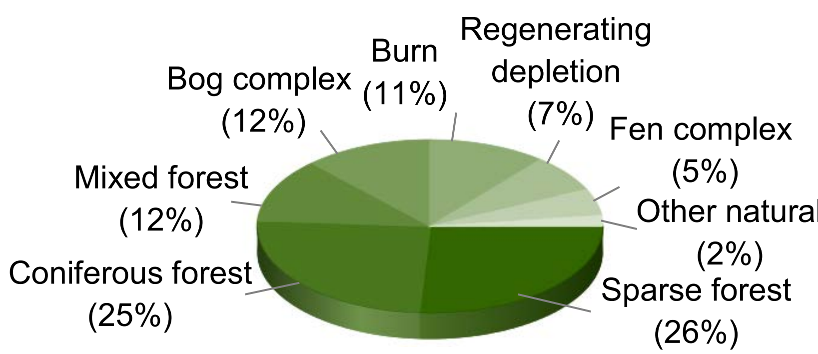


Figure 68. Land cover types in Ecodistrict 2W-3.

The northern range of eastern white cedar and black ash occurs in the southern part of the ecodistrict. American elm is limited to warmer-than-normal river banks and lake shores. Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area. Higher substrate nutrient availability that may support increased plant species diversity occurs in areas of base-rich bedrock and calcareous mineral material.

Figure 69. Mixed forests of trembling aspen and black spruce in Ecodistrict 2W-3. Sam Brinker, MNRF.

Land use

Mineral exploration, mining, trapping, hunting, fishing, timber harvesting, aggregate extraction, and the provision of services associated with resource-based tourism are the major land uses that occur in Ecodistrict 2W-3. Settlement and infrastructure primarily associated with Fort Hope, Webequie, and Kitchenuhmaykoosib Inninuwug account for less than 1% of the area (Figure 70). Approximately 4% of the ecodistrict is designated as protected areas.

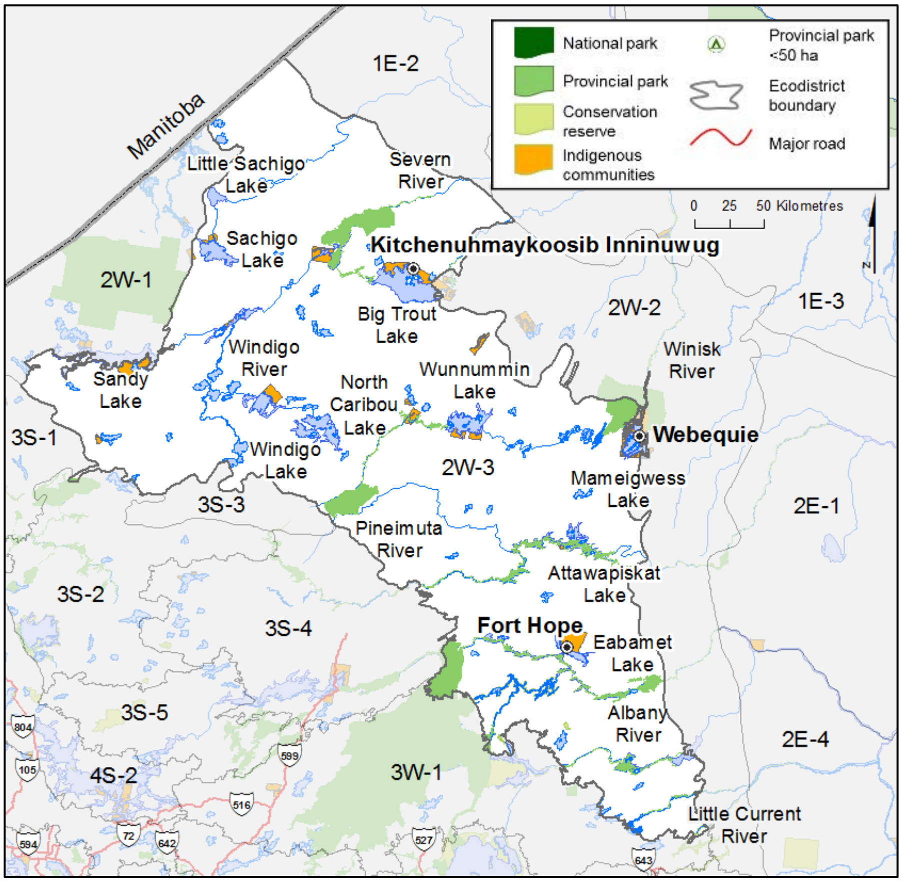


Figure 70. Select communities, natural heritage areas, rivers, and lakes in Ecodistrict 2W-3.

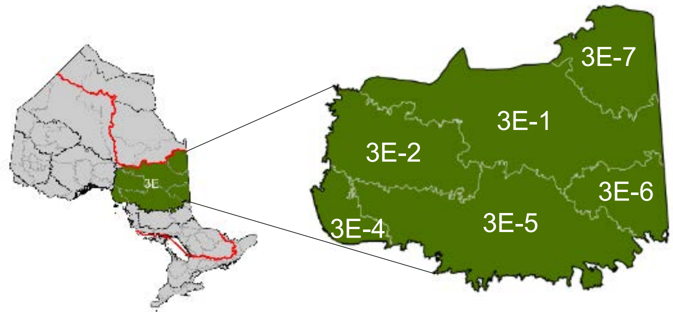
Ecodistrict boundary delineation

As more data have become available for the northern half of Ontario, Hills (1959) site district boundaries have been refined. Changes in the western boundary of Site District 2W-3 as initially proposed by Burger (1983) have been adopted. Based on work completed for the Ecoclimatic Region Map of Canada (Ecoregions Working Group 1989), Ecodistrict 2W-3 now includes Sachigo and Little Sachigo lakes as well as the south shore of Sandy Lake. The new boundary recognizes vegetation differences between 2W-1 and 2W-3 (e.g., black spruce, white spruce, and balsam fir occur on normal sites in 2W-3 where black spruce and jack pine occur on normal sites in 2W-1, with white spruce and balsam fir restricted to warmer-than-normal sites). The boundary in the northwest was extended to the border with Manitoba and 1E-2. Originally part of Site District 2W-2, the new line better encapsulates the shallow mineral material and higher elevation in the area. The southeastern corner of Site District 2W-3 was reallocated to Ecodistrict 2W-2 due to the deeper substrates that are more consistent with that ecodistrict.

The northern boundary is delineated based on ecoregional differences including bedrock and climate variables. Ecoregion 2W is underlain by Precambrian bedrock compared with Paleozoic bedrock in 1E, and is warmer and receives more precipitation. The northeastern and eastern boundary with 2W-2 reflects the change from shallow mineral material in 2W-3 to deeper, typically organic material in 2W-2. The southern boundary with 3W-1 is defined by the transition from fine-textured morainal material in 2W-3 to the coarse-textured Nakina Moraine deposits in 3W-1. The Agutua-Windigo Moraine marks the boundary between 2W-3 and adjacent 3S-3 and 3S-4. Deep mineral material in the southwestern part of 2W-3 give way to very shallow mineral deposits in 3S-1, shallow to moderately deep mineral material in 3S-2, and Mesisols in 3S-3. Ecoregional climatic attributes also distinguish 2W from 3W and 3S. Ecoregion 2W is cooler and generally receives less precipitation. The western boundary with 2W-1 reflects the vegetation changes as noted above, and in the northwest the Manitoba border serves as the limit of 2W-3.

Ecoregion 3E

Abitibi Ecoregion



Located in the Ontario Shield Ecozone, the Lake Abitibi Ecoregion stretches from the Québec border in the east to the community of Marathon in the west. It encompasses 13,681,249 ha (13.9% of the province). The ecoregion contains six ecodistricts (Table 4).

Table 4. Ecodistricts in Ecoregion 3E.

Ecodistrict	Ecodistrict Name
3E-1	Clay Belt
3E-2	Hornepayne
3E-4	Tip Top Mountain
3E-5	Foleyet
3E-6	Kirkland Lake
3E-7	Kesagami

Long, cold, snowy winters and warm, short summers characterize Ecoregion 3E. Located on the Precambrian Shield, the underlying bedrock is typically gneissic or granitic with small pockets of base-rich metavolcanic and metasedimentary rock.

The terrain is highly variable, with a more rugged expression of surficial and bedrock features in the west. Surficial geology is diverse, ranging from deep glaciolacustrine deposits from glacial lakes Barlow and Ojibway and calcareous fine-textured morainal material in the northeast, represented by the Clay Belt, to acidic coarse-textured morainal material of variable depths across most other areas. Organic, glaciofluvial, and aeolian deposits are found throughout the ecoregion.

Drainage is highly variable, resulting in a variety of substrate conditions. In well drained, calcareous fine-textured material, Brunisols and Gray Luvisols have developed. Humo-Ferric Podzols are common in well drained deep sands and, where drainage is poor, Mesisols and Gleysols have developed. Exposed rocky areas account for one-fifth of the ecoregion.

Several rivers meander through the ecoregion, with most, including the Kesagami, Abitibi, Missinaibi, and Michipicoten, flowing north through the Hudson Bay Watershed.

Over half of the area is covered by mixed and coniferous forests (Figure 71). Sparse forest, deciduous forest, and bog and fen complexes are the next most prevalent land cover types. Boreal tree species include black spruce, white spruce, balsam fir, jack pine, American larch, paper birch, trembling aspen, and balsam poplar. On warmer-than-normal sites temperate species may occur, including eastern white pine and red pine.

Boreal species including moose, northern gray wolf, Canada lynx, great blue heron, gray jay, and western palm warbler inhabit the area. Fish species include yellow perch, brook trout, and walleye. Spotted salamander, wood frog, and Midland painted turtle are a few of the amphibians and reptiles found in the area.

Figure 71. Mixed forest of black spruce, trembling aspen, and paper birch along the Englehart River. Melanie Alkins, Ontario Parks.

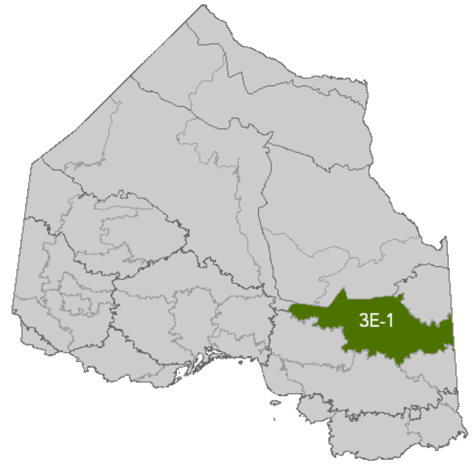
The communities of Timmins, Cochrane, Kirkland Lake, and Manitouwadge are located in the ecoregion. Timmins has the largest population and is the regional economic and industrial centre. Timber harvesting, mining, mineral exploration, and tourism occur throughout the ecoregion.

Ontario’s largest national park, Pukaskwa National Park, is located here and represents one of the 16 different types of natural heritage areas that occur in the Abitibi Ecoregion (Gray et al. 2009).

The ecoregion boundary is defined in the north by the Precambrian/Paleozoic bedrock margin. Lower annual mean temperature and less precipitation in Ecoregion 3E define the southern boundary. The western boundary with Ecoregion 3W is distinguished by precipitation (i.e., 3E is wetter) and temperature (i.e., 3E is warmer). In the east, Ecoregion 3E is defined by the Québec border.

Ecodistrict 3E-1

Clay Belt Ecodistrict



Ecodistrict 3E-1 stretches from the community of Pagwa River south to the northern part of Lake Abitibi and east to the Ontario-Québec border. The ecodistrict encompasses 4,128,732 ha (30.2% of the ecoregion, 4.2% of the province). With a gently rolling topography, the elevation climbs from 69 m above sea level along the northern boundary near the Mattagami River and reaches 438 m above sea level atop a bedrock ridge north of Lake Abitibi.

Figure 72. Black spruce dominated forests along the Little Abitibi River. Ed Morris, Ontario Parks.

Key features

- Coniferous forests with black spruce are widespread (Figure 72).
- Deep, fine-textured morainal and glaciolacustrine deposits predominate.
- Area is dominated by calcareous mineral materials.
- Ecodistrict includes the Kapuskasing structural zone and a large dike swarm.

Geology and substrates

Glaciation has contributed significantly to the landscape throughout the Clay Belt Ecodistrict. Approximately 8,000 years ago (Dyke 2004), the Cochrane readvance pushed calcareous fine-textured mineral material from the Hudson Bay Lowlands and fine-textured mineral material from glacial Lake Ojibway south, resulting in a landscape dominated by a variable layer of morainal deposits (Figure 73). The substrates in Ecodistrict 3E-1 are predominately calcareous. The carbonate content increases from the southeast to the north and west. Two moraines, the Arnott Moraine west of Hearst and the Pinard Moraine in the northeast (Boissonneau 1966) along with drumlins, such as the Ballantyne Lake Drumlins along the northern part of the Mattagami River, add relief to a gently rolling landscape. The topography is also broken by several faults including the Kapuskasing structural zone, a 500 km long (Zhang 1999) southwest-northeast trending fault between the communities of Kapuskasing and Cochrane.

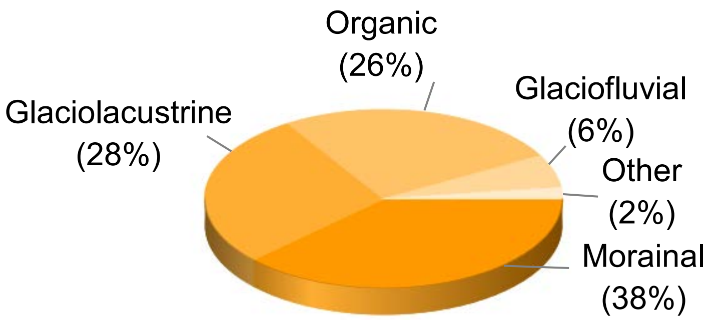


Figure 73. Modes of deposition in Ecodistrict 3E-1.

Fine-textured glaciolacustrine deposits, a remnant lake bed from glacial Lake Ojibway (Vincent and Hardy 1979), can be found throughout the ecodistrict. Starting nearly 9,000 years ago (Dyke 2004) glacial Lake Ojibway formed in front of the ice sheet, shrinking and growing as the glacier advanced and retreated, eventually following the receding ice sheet north. The presence of fine-textured morainal and glaciolacustrine deposits over half of the area influenced the ecodistrict's name.

Much of the ecodistrict is very poorly drained, resulting in extensive areas with organic accumulations. Glaciofluvial deposits are dominated by eskers that are often accompanied by kame and kettle features. These large north-south trending esker complexes occur east and west of Little Abitibi Lake and adjacent to the Abitibi River. Wave-washed terraces, a remnant of glacial Lake Ojibway, may be found on some of the larger eskers (Boissonneau 1966). Alluvial sediment is associated with large river systems including the Mattagami, Abitibi, and Missinaibi rivers. Pockets of glaciomarine material occur along the northern boundary and aeolian sediment can be found south of Little Abitibi Lake. Exposed bedrock outcrops are limited. The Precambrian bedrock is typically acidic but areas of base-rich bedrock occur in the southeast.

In the calcareous fine-textured mineral material, Gray Luvisols dominate (Figure 74). Gleysols, typically with a shallow organic cover, are more prevalent in low-lying areas along with Mesisols.

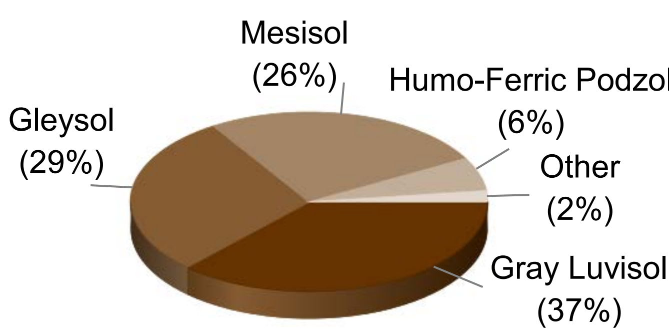


Figure 74. Substrate types in Ecodistrict 3E-1.

Significant organic accumulations occur southeast of the community of Kapuskasing and throughout the north-central portion of the ecodistrict. To the south, small amounts of Humo-Ferric Podzols have developed in acidic morainal material. Dystric Brunisols, Fibrisols, and exposed bedrock occur in limited amounts throughout the ecodistrict.

Land cover and vegetation

Located within the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and primarily within the Northern Clay Section (B.4) of the Boreal Forest Region (Rowe 1972), over one-third of the ecodistrict comprises coniferous forests (Figure 75). Black spruce is found throughout the landscape. On lowland sites, eastern white cedar, and American larch are common associates with black spruce. White spruce, jack pine, and balsam fir are more typical on upland areas. Jack pine forests occur on drier sites such as better drained glaciofluvial material. Red pine and eastern white pine can be found as scattered individuals or small forests (OMNR 2007b). Occurring at their northern limits, these pines typically grow on warmer-than-normal slopes in the southern portions of the ecodistrict. Approximately one-quarter of the ecodistrict is represented by mixed forests of balsam poplar, trembling aspen, paper birch, black and white spruce, and balsam fir. Ecodistrict 3E-1 includes forests comprising old growth black spruce, white spruce, poplar, and red pine (OMNR 2009b). Notable old growth forests are found in Little Abitibi Provincial Park (Riley 1978; Morris 2017, Ontario Parks, pers. comm.). These forests along with deciduous forests are generally found near rivers and lakes and on well drained deep mineral material deposits (Rowe 1972). Black ash and American elm can be found on nutrient rich moist sites. Sparse forests are scattered throughout the ecodistrict. Bog and fen complexes (i.e., treed and open bogs and fens) occasionally occur in low-lying areas often associated with black spruce (Figure 76). Fires are generally infrequent in this ecodistrict compared with ecodistricts to the south and west, due to higher understory and substrate moisture levels. Several areas, particularly near Highway 11, have been converted to agricultural fields. Marshes may be found in quiet bays adjacent to lakes and rivers. Exposed bedrock is limited.

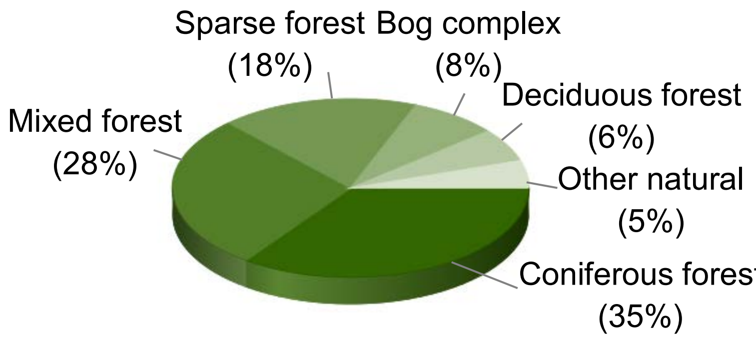


Figure 75. Land cover types in Ecodistrict 3E-1.

Figure 76. Fen and bog complexes with black spruce forests north of the community of Cochrane. Aspen Zeppa, MNRF.

The Clay Belt Ecodistrict represents a transition from the Hudson Bay Lowlands Ecozone to the Ontario Shield Ecozone. In the north, the subdued topography and prevalence of wetlands is reminiscent of areas in Ecodistrict 2E-2 and the cooler climate restricts the occurrence of plant species. Shrub species including beaked hazel and mountain maple are limited relative to areas farther south (Soper and Heimburger 1982). Cooler-than-normal habitats support Arctic-alpine species including alpine hedysarum, bird's-eye primrose, and narrow false oats (Oldham and Bakowsky 2006). The eastern limit of New York fern is found here (Shea 1977). Increased plant species diversity may occur in areas of calcareous mineral material or very shallow substrates over base-rich bedrock. Noble (1982a) noted that the calciphile, limestone oak fern, is present in the ecodistrict.

Land use

Timber harvesting, mining, mineral exploration, aggregate extraction, hydroelectric generation, agriculture, and services associated with resource-based tourism are the primary land uses in Ecodistrict 3E-1. Protected areas encompass approximately 3.8% of the ecodistrict. The communities of Kapuskasing, Cochrane, and Hearst and their associated infrastructure represent less than 1% of the area (Figure 77).

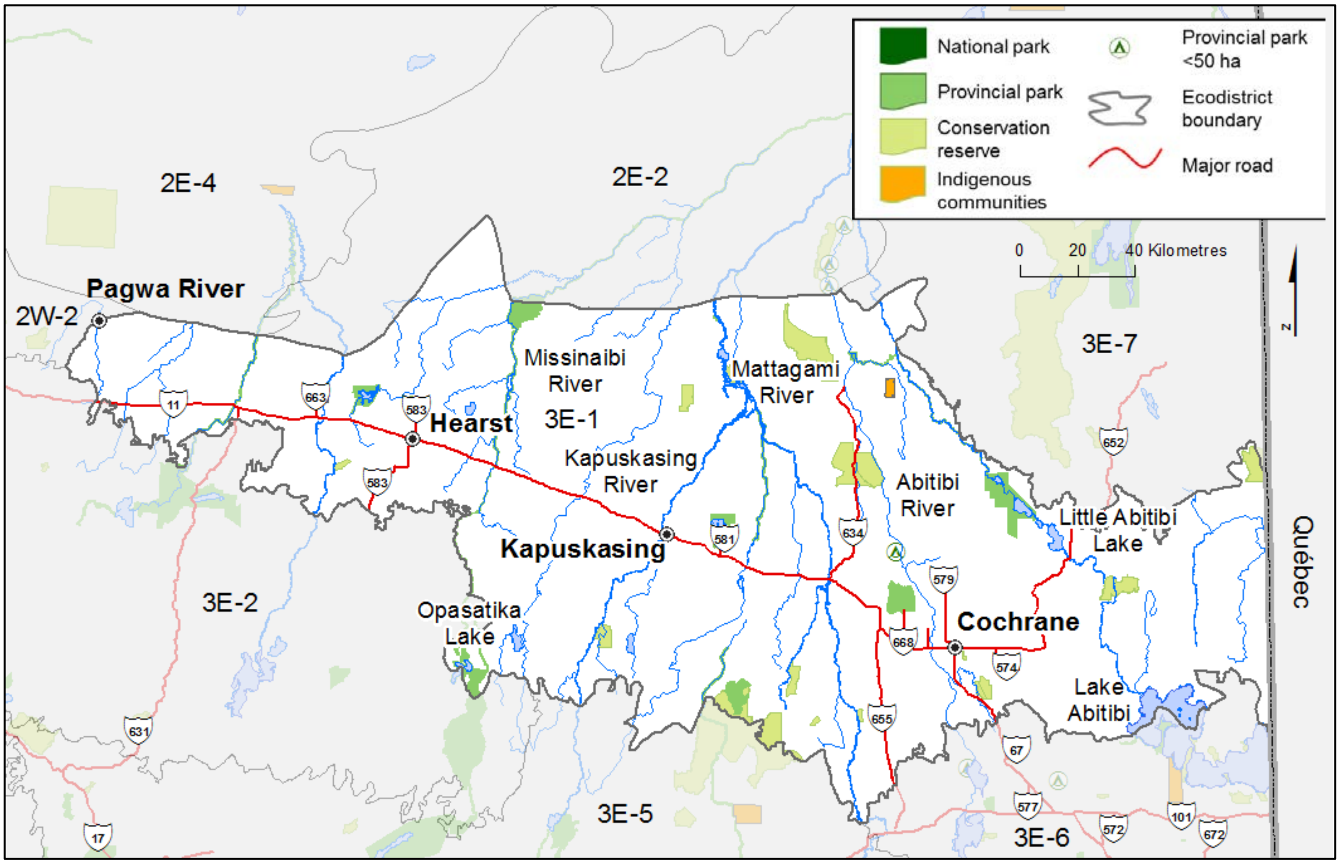


Figure 77. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3E-1.

Ecodistrict boundary delineation

The Clay Belt Ecodistrict is a merger of Hills' (1959) Site Districts 3E-1 and 3E-3 (Crins and Uhlig 2000). A further examination of surficial geology and other relevant layers at this scale (e.g., Ontario Land Inventory) showed no clear differences between the former site districts. The southwestern boundary of Ecodistrict 3E-1 is defined by the transition from typically deep morainal and glaciolacustrine deposits to bedrock exposed at the surface or with a very shallow layer of morainal material and deeper pockets of glaciolacustrine deposits in 3E-2. The boundary with 3E-5 reflects the change from a gently rolling topography covered by a deep layer of morainal, glaciolacustrine, and organic substrates in 3E-1 to a hilly landscape with an increase in elevation overlain with a variable depth of morainal material and a significant proportion of glaciofluvial sediment in 3E-5. The predominance of glaciolacustrine material in 3E-6 separates the landscape from the deep morainal and glaciolacustrine sediment in 3E-1. The eastern boundary is delineated by the province of Québec. In the northeast, 3E-1 is drier and less subdued than adjacent 3E-7. The transition from

Precambrian bedrock in Ecoregion 3E to Paleozoic bedrock in Ecoregion 2E and a warmer, wetter climate in 3E delineates the northwestern boundary. The morainal deposits in 3E-1 contrast with the deep, glaciolacustrine deposits in 2W-2 and Ecoregion 3E is warmer and wetter than 2W.

Dikes

As the continent was shaped and molded, vertical cracks occurred in the earth's crust. As the cracks were intruded by mainly igneous (i.e., diabase and basalt) bedrock, dikes were formed (Figure 78). These intrusions often occur as parallel linear bodies, forming a dike swarm, which are grouped based on age and dominant rock types. In Ecodistrict 3E-1, the most prevalent swarm is the Matachewan-Hearst Dike Swarm. Created over 2.45 billion years ago the north to northwest trending swarm extends for 700 km covering an area of 250,000 km^2 (Nelson et al. 1990). Increased plant species richness may occur in areas of base-rich dikes where substrate nutrient availability is higher.

Figure 78. Horizontal dike. David Webster, MNRF.

Ecodistrict 3E-2

Hornepayne Ecodistrict

The Hornepayne Ecodistrict is the most northwestern ecodistrict in Ecoregion 3E, stretching from Mons Lake in the east to the community of Manitouwadge in the west. The northern boundary lies just above Nagagamisis Lake and in the south includes the northern portion of White Lake. The ecodistrict encompasses 2,143,883 ha (15.7% of the ecoregion, 2.2% of the province). The lowest elevation (197 m above sea level) occurs along the Pagwachuan River valley. The highest elevation (560 m above sea level) can be found southwest of Kabinakagami Lake.

Figure 79. Mixed forests in Ecodistrict 3E-2. Virginia Thompson, MNRF.

Key features

- Black spruce is a common component of the coniferous and mixed forests occurring over two-thirds of the area (Figure 79).
- Acidic bedrock exposed at the surface or with a shallow layer of mineral material dominates the landscape.
- Ecodistrict contains a mix of calcareous and acidic mineral material.

Geology and substrates

Acidic bedrock, exposed at the surface or with a discontinuous layer of shallow, generally morainal material dominates (Figure 80), especially in the south. The terrain is characterized by a rolling bedrock controlled landscape combined with undulating typically glaciolacustrine areas. Exposed bedrock is more common in the south. Bands of base-rich bedrock can be found east of the community of Manitouwadge and south and east of Kabinakagami Lake. Between the communities of Manitouwadge and Hornepayne, a series of faults adds relief to the landscape. In the north, deep glaciolacustrine sediments are more common. Starting nearly 9,000 years ago (Dyke 2004), glacial Lake Ojibway inundated the area, shrinking and growing as the glaciers moved across the landscape. Wave action and fluctuating lake levels removed and modified morainal material. As the glacial lake retreated, it left behind several relict beaches (Gartner and McQuay 1980a). Glaciolacustrine sediments found in the east and the White Otter River valley may be attributed to glacial lakes that covered the Lake Superior basin (Gartner and McQuay 1980b). Deep morainal deposits include the Arnott Moraine near Nagagamisis Lake, drumlins in the northwest and southeast, and small areas of flat morainal material in the north. Approximately 8,000 years ago (Dyke 2004) a glacial advance, referred to as the Cochrane readvance, brought calcareous material from Hudson Bay into the northern portion of the Hornepayne Ecodistrict including areas around Nagagami and Nagagamisis lakes (Noble 1982a). Several glacial features including the Arnott Moraine were overridden by the Cochrane readvance (Noble 1982a). Isolated areas of organic deposits occur in low-lying areas with very poor drainage. Glaciofluvial deposits are limited. Kames and kettle features are found near the Arnott Moraine, eskers occur south of the community of Hornepayne and east of Kabinakagami Lake, and pockets of outwash occur in the south. Alluvial deposits occur adjacent to larger rivers including the Nagagami, Oba, and Mattawitchewan. Large lakes (e.g., Nagagamisis, Kabinakagami) may contain lacustrine sediment.

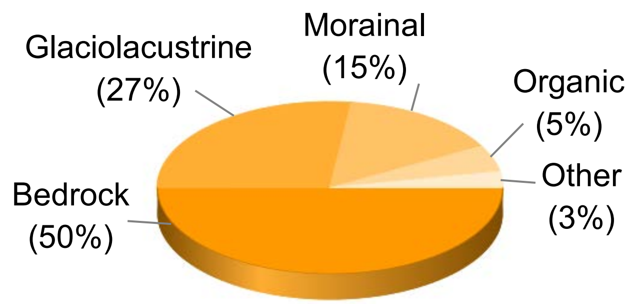


Figure 80. Modes of deposition in Ecodistrict 3E-2.

Half of the ecodistrict is characterized by bedrock at or near the surface (Figure 81). Gray Luvisols, generally calcareous, have developed in better drained materials, particularly in the east. In poorly drained areas, Gleysols occur, including a thin arc from the Nagagami River to White Otter River. Humo-Ferric Podzols have developed in acidic, mineral material in the extreme southeast and along the kame and morainal deposits at Nagagamisis Lake. Large organic accumulations, typically Mesisols, are prevalent east of the Mattawishkwia River and west of Brunswick and Gourlay lakes. Dystric Brunisols and Regosols are limited.

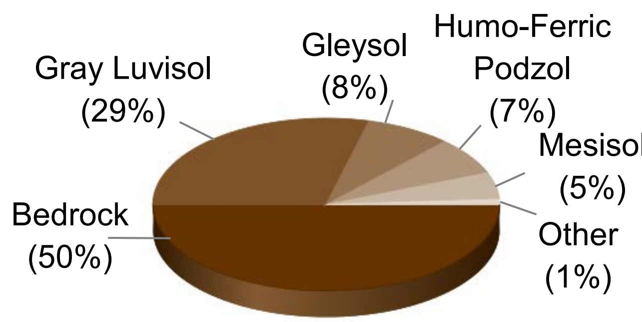


Figure 81. Substrate types in Ecodistrict 3E-2.

Land cover and vegetation

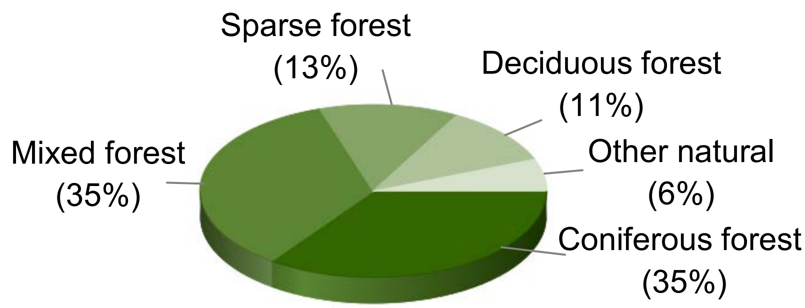


Figure 82. Land cover types in Ecodistrict 3E-2.

Associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Central Plateau Section (B.8) of the Boreal Forest Region (Rowe 1972), approximately two-thirds of the ecodistrict comprises coniferous and mixed forests (figures 82, 83). Dominant forest species include black spruce, paper birch, trembling aspen, and balsam fir. Jack pine is common on bedrock ridges and on extensive areas of well drained, coarse-textured material. Eastern white pine and red pine occur as scattered individuals or small areas, often adjacent to lakes (OMNR 2007b) or on warmer-than-normal slopes associated with bedrock ridges. Near Kabinakagami Lake, red and eastern white pine old growth forests can be found (OMNR 2009b). White spruce occurs on upland areas such as river banks, lake shores, and low ridges. American larch and eastern white cedar grow in association with black spruce in poorly drained areas.

Sparse forests are more prevalent in areas with discontinuous mineral material and exposed bedrock. Along rivers and lakes, deciduous forests may include balsam poplar, black ash, and American elm particularly on warmer-than-normal sites (Noble 1982a). Pockets of bog and fen complexes are scattered throughout the ecodistrict, occurring more frequently in the north. Fire is a significant natural disturbance in Ecodistrict 3E-2. Smaller fires are more frequent but shallow substrates, particularly in the south, increase the intensity of surface and crown fires due to their lower moisture holding capacity (Van Sleeuwen 2006). Deciduous forests composed of trembling aspen and paper birch often are fire originated forests. Exposed bedrock is more common in the south. Marshes have developed in quiet bays associated with lakes and rivers.

The undulating to rolling topography of Ecodistrict 3E-2 results in a varied local climate (Noble 1982a). Warmer-than-normal conditions can be found on bedrock ridges and associated with the Arnott Moraine. Cooler-than-normal sites may occur associated with kettles and low-lying areas. These sites may support Arctic-alpine disjuncts including bird's-eye primrose and common butterwort. Increased plant species diversity may occur in areas with calcareous substrates or shallow mineral material over base-rich bedrock due to increased nutrient availability. Calciphiles found in the area include limestone oak fern (Noble 1982a). Plant species that occur at their range limits in Ecodistrict 3E-2 include Nuttall's waterweed and showy lady's-slipper (northern extent), and showy locoweed (eastern extent) (Shea 1977).

Figure 83. Mixed forest in the Nagagamisis Plateau Signature Site in the north-central portion of Ecodistrict 3E-2. MNRF.

Land use

Larger communities found in Ecodistrict 3E-2 include Hornepayne and Manitouwadge (Figure 84). Little area (less than 1%) is devoted to settlement and associated infrastructure. Land use practices include timber harvesting, mineral exploration, aggregate extraction, trapping, hunting, fishing, and services associated with resource-based tourism. Approximately 4% of the ecodistrict has been designated as protected areas.

Ecodistrict boundary delineation

The northern and northwestern boundaries reflect the transition from bedrock exposed at the surface or with a shallow layer of morainal material and deeper pockets of glaciolacustrine sediment to deeper morainal and glaciolacustrine deposits in 3E-1 and deep glaciolacustrine deposits in 2W-2. The northwestern boundary with 2W-2 is also based on ecoregional climatic attributes, where 3E is warmer and moister. In the southeast and south, the lower elevation and shallower mineral material of 3E-2 distinguish it from 3E-5. Along the southwestern boundary, a change to a more rugged topography, a lake effect climate regime, and very shallow mineral material in 3E-4 help distinguish it from 3E-2. The western boundary with 3W-4 and 3W-5 reflects the change in climate at the ecoregional scale, where Ecoregion 3E is warmer and wetter than 3W. The southwestern corner was shifted west and south to incorporate the contiguous gneissic bedrock from 3E-4.

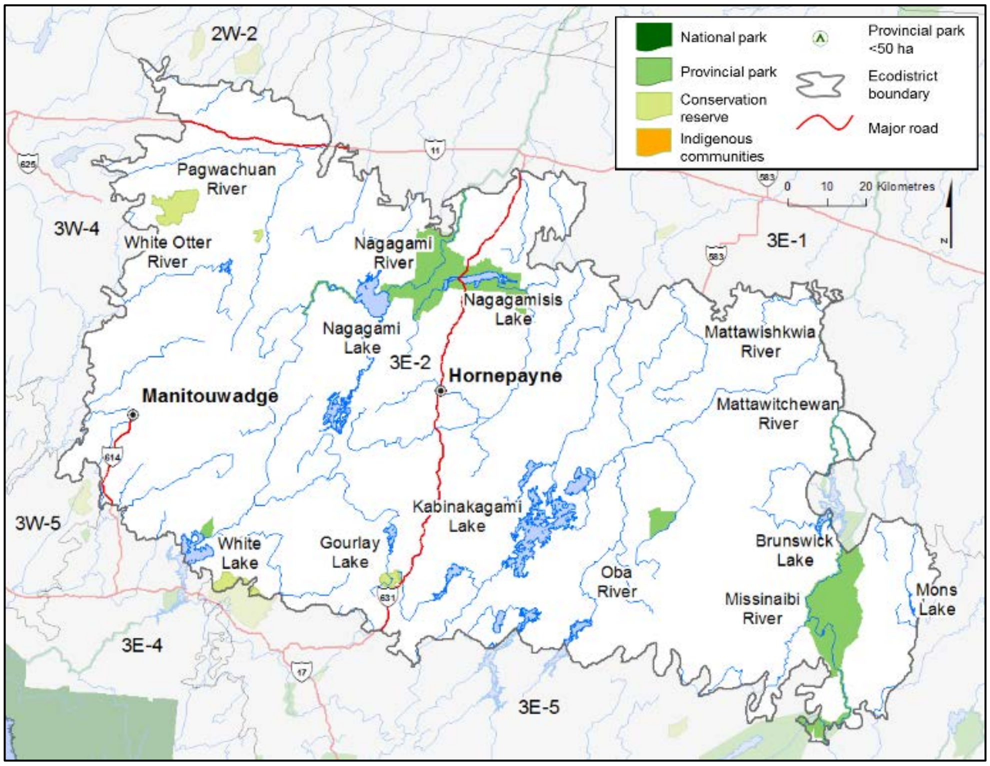


Figure 84. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3E-2.

Nagagamisis Central Plateau Signature Site

Throughout Ontario, nine signature sites were identified for exceptional natural and cultural heritage features (OMNR 2002). The Nagagamisis Central Plateau Signature Site, located primarily in the north-central part of Ecodistrict 3E-2, incorporates two provincial parks, a park addition, and an enhanced management area. Features protected in the signature site include archaeological sites representing Eastern Woodland Aboriginal heritage in Ontario, the provincially significant Arnott Moraine, and high quality recreational opportunities. Cultural surveys in the Signature Site have documented many *culturally modified trees* that show scars where planks have been removed for use by Indigenous peoples (Figure 85; OMNR 2002).

Figure 85. Culturally modified tree found in Nagagamisis Central Plateau Signature Site. MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3E-4

Tip Top Mountain Ecodistrict

Following the northeastern shore of Lake Superior, Ecodistrict 3E-4 contains one of the highest peaks in the province. North of Swallow River, Tip Top Mountain, reaches an elevation of 640 m above sea level. The ecodistrict extends from the Black River in the north to the community of Michipicoten River in the south. The eastern boundary occurs at the community of Wawa. The smallest ecodistrict in Ecoregion 3E, it is 640,688 ha (4.7% of the ecoregion, 0.7% of the province). The lowest point of elevation (179 m above sea level) is located along the Lake Superior coastline.

Figure 86. Mixed forests of Pukaskwa National Park. Monique Wester, MNRF.

Key features

- Typically is mixed forests of paper birch, white spruce, trembling aspen, and black spruce (Figure 86).
- Acidic bedrock, exposed at the surface or covered with a very shallow layer of mineral material, dominates the ecodistrict.
- Pukaskwa National Park covers much of the landscape.
- Arctic-alpine plant species occur.

Geology and substrates

Vast areas of Precambrian bedrock dominate the hilly to rugged landscape of Ecodistrict 3E-4 (Figure 87). Shaped and scoured by glaciers, the acidic bedrock is typically bare or covered by a discontinuous, very shallow layer of acidic, coarse-textured, generally morainal material. Areas of base-rich bedrock occur in the north and south. Bedrock ridges occur along the Lake Superior shoreline and in isolated areas inland, often associated with steep-walled valleys with colluvial (i.e., talus) materials. Faults can be found in the south particularly near Mishibishu Lake (Bennett and Thurston 1977) and in the north related to the Lake Superior-Hemlo fault zone (Williams et al. 1991). Bare bedrock dominates the area immediately behind the shoreline, a result of wave action and fluctuating water levels of higher glacial lakes that occupied the area (Noble 1982a). Approximately 9,600 years ago (Dyke 2004), glacial Lake Minong, one of a series of glacial lakes that occupied the Lake Superior basin, expanded north following the edge of the glacier and inundated the western side of the ecodistrict. Relict shorelines and cobble beaches from the glacial lakes can be found adjacent to Lake Superior. Near the Pukaskwa River the relict shorelines are 30 to 139 m above the lake (Noble 1982a). Lacustrine materials have accumulated at river mouths, including the Swallow and Pukaskwa rivers, and along the Lake Superior shoreline. Glaciofluvial features (i.e., outwash and eskers) are limited. Glacial meltwaters left behind glaciofluvial material as they flowed through river valleys and areas of lower elevation. A major esker can be found east of Bremner River (Gartner and McQuay 1979b). Deep, glaciolacustrine deposits are associated with level areas adjacent to the Black, White, and Willow rivers. Alluvial sediments can be found along river systems, especially the White, Swallow, and Pukaskwa rivers. Organic accumulations may be found in poorly drained areas between bedrock ridges or associated with river valleys. Deep pockets of morainal material occur in depressions or on south-facing slopes (Gartner and McQuay 1979b). Aeolian deposits occur adjacent to the Lake Superior shoreline.

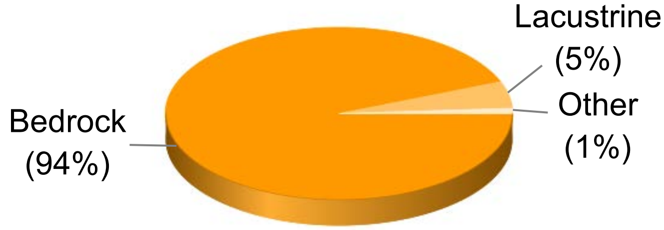


Figure 87. Modes of deposition in Ecodistrict 3E-4.

While the ecodistrict is strongly influenced by bedrock (Figure 89), the northern portion near Black River is dominated by Gleysols that have developed in glaciolacustrine deposits. Organic deposits, primarily Mesisols, occur in low-lying areas often associated with glaciofluvial and glaciolacustrine material. Regosols typically occur in active aeolian, alluvial, and lacustrine materials.

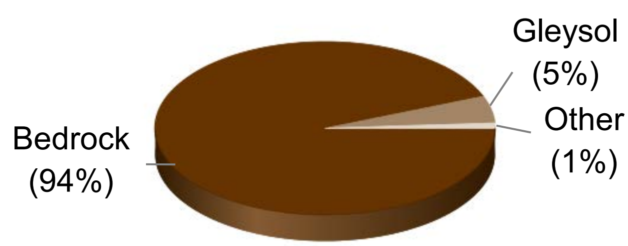


Figure 89. Substrate types in Ecodistrict 3E-4.

Land cover and vegetation

The Tip Top Mountain Ecodistrict is found in the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). It is also mostly located in the Superior Section (B.9) of the Boreal Forest Region, a section which is extremely variable, ranging from mixed forests with luxuriant shrub undergrowth to floristically poor single-species dominant conifer types (Rowe 1972). Mixed forests of intolerant hardwoods (e.g., paper birch, trembling aspen) and conifers (e.g., white spruce, black spruce, balsam fir) occur over nearly half of the ecodistrict (Figure 90). Paper birch and white spruce are common on glaciofluvial deposits, along with balsam fir and trembling aspen. Deciduous forests comprising species such as paper birch occur on the rugged uplands, talus slopes, and high rock elevations in the ecodistrict. Adjacent to lakes and rivers on wetter, nutrient rich sites, balsam poplar, black ash, and American elm may grow. Coniferous forests of black spruce also occur on wet substrates along with American larch and eastern white cedar, and in imperfectly drained lowlands such as the area around White River (Noble 1982a). Jack pine and black spruce grow on uplands at higher elevations. Sparse forests are more common in the west and south, growing on higher, rocky areas with a shallow layer of mineral material. Bog and fen complexes are limited, dominating flat areas with poor drainage. Marshes are often found at the edges of lakes and streams where they are periodically inundated by standing or slow moving water. Exposed bedrock is more common in areas with rugged topography and near the shore of Lake Superior (Figure 91).

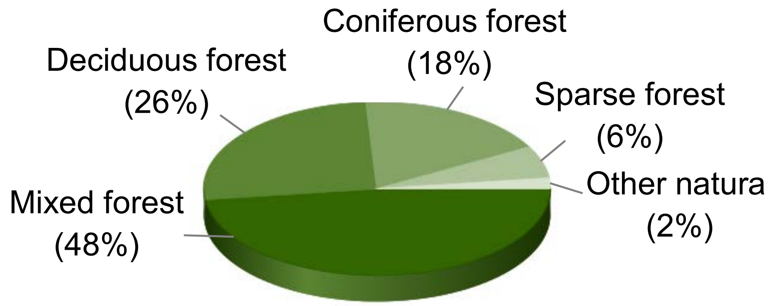


Figure 90. Land cover types in Ecodistrict 3E-4.

Proximity to Lake Superior and rapid changes in topography result in extreme variations in local climate. The modifying effects of Lake Superior result in increased precipitation and promote cooler-than-normal summers and warmer-than-normal winters. In addition, periods of fog often occur. Changes in topography result in a complex mosaic of normal, warmer-than-normal, and cooler-than-normal microclimates over relatively short distances (Noble 1982a). Warmer-than-normal conditions occur on upper slopes and hill tops and in river valleys, permitting the growth of temperate species such as red maple, sugar maple, eastern white pine, and red pine (Crofts and Parent 1999). Cooler-than-normal sites are more prevalent along the Lake Superior shoreline (Noble 1982a) and support several Arctic-alpine disjunct species including alpine hedysarum and sparrow's-egg lady's-slipper (Henson and Brodribb 2005). Along the coast, active aeolian sites host plant species (e.g., American beachgrass and beach pea) adapted to grow in areas with moving mineral material and shoreline species adapted to the harsh conditions (i.e., wind, ice) adjacent to Lake Superior including eastern ninebark. Species endemic to the Great Lakes, including Pitcher's thistle, and western disjunct species (e.g., mountain huckleberry and western fescue) may also occur (Henson and Brodribb 2005).

Figure 91. Pukaskwa National Park shoreline. Sam Brinker, MNRF.

Land use

Communities, including Wawa, Pic River, and Michipicoten River, and associated infrastructure cover less than 1% of the area (Figure 92). Resource-based tourism (camping, hunting, fishing, etc.), timber harvesting, mining, mineral exploration, hydroelectric generation, and aggregate extraction are major land uses. The ecodistrict comprises nearly 30.8% protected areas. In addition, approximately 64,321 ha of water are protected in the Lake Superior National Marine Conservation Area (not shown in Figure 92).

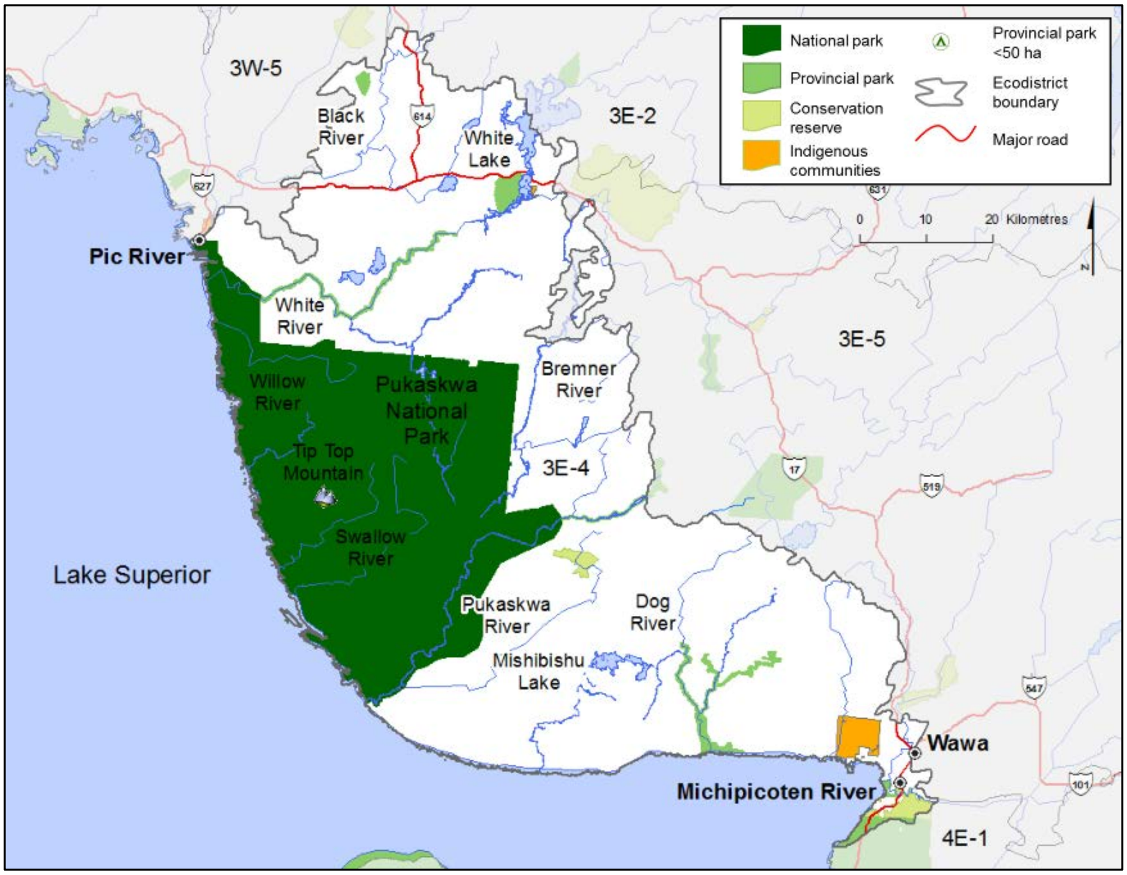


Figure 92. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3E-4.

Ecodistrict boundary delineation

Differences in ecoregional climatic attributes define the northwestern boundary between Ecoregion 3E and 3W. Ecoregion 3E is warmer and receives more precipitation than 3W. The northeastern and eastern boundary with 3E-2 and 3E-5 reflects a more rugged topography and a cooler and wetter climate due to the proximity to Lake Superior. In addition, there is a transition from very shallow mineral material in 3E-4 to deeper mineral material in 3E-2 and 3E-5. The southern boundary of 3E-4 was adjusted to south of the community of Michipicoten River to better encompass the bands of mafic metavolcanic bedrock (Early Precambrian) that start north of the community. In the south and west, Lake Superior defines the Tip Top Mountain Ecodistrict. The northern tip was shifted south to remove the gneissic bedrock that is contiguous to 3E-2.

Pukaskwa Pits

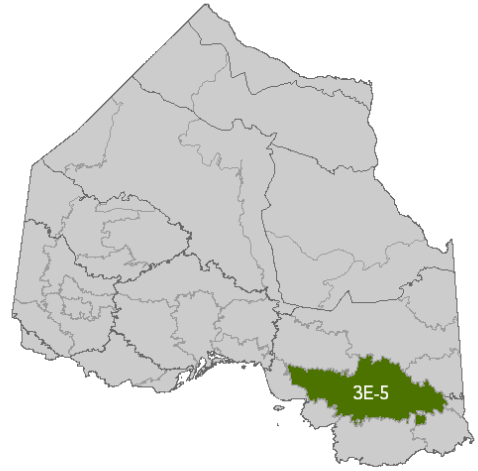
Figure 93. Pukaskwa pit. Parks Canada Agency.

Created approximately 5,000 to 10,000 years ago, the Pukaskwa Pits are cobble stone formations that represent a significant part of Indigenous history in Ontario (Figure 93; Parks Canada 2008). The pits consist of walled enclosures, simple pits, or flat floors fashioned through the piling up, removal, or shifting of stones. It is believed that the pits represent the remains of Indigenous lodges, windbreaks, tent rings, storage pits, and hearths. Pukaskwa Pits can be found along the shore of Lake Superior, stretching from Thunder Bay to Georgian Bay along Lake Huron. Pukaskwa National Park located in Ecodistrict 3E-4 contains several of these culturally significant structures, often in clusters of up to several dozen (Parks Canada 2008).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3E-5

Foleyet Ecodistrict



The Foleyet Ecodistrict encompasses 4,057,871 ha (29.7% of the ecoregion, 4.1% of the province). It spans from the Englehart River in the east to the community of White River in the west and the north. The southern boundary is approximately at Highway 560. The undulating to rolling topography ranges in elevation from 262 m above sea level adjacent to rivers and creeks at the northern boundary to 624 m above sea level northwest of Chapleau.

Figure 94. Mixed forests near the Englehart River, Melanie Alkins, Ontario Parks.

Key features

- Nearly half of the land base is covered by mixed forests (Figure 94).
- Morainal deposits are the primary substrates in much of the ecodistrict.
- The northern boundary generally coincides with the northernmost limits of eastern white pine and red pine.

Geology and substrates

The Foleyet Ecodistrict is characterized by an undulating landscape covered by glaciolacustrine and organic material in the north, grading to a rolling topography of morainal and glaciofluvial deposits in the south. The mineral material is a combination of acidic morainal and glaciofluvial sediment across the central and southern landscape and calcareous morainal and glaciolacustrine deposits in the north (Evans and Cameron 1984).

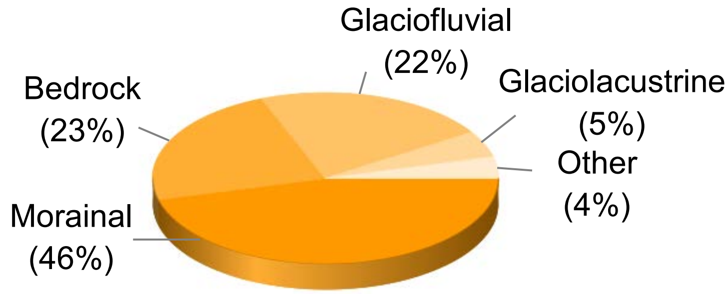


Figure 95. Modes of deposition in Ecodistrict 3E-5.

The southern extent of calcareous material roughly coincides with the Chapleau moraines (Karrow 1992) — three parallel moraines stretching between the communities of Chapleau and Elk Lake (Boissonneau 1968). Morainal materials that cover nearly half of the ecodistrict (Figure 95) are a combination of moderately deep to deep deposits, deeper drumlins, and moraines. As the glaciers advanced they deposited coarse-textured morainal material and formed drumlins, particularly north and west of the community of Foleyet. Where the glacier halted, moraines now occur. A readvance of the glacier (i.e., the Cochrane readvance) nearly 8,000 years ago (Dyke 2004) deposited calcareous, fine-textured mineral material from Hudson Bay into the northern portion of the ecodistrict.

Bedrock, exposed at the surface or with a discontinuous layer of very shallow to shallow mineral material, is scattered throughout the ecodistrict. The bedrock is generally acidic but areas of base-rich bedrock occur south of the communities of Dubreuilville and Foleyet and in the east. Faults are quite prominent in the east, often resulting in a network of long, linear lakes and rivers. The Kapuskasing structural zone near the community of Chapleau (Zhang 1999), the Montreal River Main fault near the community of Elk Lake, the Cross Lake fault east of the community of Elk Lake, and the Mattagami River fault system (Lovell and Caine 1970) east of Kenogamissi Lake are four large northwest-southeast trending faults in the area. The Montreal River Main, Cross Lake, and Mattagami River faults are part of the Lake Timiskaming fault system (Lovell and Caine 1970), the northwest trending branch of the Ottawa-Bonnechere Graben (Sage 1992). Large volumes of meltwater from the glaciers deposited glaciofluvial material across the ecodistrict. Glaciofluvial features (i.e., outwash) are particularly evident south of the Chapleau moraines and associated with the many southward-trending esker complexes that can be found throughout the area. Additional glaciofluvial features including kettle lakes are common.

Glaciolacustrine deposits in the north are associated with glacial Lake Ojibway, in the east with glacial Lake Barlow (Vincent and Hardy 1979), and in the south with three short-lived glacial lakes — Sultan, Oström, and Ogilvie — that formed between the ice front and bedrock ridges to the south (Boissonneau 1968). Relict shorelines of the glacial lakes are also evident, especially near the community of Sultan. In the southwest, glacial Lake Minong followed the retreating ice margin into Wawa Lake and the Magpie River valley to the north (Morris 2001). Numerous shorelines of glacial Lake Minong occur along the Magpie River (Kenerknecht 2004). Significant pockets of aeolian sediment occur in the south, west of the community of Foleyet, and around Kenogamissi Lake. Organic materials are prevalent in the north where subdued areas with poor drainage have facilitated their accumulation. Alluvial sediment occurs along river systems including the Groundhog and Englehart rivers.

Generally occurring in coarse-textured morainal material, Humo-Ferric Podzols have formed over half of the ecodistrict (Figure 96). Bedrock, exposed at the surface or with a discontinuous layer of very shallow to shallow mineral material, is often associated with bedrock ridges. Dystric Brunisols have developed in the central portion, typically in glaciofluvial material. Limited amounts of Mesisols have accumulated in poorly drained sites including areas adjacent to the Groundhog and Kapuskasing rivers. Gray Luvisols, generally associated with fine-textured, calcareous glaciolacustrine materials are more common in the north. Gleysols have formed in areas characterized by subdued topography with imperfect drainage. Regosols are associated with alluvial materials.

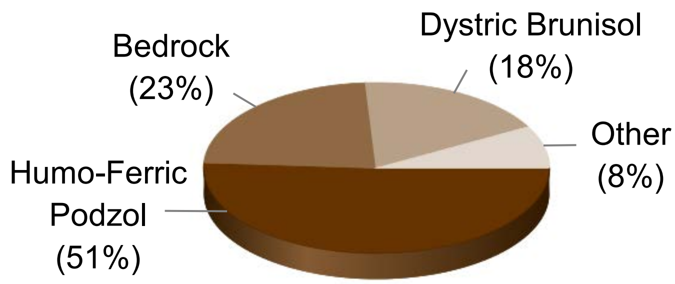


Figure 96. Substrate types in Ecodistrict 3E-5.

Land cover and vegetation

The southern boundary of the Foleyet Ecodistrict generally defines the transition between the boreal vegetation zone to the north and the temperate vegetation zone to the south. Thus, the ecodistrict supports limited occurrences of tree and understory species with temperate affinities, including yellow birch, sugar maple, and red maple. Generally associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Missinaibi-Cabonga Section (B.7) of the Boreal Forest Region (Rowe 1972), mixed forests of trembling aspen, paper birch, balsam fir, black spruce, and white spruce dominate the area (Figure 97, 98). Along the northern boundary, conifer forests of black spruce occur in low-lying areas, often with eastern white cedar or American larch. Jack pine forests are present on coarse-textured, drier sites associated with glaciofluvial deposits (Evans and Cameron 1984). Old growth forests of both conifer and mixedwoods can be found in the area (Morris 2002).

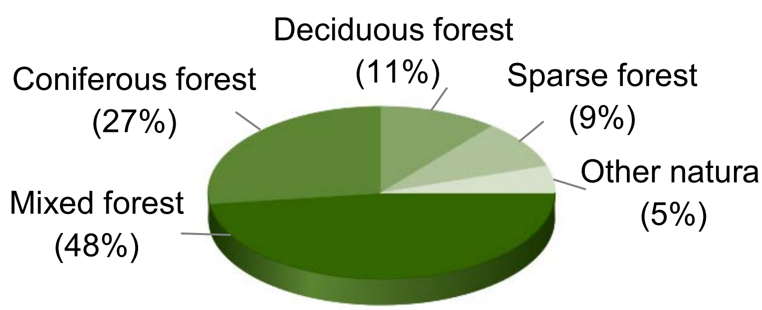


Figure 97. Land cover types in Ecodistrict 3E-5.

Deciduous forests of trembling aspen and paper birch occur on middle slopes, with balsam poplar, black ash, and American elm growing on nutrient rich, wetter sites often associated with rivers and lakes. Sparse forests are more common in the east, generally growing on very shallow to shallow mineral material associated with exposed bedrock. Common tree species on these sites include red pine, eastern white pine, and jack pine (Evans and Cameron 1984). Bog and fen complexes are restricted to cool, moist, low-lying areas, typically on organic substrates. Limited areas of cropland and pasture occur in the southeast near the community of Elk Lake. Marshes may occur adjacent to lakes and rivers in shallow, quiet areas.

Plant species at their northern limits include eastern poison ivy, narrow-leaved gentian, and daisy-leaved moonwort (Morris and Sheppard 2017, Ontario Parks, pers. comm.). Increased plant species diversity may occur on shallow substrates over base-rich bedrock and areas of calcareous mineral material. Calciphiles that occur in the ecodistrict include Kalm's lobelia and greenish sedge (Morris and Sheppard 2017, Ontario Parks, pers. comm.).

Figure 98. Mixed forest on shallow morainal material over bedrock near the community of Chapleau. John Stephens, MNRF.

Land use

Settlement and infrastructure associated primarily with the communities of Chapleau, Dubreuilville, White River, and Foleyet account for less than 1% of the area (Figure 99). Protected areas encompass approximately 6.8% of the ecodistrict. Timber harvesting, mining, mineral exploration, aggregate extraction, hydroelectric generation, hunting, fishing, services associated with resource-based tourism, and agriculture occur in Ecodistrict 3E-5.

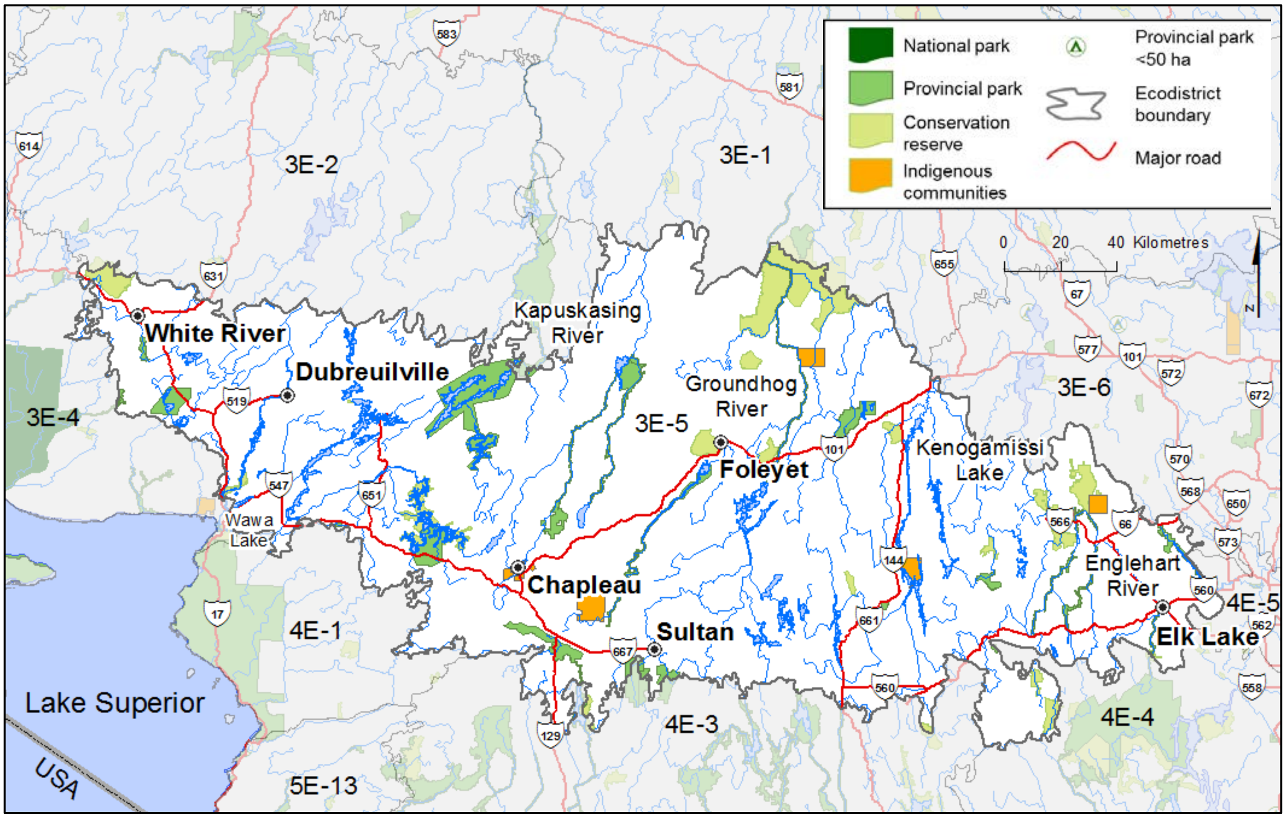


Figure 99. Select communities, major roads, natural heritage areas, lakes, and rivers in Ecodistrict 3E-5.

Ecodistrict boundary delineation

Ecodistrict 3E-5 borders eight other ecodistricts. The northwest boundary with 3E-2 is defined by the higher elevation and deeper mineral material in 3E-5 compared with 3E-2. The north-central boundary with 3E-1 is primarily differentiated by a shift from a hilly landscape overlain with a variable depth of morainal material and a significant proportion of glaciofluvial sediment in 3E-5 to a gently rolling topography covered by a deep layer of morainal, glaciolacustrine, and organic substrates in 3E-1. The predominately morainal and glaciofluvial material on an undulating to rolling topography in 3E-5 is replaced by an undulating, glaciolacustrine and glaciofluvial landscape in 3E-6. The western boundary with 3E-4 reflects a less rugged topography and a deeper layer of mineral material in 3E-5 compared with 3E-4. In addition, climatically 3E-4 is under the influence of Lake Superior. To the south, ecoregional climatic attributes help define the boundary with Ecoregion 4E. In general, Ecoregion 3E is cooler and drier than 4E. The southern boundary has been adjusted to the south from Hills' (1959) original site district classification. The shift better captures the continuous glaciolacustrine and glaciofluvial material originally split between Ecodistricts 3E-5 and 4E-3 and aeolian and bedrock ridges from 4E-4.

Iron ore mining

Ontario's first large scale iron mine, the Helen Mine (Figure 100), began operations in 1900 following the discovery of hematite ore (Sault History Online 2008). Large deposits of hematite occur in banded iron formations, which are distinct types of sedimentary rock that consist of thin bands of iron oxides with alternating layers of iron-poor rock. Banded iron formations (Figure 101) result from the oxidization of dissolved iron found in heated seawater and subsequent deposition of insoluble iron oxides on the ocean floor (Eyles 2002). Extensive deposits of banded iron formations occur throughout the Lake Superior basin.

Figure 100. Helen Iron Ore Mine, North of Wawa Lake. Sault Ste. Marie Museum.

Figure 101. Banded iron formation. Anthony Pace, MNDM.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3E-6

Kirkland Lake Ecodistrict

Extending from the community of Timmins in the west to the Ontario-Québec border in the east, Ecodistrict 3E-6 encompasses 1,114,626 ha (8.2% of the ecoregion, 1.1% of the province). The northern boundary is near the community of Iroquois Falls, while in the south the boundary occurs at Skeleton Lake. The lowest elevation (181 m above sea level) occurs at the southern portion of the Larder River and the highest elevation (503 m above sea level) can be found east of Larder Lake.

Figure 102. Fen complexes and upland mixed forests of Larder River Provincial Park. Melanie Alkins, Ontario Parks.

Key features

- Mixed forests cover approximately half of the ecodistrict (Figure 102).
- Area is characterized by glaciolacustrine deposits.
- Precambrian base-rich bedrock dominates the ecodistrict.
- This ecodistrict is at the southern boundary of the boreal forest.

Geology and substrates

Large areas of the Kirkland Lake Ecodistrict were affected by glacial lakes Barlow and Ojibway that first inundated the area nearly 9,600 years ago (Dyke 2004). As the glacial lakes followed the advance and retreat of the glaciers, wave action and fluctuating lake levels removed surficial mineral material from bedrock, depositing it into the lake bed. Fine-textured, generally calcareous glaciolacustrine sediment occurs over nearly half of the area, particularly in the north (Figure 103). The undulating landscape is broken by low bedrock knobs, a series of faults, and in the southeast escarpments and high hills. Larger faults include the northwest-southeast trending Cross Lake fault west of Watabeag Lake, a part of the Ottawa-Bonnechere Graben, and the west-east trending Destor-Porcupine fault north of Night Hawk Lake (Pyke et al. 1973). Large, linear north-south trending glaciofluvial features, including esker-outwash complexes also provide relief to the area (Figure 104; Noble 1982a). A prominent esker on the landscape is the Munro Esker west of Lake Abitibi. The esker forms a nearly continuous landform for approximately 250 km (Noble 1982a), varying from 1 to 2 km wide, but can be up to 7 km wide (Banerjee and McDonald 1975). Kettles can be found in or near the top of esker ridges (Baker 1985). Relict beaches may be evident along esker sides, indicating the former shorelines of glacial lakes.

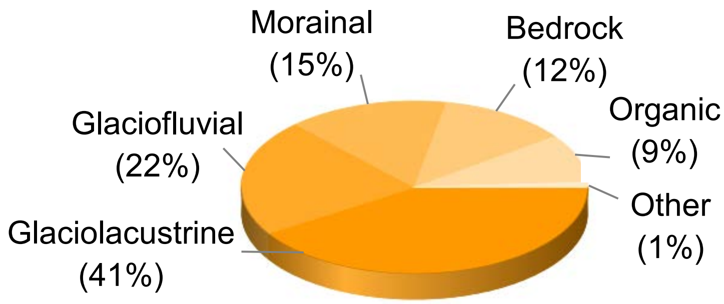


Figure 103. Modes of deposition in Ecodistrict 3E-6.

Figure 104. Wildgoose Outwash Deposit Provincial Park. Melanie Alkins, Ontario Parks.

Discontinuous morainal deposits of variable depth can be found throughout the ecodistrict. Typically acidic, deeper areas of morainal material occur in the central region near the community of Kirkland Lake west to Watabeag Lake. Bedrock exposed at the surface or with a very shallow layer of mineral material is interspersed among the glaciolacustrine, glaciofluvial, and morainal materials, particularly in the southeast. The Precambrian bedrock is generally base-rich but acidic bedrock occurs north of Lake Abitibi, and in the west and south. Organic materials occur in low-lying areas where large accumulations have developed on glaciolacustrine material. Along creeks and streams, shallow linear organic deposits can be found while smaller pockets occur in bedrock depressions (Baker 1985). They may also be found adjacent to glaciofluvial deposits forming distinct aeolian-organic patterns (Noble 1982a). Aeolian deposits have developed on glaciofluvial and glaciolacustrine material, particularly on either side of the Munro Esker and west of Watabeag Lake. Alluvial sediment has accumulated along larger rivers and streams, including the Mattagami, Magusi, and Black rivers. Colluvial debris is particularly evident in the southeast adjacent to escarpments.

Humo-Ferric Podzols have formed in better drained glaciofluvial and morainal deposits throughout the ecodistrict (Figure 105). In the northern portion, Gray Luvisols are more common, associated with calcareous fine-textured, typically glaciolacustrine materials. Bedrock, exposed at the surface or with a very shallow to shallow layer of mineral material, is more widespread in the southeast. Organic deposits, generally a combination of Mesisols and Humisols (Canadian Department of Agriculture 1978) have accumulated in low-lying areas with poor drainage. Large areas occur at the northern boundary west of Fredrick House Lake and north and east of the community of Iroquois Falls. Gleysols have developed in mineral material with poor drainage and Regosols are associated with active deposits including alluvial sediment.

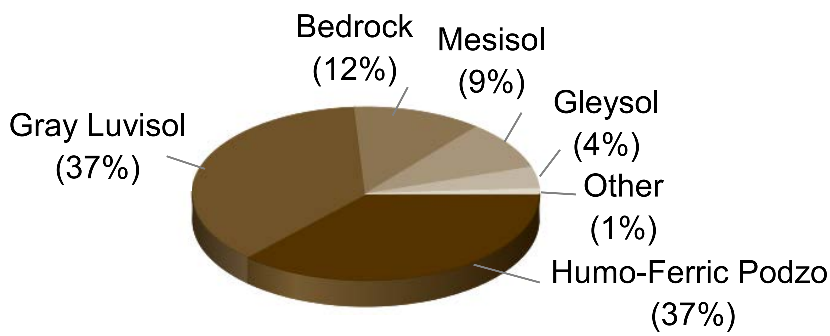


Figure 105. Substrate types in Ecodistrict 3E-6.

Land cover and vegetation

Lying at the border with the temperate vegetation zone, the Kirkland Lake Ecodistrict is one of the most southerly ecodistricts in the boreal vegetation zone. It is associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). The northern half of the ecodistrict occurs in the Northern Clay Section (B.4) and the southern portion is associated with the Missinaibi-Cabonga Section (B.7) of the Boreal Forest Region (Rowe 1972). The latter contains occurrences of tree species with temperate affinities, including yellow birch, red maple, red pine, and eastern white pine, that reach their northernmost limits here.

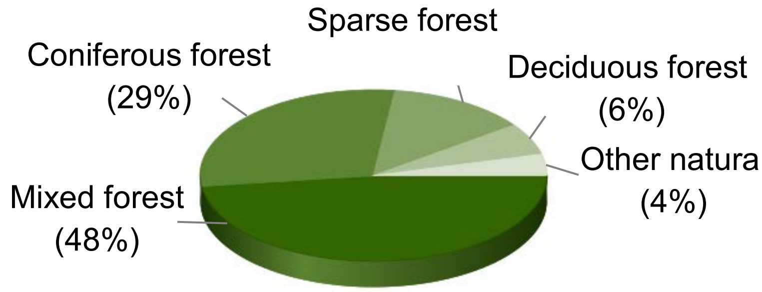


Figure 106. Land cover types in Ecodistrict 3E-6.

Mixed forests of balsam fir, black spruce, paper birch, trembling aspen, and white spruce dominate, particularly in the eastern part of the ecodistrict (Figure 106). Organic and moist mineral material support coniferous forests of black spruce in the northern and central portions. Eastern white cedar and/or American larch can grow with black spruce in these lowland areas. Red pine and eastern white pine are found throughout the ecodistrict occurring as small forests or as scattered individuals generally growing on dry, bedrock ridges. Jack pine associations are prevalent on eskers and areas of outwash. Sparse forests are more common where the substrate depth is very shallow to shallow, including bedrock ridges and colluvial deposits in the southeast. Trembling aspen forests occur in the north-central portion and large-toothed aspen may occur as scattered individuals on deep, moist substrates in the south (Brownell 1992). On wetter, nutrient rich sites, deciduous forests may grow black ash, American elm, and balsam poplar. Bog and fen complexes are restricted to cool, moist, low-lying areas, typically on organic substrates. Portions of land near several communities have been cleared for agriculture. Exposed bedrock is limited. Marshes occur adjacent to lakes, rivers, and streams in quiet embayments.

The base-rich nature of the underlying bedrock and areas of calcareous mineral material in the north results in a higher availability of substrate nutrients and increased plant species diversity. Plant species at their northern limits that occur in Ecodistrict 3E-6 include alternate-leaved dogwood and marginal wood fern (Brownell 1992).

Land use

The communities of Timmins, South Porcupine, Kirkland Lake, Larder Lake, and Iroquois Falls and associated infrastructure cover approximately 4% of the ecodistrict (Figure 107). Land uses include timber harvesting, mining, mineral exploration, aggregate extraction, hydroelectric generation, tourism, services associated with resource-based activities (e.g., hunting, fishing), and agriculture. Nearly 3.3% of the ecodistrict is designated as protected areas.

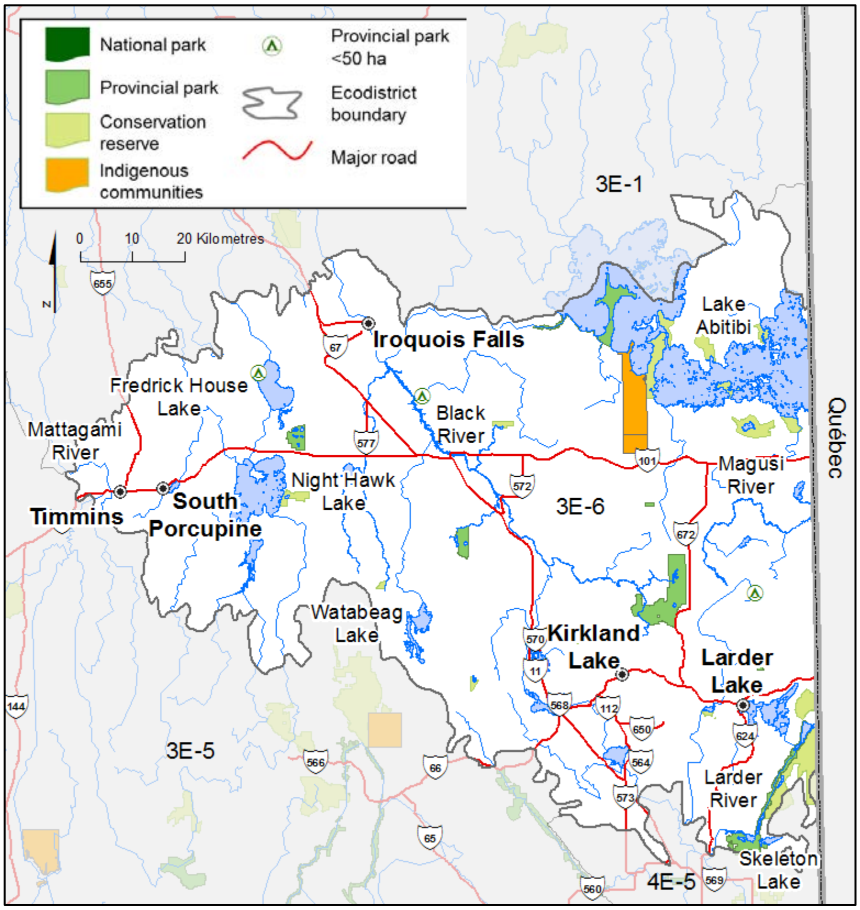


Figure 107. Select communities, major roads, natural heritage areas, river, and lakes in Ecodistrict 3E-6.

Ecodistrict boundary delineation

To the north, the predominance of glaciolacustrine material in 3E-6 separates the area from the deep morainal and glaciolacustrine sediment in 3E-1. The eastern boundary is delineated by the province of Québec. Ecoregional climatic variables initially distinguish Ecodistrict 3E-6 from 4E-5. Ecoregion 3E is cooler and on average receives less precipitation than 4E. Additional differences include: Ecodistrict 3E-6 is dominated by Precambrian bedrock, whereas much of 4E-5 is underlain by Paleozoic bedrock; and 3E-6 contains a mix of glacial material including glaciolacustrine, glaciofluvial, and morainal deposits whereas 4E-5 is predominantly glaciolacustrine. The western boundary with 3E-5 represents a change from an undulating glaciolacustrine and glaciofluvial landscape in 3E-6 to an area dominated by morainal and glaciofluvial deposits on an undulating to rolling topography in 3E-5.

Ecodistrict 3E-7

Kesagami Ecodistrict

The Kesagami Ecodistrict is situated along the Ontario-Québec border and extends west to the Little Abitibi River. The northern limit occurs approximately 50 km north of Kesagami Lake, and the southern boundary is 40 km south of Lawagamau Lake. The ecodistrict encompasses 1,595,450 ha (11.7% of the ecoregion, 1.6% of the province). The elevation ranges from 38 m above sea level along the northern boundary, west of the Partridge River, to 369 m above sea level northeast of Lawagamau Lake.

Figure 108. Trembling aspen-black spruce mixed forests in Ecodistrict 3E-7. Sam Brinker, MNRF.

Key features

- Coniferous and mixed forests occur over nearly half of the land base (Figure 108).
- Morainal deposits dominate the area.
- Approximately one-third of the ecodistrict is covered by bog and fen complexes.

Geology and substrates

The subdued landscape of the Kesagami Ecodistrict has been influenced by the movement of glaciers, a glacial lake, and a sea. At the surface, nearly half of the ecodistrict is covered by calcareous, fine-textured morainal material (Figure 109), a result of the Cochrane readvance, a glacial advance that occurred nearly 8,000 years ago (Dyke 2004). Deeper morainal deposits can be found from Kesagami Lake south. Barnett et al. (2011c, f) identified several moraines and drumlin fields near Kesagami Lake that add relief to the area. Shallow to

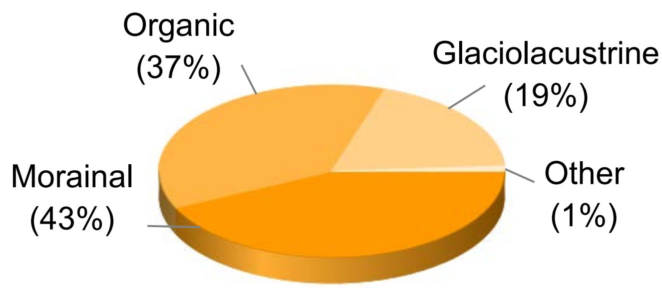


Figure 109. Modes of deposition in Ecodistrict 3E-7.

moderately deep morainal deposits are more common in the north, generally interspersed with bedrock exposed at the surface or with a very shallow layer of mineral material (Barnett et al. 2011b, d, e). In areas of subdued topography and poor drainage, deep organic layers have accumulated. Organic materials dominate in the north and are interspersed with typically morainal material in the central portion of the ecodistrict and morainal and glaciolacustrine material in the south. Glaciolacustrine sediments, deposited in the deep parts of glacial Lake Ojibway, are more common in the south. The ice-contact lake first inundated the area approximately 9,000 years ago (Dyke 2004) following the advance and retreat of the ice sheet. Small areas of glaciomarine material occur at the northernmost edge of the ecodistrict, representing the southern extent of the Tyrrell Sea. Relict shorelines and beaches are often associated with the glaciomarine materials (Barnett et al. 2011b, d). Glaciofluvial features including outwash and eskers are limited throughout the ecodistrict. Exposed bedrock, with a discontinuous layer of very shallow to shallow mineral material is more common in the north. The underlying Precambrian bedrock is generally acidic but bands of base-rich bedrock occur to the west of Kesagami Lake, in the north, and near the Ontario-Québec border by Lower Detour Lake. Major faults include the Kapuskasing structural zone (Williams 1991). Alluvial deposits are restricted to larger river systems including the Partridge, Bodell, and Kesagami rivers.

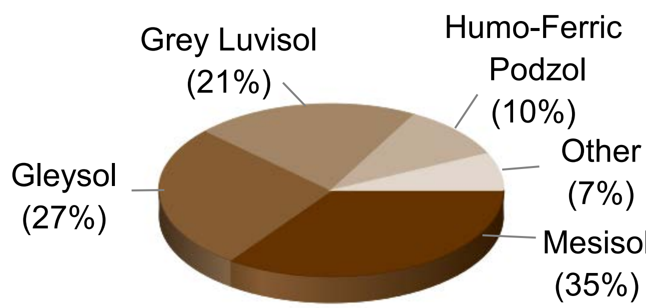


Figure 110. Substrate types in Ecodistrict 3E-7.

A subdued topography and poor drainage have resulted in the development of Mesisols over one-third of the ecodistrict (Figure 110). Gleysols are found primarily along the southern and western boundaries, in low-lying areas. Gray Luvisols have developed in fine-textured, typically calcareous, morainal deposits and Humo-Ferric Podzols occur in better drained glaciofluvial deposits near Kesagami Lake and on eskers in the southern portion of the ecodistrict. Limited Melanic Brunisols occur in fine-textured mineral material associated with morainal deposits along the southeastern boundary. Fibrisols have developed in wet depressions, while isolated pockets of Dystric Brunisols occur along the northeastern boundary associated with coarse-textured mineral material. Active mineral deposits including alluvial material are typically Regosols.

Land cover and vegetation

The ecodistrict is associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and mostly with the Hudson Bay Lowlands Section (B.5) of the Boreal Forest Region. The Northern Clay Section (B.4) occurs south of Lawagamau Lake (Rowe 1972). Approximately half of the ecodistrict is characterized by coniferous forest, primarily black spruce, particularly on upland sites (Figure 111). In low-lying areas with poor drainage black spruce is often associated with American larch and eastern white cedar. Jack pine forests are limited, occurring on well drained glaciofluvial material associated with eskers (Foley 2005). White spruce and balsam fir grow on drier sites. Bog and fen complexes have developed on organic material throughout the ecodistrict (Figure 112). Sparse forests are scattered throughout. On river banks, elevated ridges, and other areas with better drainage, mixed forests of trembling aspen, paper birch, balsam poplar, balsam fir, white spruce, and black spruce grow (Hills 1959, Rowe 1972).

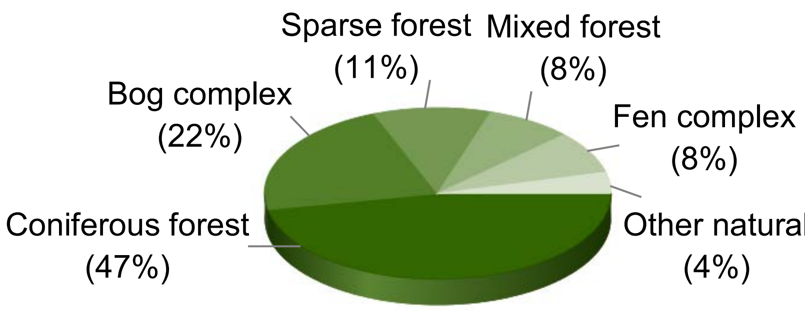


Figure 111. Land cover types in Ecodistrict 3E-7.

Figure 112. Patterned fen in the Kesagami Ecodistrict. Wasyl Bakowsky, MNRF.

Fires are typically few and small (Van Sleeuwen 2006). Shallow substrates may exhibit occasional large, more intense surface and crown fires. Quiet bays support marsh communities. Plant species that occur at their southern limits include Saint John River locoweed and sheared gentian (Riley 2003). On warmer-than-normal south facing slopes, plant species more typically found in the temperate vegetation zone (e.g., slender naiad and Canadian yew) may occur (Brunton 1984). Rough aster is near its western range limit in Ecodistrict 3E-7 (Semple et al. 1996). Increased numbers of plant species may occur in areas with calcareous mineral material or very shallow to shallow mineral material over base-rich bedrock. Calciphiles found in the ecodistrict include rush aster and English sundew (Brunton 1984).

Land use

Timber harvesting, mineral exploration, mining, aggregate extraction, fishing, hunting, and services associated with resource-based activities occur throughout the ecodistrict. Protected areas cover approximately 13.6% of the area. No settlements occur in this ecodistrict (Figure 113).

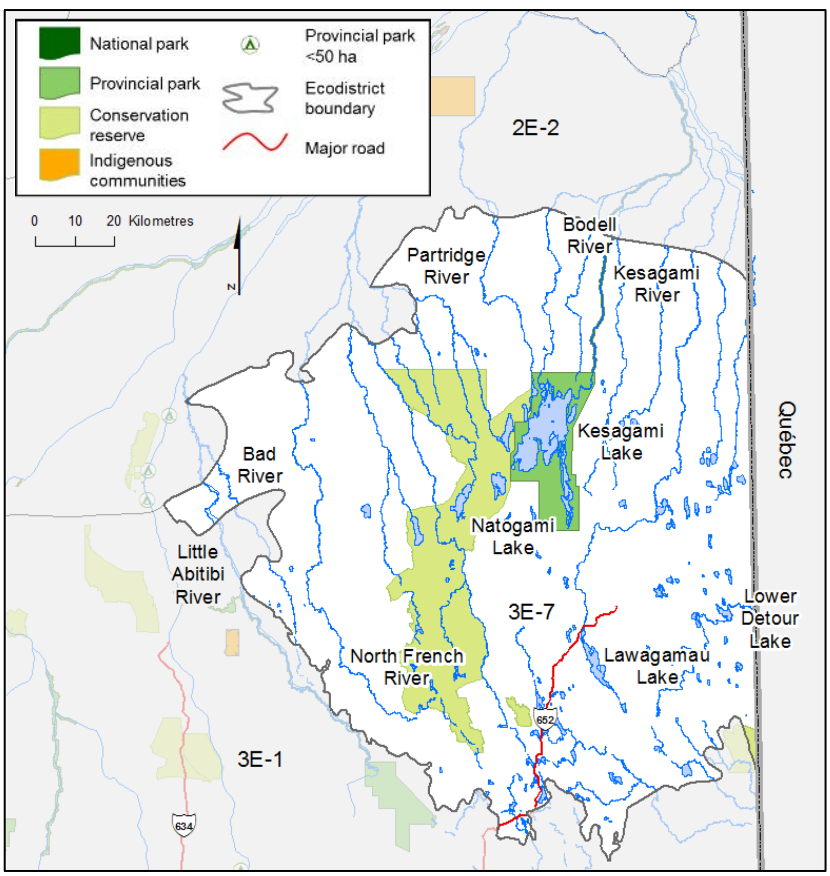


Figure 113. Select natural heritage areas, major road, lakes, and rivers in Ecodistrict 3E-7.

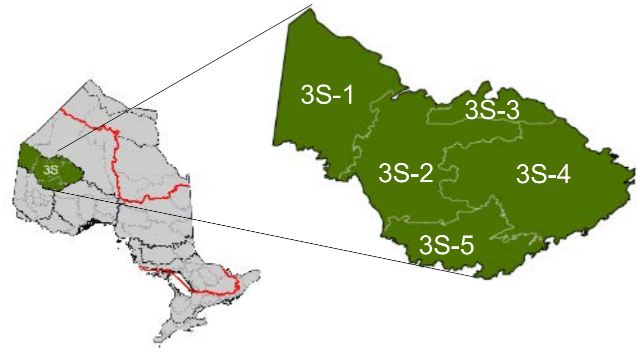
Ecodistrict boundary delineation

Originally described as Site District 2E-3 by Hills (1959), the Kesagami Ecodistrict has since been included in Ecoregion 3E. The alternating Mesisols, Gleysols, and Gray Luvisols are similar to the substrates in Ecoregion 3E, particularly Ecodistrict 3E-1, while Ecoregion 2E is dominated by Fibrisols that have developed over glaciomarine deposits. The transition from Precambrian bedrock in Ecoregion 3E to Paleozoic bedrock in Ecoregion 2E and a warmer, wetter climate in 3E delineates the northern boundary. This boundary also reflects the transition between a landscape dominated by morainal and organic material in 3E-7 to organic accumulations in 2E-2. In the south and west, 3E-7 is wetter and the topography is subdued relative to 3E-1. The eastern boundary is defined by the province of Québec.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecoregion 3S

Lake St. Joseph Ecoregion



The Lake St. Joseph Ecoregion extends east from the Manitoba border to the fork of the Albany and Misehkow rivers. It is located north of Red Lake and south of the Agutua-Windigo Moraine. This ecoregion comprises five ecodistricts in the Ontario Shield Ecozone (Table 5).

Table 5. Ecodistricts in Ecoregion 3S.

Ecodistrict	Ecodistrict name
3S-1	Berens River Bedrock Plateau
3S-2	Throat River Plain
3S-3	Agutua Moraine (Windigo Lobe)
3S-4	Pickle Lake Drumlin Field
3S-5	St. Raphael Lake

Located on the Precambrian Shield, the underlying bedrock is primarily granite and gneiss with a small amount of metavolcanic rock in a south-central to east-west band. Eskers and moraines interrupt a gently rolling landscape of morainal material over bedrock. Glaciolacustrine deposits, exposed bedrock, and organic materials are also present. Ruggedness and elevation increases along the southern boundary connected with the extensive Hartman-Lac Seul-Trout Lake morainal system.

Acidic morainal materials dominate the ecoregion. Dystric Brunisols are the predominant substrate type, followed by Mesisols in poorly drained low-lying areas, weakly developed Humo-Ferric Podzols, Gray Luvisols, and Gleysols. Variable depths of folisolic material occur on shallow bedrock sites.

Shallow to moderately deep substrates and a relatively dry climate create conditions for frequent and intense wildfires. Stand-replacing fires typically occur in areas dominated by coniferous forests that cover a third of the land base. Other types of land cover include sparse forests, mixed forests (Figure 114), and bog complexes.

Most rivers in the Lake St. Joseph Ecoregion flow through the Hudson Bay Watershed; however, some move westward through the Nelson Watershed into Manitoba. Major river systems include the Severn, Albany, and Berens rivers. Important lakes in the area include Lake St. Joseph, Pikangikum Lake, and Cat Lake.

A variety of upland and lowland sites supporting boreal vegetation can be found. Open jack pine-lichen woodlands often occur on dry sites. Jack pine and black spruce grow on upland sites and, depending on the time since the last fire, white spruce and balsam fir may also occur. Trembling aspen and paper birch grow in the conifer dominated areas or form deciduous forests on their own. In the lowland areas, large open peatlands are dominated by black spruce and American larch. Balsam poplar and black ash may grow in the lowlands but are also found in riparian areas on rich mineral substrates.

Mammal species include American mink, wolverine, and woodland caribou. Birds include common loon, bald eagle, and white-throated sparrow. American toad, wood frog, and red-sided gartersnake also inhabit this ecoregion. Fish species include lake sturgeon, walleye, and the less widely distributed goldeye.

Figure 114. Mixed and coniferous forest found near Brunette Lake. Gerry Racey, MNRF.

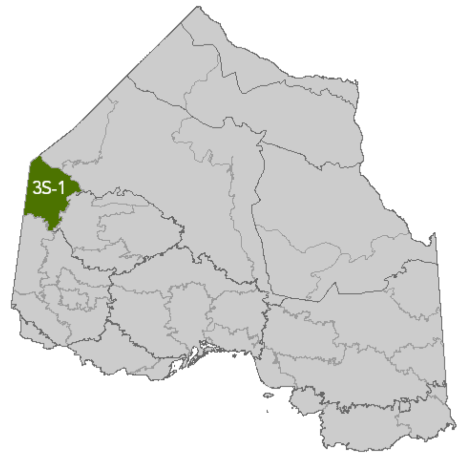
Indigenous communities include Cat Lake, Slate Falls, and Pikangikum. Land use activities typically include fishing, hunting, and trapping; however, mineral exploration and timber harvesting are increasing.

Six types of natural heritage areas have been established in Ecoregion 3S (Gray et al. 2009), including St. Raphael Lake Provincial Park which features a red pine stand with several pockets of old growth (Ontario Parks 2001c).

Major moraine systems (e.g., Trout Lake and Agutua-Windigo), in part, coincide with the northern and southern boundaries of the ecoregion. The northern boundary between Ecoregion 3S and 2W is also based on a warmer mean annual temperature in 3S. A cooler, wetter climate in Ecoregion 3S as well as differences in bedrock help to differentiate it from 4S. Ecoregion 3S is mostly composed of granite and tonalite, whereas 4S includes metavolcanics and metasedimentary bedrock. The boundary between Ecoregion 3S and 3W is defined by cooler, drier conditions in 3S and the transition from shallow to moderately deep mineral material in 3S to very shallow material in 3W.

Ecodistrict 3S-1

Berens River Bedrock Plateau Ecodistrict



Encompassing 1,676,450 ha (25.3% of the ecoregion; 1.7% of the province), Ecodistrict 3S-1 extends from the Manitoba-Ontario border in the west to east of McInnes Lake and the community of Pikangikum. The northern boundary is located north of the Cobham River and the southern near Kirkness Lake. Elevation ranges from 290 m above sea level along rivers in the northwest to 451 m above sea level in the southeast, east of Kirkness Lake.

Figure 115. Sparse and mixed forests south of the community of Deer Lake. Bill Crins, MNRF.

Key features

- Sparse and coniferous forests occupy over half of the ecodistrict (Figure 115).
- Precambrian bedrock, exposed or with a very shallow mineral material layer, covers nearly three-quarters of the ecodistrict.
- Forest fires, small and frequent or large and intense, shape the landscape.

Geology and substrates

The Berens River Bedrock Plateau Ecodistrict is a gently rolling landscape of Precambrian bedrock (Figure 116) with a very shallow mineral material overburden. Approximately 10,000 years ago, glacial Lake Agassiz inundated the area in the south, expanding to the north as the glaciers retreated (Dyke 2004). Variability in the size and depth of the lake and wave action removed much of the surface material, exposing bedrock, and depositing mineral material in lowland areas (Harvey et al. 1980). Deeper acidic deposits of coarse-textured morainal materials occur east of the community of Pikangikum and adjacent to Kirkness Lake. A moraine can be found in the southeast. Neutral to calcareous fine-textured glaciolacustrine deposits from glacial Lake Agassiz occur in the central part of the ecodistrict near Barton Lake. Limited quantities of glaciofluvial deposits occur in the southeast adjacent to the moraine. Organic materials are localized in low-lying, poorly drained areas.

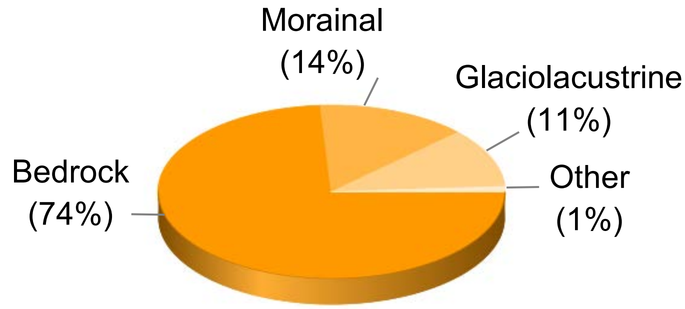


Figure 116. Modes of deposition in Ecodistrict 3S-1.

Bedrock, typically acidic with a discontinous layer of mineral material, covers nearly three-quarters of the ecodistrict (Figure 117). Bands of base-rich bedrock occur along the shore of McInness Lake, southeast of the community of Deer Lake, and south of the Cobham River near the Ontario-Manitoba border. In the southeast, Dystric Brunisols have developed in coarse-textured material typically associated with deeper morainal or glaciofluvial deposits. Gray Luvisols have developed in better drained, typically glaciolacustrine, sites near the community of Poplar Hill, Stout Lake, and the Berens River extending to the community of Pikangikum. Organic deposits are limited, typically found adjacent to lakes and rivers and in bedrock depressions. Localized pockets of discontinuous permafrost may occur in the extreme northwest (Smith and Burgess 2004).

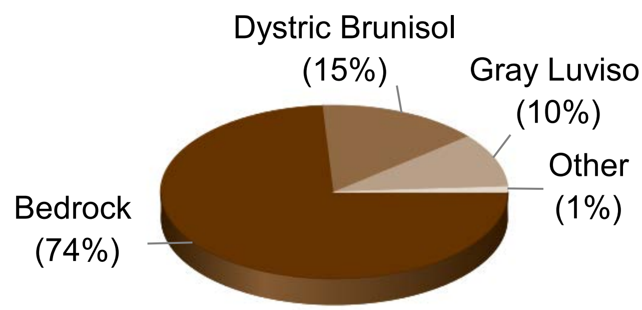


Figure 117. Substrate types in Ecodistrict 3S-1.

Land cover and vegetation

Ecodistrict 3S-1 is associated with the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous Section (B.22a) of the Boreal Forest Region (Rowe 1972). Sparse forests with visible ground cover have developed over one-third of the land base, typically in the western half of the ecodistrict (Figure 118). Coniferous forests dominated by black spruce are also common, occurring mainly in the southeast and along the northern border (Figure 119). Common associates include jack pine on very shallow sites and American larch on moister sites.

The ecodistrict is highly susceptible to small, frequent fires (Van Sleeuwen 2006). Large, high intensity surface fires or stand-replacing crown fires may also occur, especially in conifer forests (Van Sleeuwen 2006). In Ecodistrict 3S-1, fire intensity is typically higher than that in adjacent areas due to very shallow mineral material and a drier climate. Old burns with sparse vegetation (i.e., regenerating depletion) and more recent burns cover nearly one-fifth of the land base. Mixed forests consisting of black spruce, white spruce, balsam fir, paper birch, and trembling aspen typically occur in the central and southeastern parts of the ecodistrict. White spruce is commonly associated with lakes and river systems. Extensive areas of exposed bedrock occur in the north and along the Manitoba border. Deciduous forests grow along lakes and rivers, mainly in the central to southern regions, and small pockets of bog and fen complexes are scattered throughout the area.

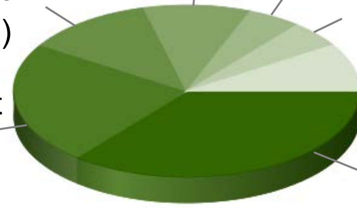


Figure 118. Land cover types in Ecodistrict 3S-1.

Figure 119. Coniferous and mixed forests of Ecodistrict 3S-1. Gerry Racey, MNRF.

Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area. Also present, but less common across the landscape, are western species affiliated with grasslands including Richardson’s alumroot (Noble 1998c). Alaska paper birch may occur and black ash reaches its northern limit here. Increased plant species richness is evident in some areas of shallow substrates over base-rich bedrock or calcareous materials where substrate nutrient availability is greater.

Land use

The communities of Pikangikum, Deer Lake, and Poplar Hill are located in Ecodistrict 3S-1. Settlement and infrastructure related to these communities represent less than 1% of the area (Figure 120). Approximately 12.6% of the ecodistrict is designated as protected areas. Principal land uses include timber harvesting, trapping, hunting, fishing, hydroelectric generation, and the provision of services associated with resource-based activities.

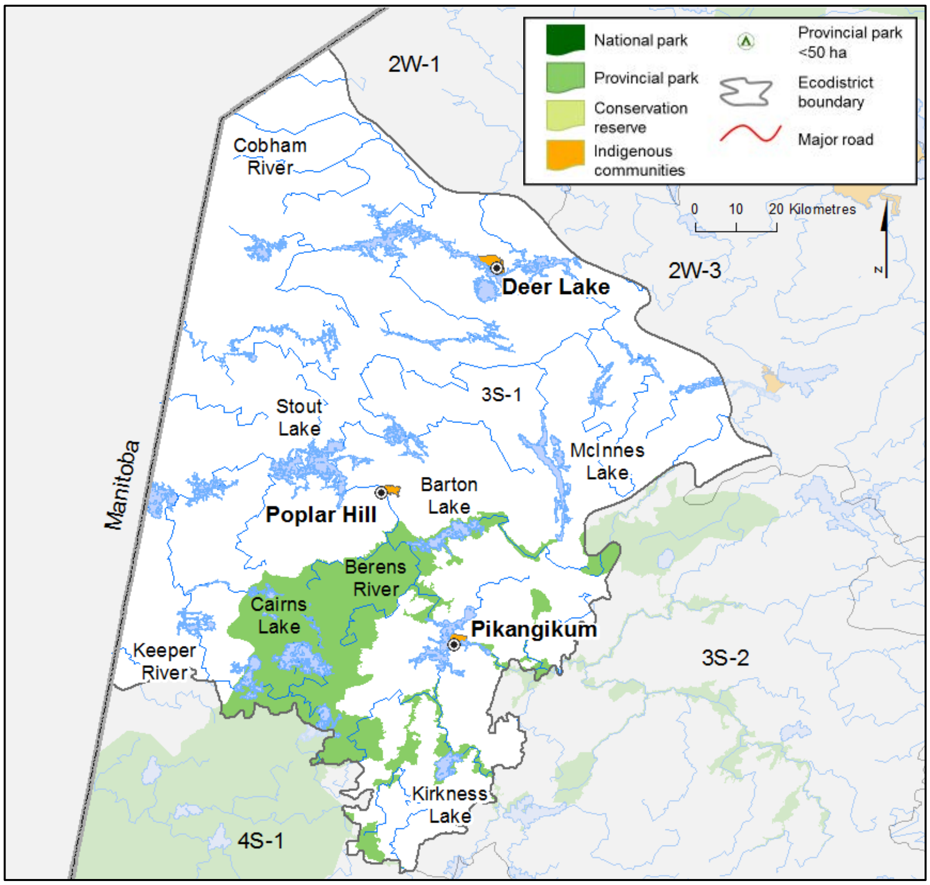


Figure 120. Select communities, natural heritage areas, lakes, and rivers in Ecodistrict 3S-1. (Note that Barton Lake is also referred to as Sheshepaeseewee Sahkaheekahn, McInnes Lake as Oooowee Sahkaheekahn, Cairns Lake as Keechewahshaykahmeeshek, and Kirkness Lake as Wahshaykahmeesheeng).

Ecodistrict boundary delineation

In 1961, Hills updated his 1959 site region classification dividing Site Region 3W, which spanned from the Manitoba-Ontario border to east of Lake Nipigon, into a western site region (i.e., 3S) and an eastern site region (i.e., 3W) based on climatic variables (e.g., humidity gradient) and the response of vegetation to landform features (Hills 1959, 1961). The subdivision of Ecoregion 3S into five ecodistricts, as proposed by Crins and Uhlig (2000), is based on newer climatic and geological data that allows for a better understanding of underlying controlling variables.

The northern boundary is defined by ecoregional climatic attributes where Ecoregion 3S is warmer and wetter than 2W. This coincides with the transition from very shallow mineral material in Ecodistrict 3S-1 to deeper mineral materials, typically Dystric Brunisols and Gray Luvisols in 2W-1 and 2W-3. The eastern boundary with 3S-2 marks the transition from very shallow mineral material in 3S-1 to shallow to moderately deep deposits in 3S-2. The border is also marked by a moraine and the margins of a large glaciolacustrine deposit in 3S-2. The southern boundary with 4S is correlated with bedrock types and is supported by climatic variables. The underlying bedrock in Ecoregion 3S is mainly granite and tonalite, whereas Ecoregion 4S is more geologically diverse including metavolcanics and metasedimentary rock. Ecoregion 3S is also typically cooler and wetter than 4S. The western boundary is defined by the Manitoba-Ontario border.

Whitefeather Forest Cheemuhnuhcheecheekuhtaykeehn (dedicated protected areas)

Spanning Ecodistrict 3S-1 and 3S-2, the Whitefeather Forest Cheemuhnuhcheecheekuhtaykeehn are a collection of five protected areas. The sites have been identified for their geographic and landform characteristics, ecological and cultural features, life and earth science values, and recreational features. The waterways of the Beekahncheekahmeeng Deebahncheekayweehn Eenahohnahnuhn (Figure 121) in the southeastern portion of 3S-1 define the Whitefeather landscape. They serve as travel routes and are used for traditional activities, including hunting and cultural purposes. Several sacred sites are found within the ecodistrict's boundaries (Ontario Parks and The Whitefeather Forest Management Corporation 2010).

Figure 121. Beekahncheekahmeeng Deebahncheekayweehn Eenahohnahnuhn. Phil Kor, MNRF.

Ecodistrict 3S-2

Throat River Plain Ecodistrict

Situated roughly in the centre of Ecoregion 3S, Ecodistrict 3S-2 extends from Nungesser Lake eastward to Birch Lake, including a northern finger that extends past Whitestone Lake to Kinloch Lake. The northern boundary occurs at MacDowell Lake and extends south to Confederation and Jeanette lakes. The topography is gently rolling with a lower elevation of 329 m above sea level near Berens Lake and an upper elevation of 489 m above sea level west of Trout Lake along the Lac Seul Moraine. The Throat River Plain Ecodistrict is approximately 1,615,655 ha (24.4% of the ecoregion, 1.6% of the province).

Figure 122. Coniferous forests of Ecodistrict 3S-2. Rob Foster, Northern Bioscience.

Key features

- Over two-thirds of the ecodistrict is covered by coniferous and sparse forests (Figure 122).
- Morainal material, typically acidic and coarse-textured, dominates the area.
- In the southwest, the Lac Seul Moraine is a prominent feature on the landscape.

Geology and substrates

Ecodistrict 3S-2 is characterized by morainal material overlying Precambrian bedrock (Figure 123). Approximately 9,000 years ago (Dyke 2004), as the ice margin retreated, it left behind a blanket of morainal material of variable depths across the area. Typically shallow to moderately deep, deeper morainal deposits occur in the south, including small moraines (i.e., DeGeer moraines) found between Trout Lake and Kinloch Lake. These ridges result from morainal material deposited at the edge of a glacier that was in almost continuous contact or potentially floating in glacial Lake Agassiz, which expanded northward as the ice margin retreated (Noble and Kor 1997). A prominent feature along the western boundary is the Lac Seul Moraine, which stretches from MacDowell Lake along the ecodistrict boundary with 3S-1 to west of Trout Lake along the boundary with 4S-2 (Prest 1963, Noble and Kor 1997).

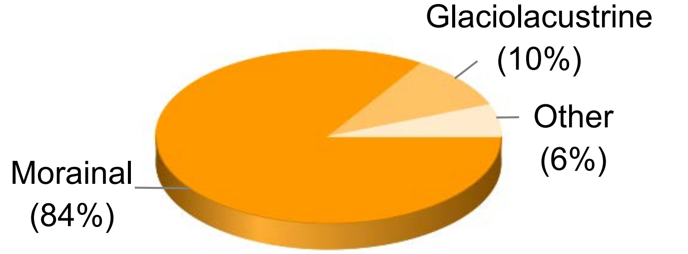


Figure 123. Modes of deposition in Ecodistrict 3S-2.

Glaciolacustrine deposits, neutral to calcareous lake bed remnants of glacial Lake Agassiz, occur north and south of Sampson Lake, west of Kinloch Lake, and south of Trout Lake. Glacial Lake Agassiz modified morainal and glaciofluvial features, shifting mineral material and creating beaches, bluffs, and wave washed areas. Relict beaches and bluffs occur along the Lac Seul Moraine, on portions that remained above the surface of the lake (Prest 1963). Glaciofluvial deposits, typically associated with moraines, occur along the western and southern edges of the ecodistrict. In low-lying areas, organic deposits have accumulated, often adjacent to glaciolacustrine material. Bedrock, exposed at the surface or with a very shallow layer of mineral material is limited. Aeolian deposits are restricted, occurring near the western shore of Trout Lake (Noble 1998c).

The Throat River Plain Ecodistrict is dominated by Dystric Brunisols (Figure 124) which have developed in morainal and glaciofluvial deposits. Gray Luvisols occur on better drained fine-textured sites around MacDowell and Sampson lakes. Mesisols have developed in poorly drained depressions with larger accumulations occuring west of the Morris River and east of the Flanagan River. Bedrock material exposed at the surface is limited throughout the ecodistrict. The underlying bedrock is typically acidic; however, bands of base-rich bedrock occur from Birch Lake to Confederation Lake.

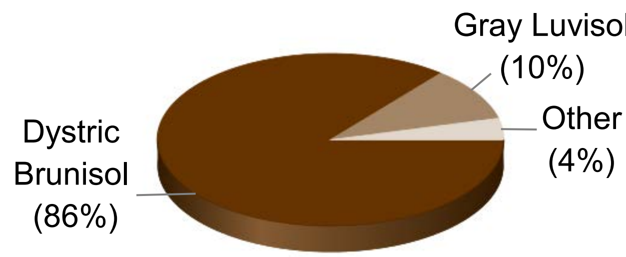


Figure 124. Substrate types in Ecodistrict 3S-2.

Land cover and vegetation

Ecodistrict 3S-2 is found in the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) allocated the ecodistrict to the Northern Coniferous Section (B.22a) of the Boreal Forest Region. Coniferous forests, characterized by black spruce, grow over one-third of the ecodistrict, particularly near Trout Lake and in the south (Figure 125).

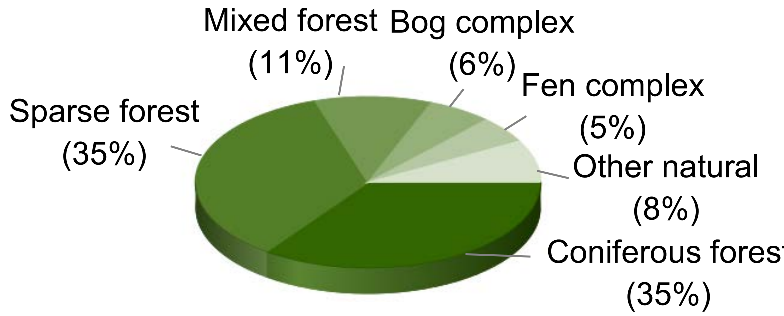


Figure 125. Land cover types in Ecodistrict 3S-2.

Jack pine forests are restricted to drier upland sites, while American larch grows with black spruce on moister sites. Sparse forests occur more often in the northwest and central portions of the ecodistrict. Mixed forests of black spruce, white spruce, balsam fir, trembling aspen, and paper birch are scattered across the landscape. White spruce is more prevalent adjacent to rivers and lakes. Wetland systems east of the Flanagan River and west of the Morris River support bog and fen complexes (Figure 126). Limited amounts of the land base are characterized as old or recent burns (referred to as regenerating depletion). Small fires are common but larger, high intensity surface fires or stand-replacing crown fires do occur, especially in coniferous forests (Van Sleeuwen 2006). Growing season drought can increase fire intensity. Bedrock and deciduous forests composed primarily of trembling aspen and paper birch are limited. Marshes may occur along the margin of lakes.

Figure 126. Wetland complex along Harley Creek, northeast of Sampson Lake. Phil Kor, MNRF.

Increased plant species richness may be found in areas of base-rich bedrock or on calcareous mineral material where substrate nutrient availability is greater. Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area while black ash and American elm reach their northern limits here.

Land use

Mineral exploration, trapping, hunting, fishing, aggregate extraction, and the provision of services associated with resource-based activities are the major land uses in Ecodistrict 3S-2. Area devoted to infrastructure and settlement is less than 1% and includes the village of MacDowell (Figure 127). Protected areas cover approximately 11% of the ecodistrict.

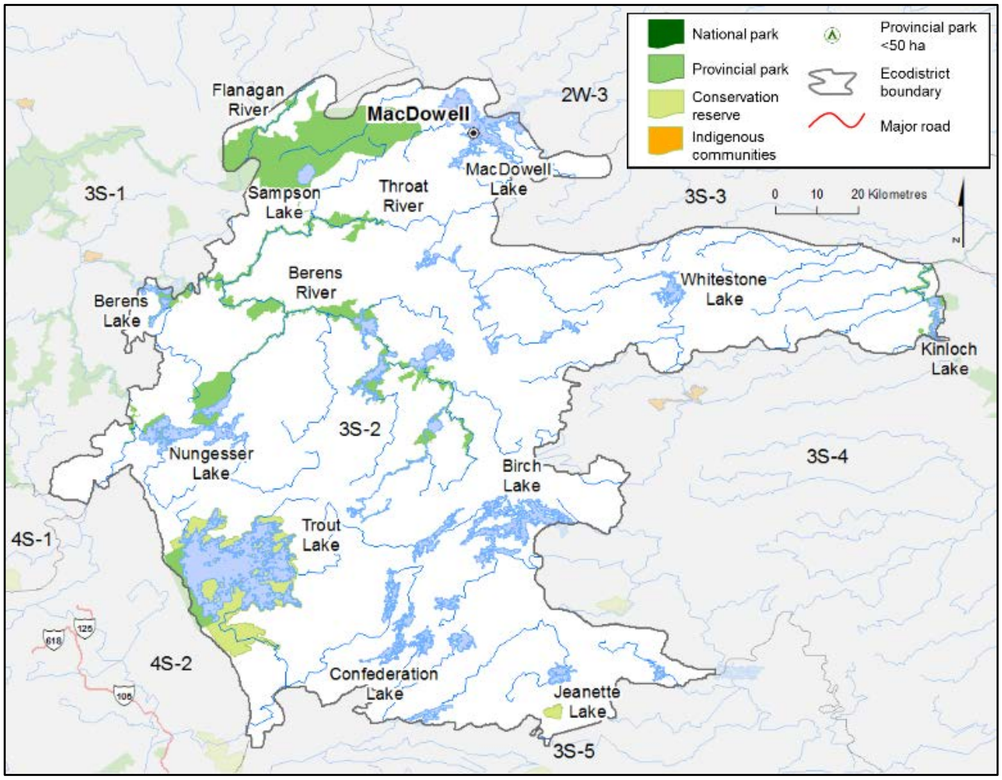


Figure 127. Select communities, natural heritage areas, and lakes in Ecodistrict 3S-2. (Note that Berens Lake is also referred to as Peekwatahmaewee Sahkaheekahn, Sampson Lake as Mahkahtahkahmaekoo Sahkaheekahn, and Nungesser Lake as Ooshkahtahkahwee Sahkaheekahn.)

Ecodistrict boundary delineation

Revisions to Hills' (1959) site regions of Ontario truncated the western part of Site Region 3W to form Site Region 3S (Hills 1961) based on climatic variables, including the humidity gradient and vegetation response to landform features. Using newer climatic and geological data, Crins and Uhlig (2000) subdivided the ecoregion into five ecodistricts based on a better understanding of the core ecological principles that influence the landscape.

The western boundary with Ecodistrict 3S-1 marks the transition from shallow to moderately deep mineral material deposits in 3S-2 to very shallow mineral sediments in 3S-1. The border is also marked by a moraine and the margins of a large glaciolacustrine deposit in 3S-2. Ecoregional climatic attributes help define the northwestern boundary with Ecoregion 2W. Typically, Ecoregion 3S is warmer and wetter than 2W. In addition, the boundary reflects the transition of shallow to moderately deep mineral material in 3S-2 to deep mineral deposits in the southern portion of 2W-3. In the northeast, the boundary with 3S-3 is defined by a linear band of glaciofluvial deposits in 3S-3 and a transition from morainal deposits in 3S-2 to organic accumulations in 3S-3. In the east, the boundary reflects the change from shallow to moderately deep morainal material in 3S-2 to deep morainal material in 3S-4. The southern boundary represents the transition from deeper morainal deposits that occur in the southern part of 3S-2 to shallow to moderately deep morainal deposits in 3S-5. The southwestern boundary with 4S coincides with bedrock types and ecoregional climatic variables. The underlying bedrock in Ecodistrict 3S is mainly granite and tonalite, whereas Ecodistrict 4S is more geologically diverse with metavolcanics and metasedimentary rock. Ecoregion 3S is also typically cooler and wetter than 4S. The southwestern boundary of 3S-2 with 4S-2 is also defined by part of the Lac Seul Moraine.

Pinesiwachiink — Where the Thunderbirds live

Along the west edge of Trout Lake, the steep terrain of the Lac Seul Moraine rises above a relatively flat landscape (Figure 128). The moraine forms a thin, nearly continuous 600 km linear ridge from MacDowell Lake to Lake Nipigon (Noble 1998c).

The Lac Seul Moraine or Pinesiwachiink as it is referred to by the Namekosipiiw Anishinaapek remains a culturally significant feature on the land base (OMNR 2005d).

Figure 128. Lac Seul Moraine, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3S-3

Agutua Moraine (Windigo Lobe) Ecodistrict

The smallest ecodistrict in Ecoregion 3S, Ecodistrict 3S-3 covers an area of 394,741 ha (6.0% of the ecoregion, 0.4% of the province). It extends from Mix Lake in the west to the Pineimuta River in the east. The northern limit occurs along the south shore of Upper Windigo Lake, stretching south for approximately 50 km to south of the Pipestone River. The flat landscape ranges in elevation from 340 m above sea level south of Upper Windigo Lake to 469 m above sea level east of Mix Lake.

Key features

- Coniferous and sparse forests cover over half of the area (Figure 129).
- The ecodistrict is dominated by organic material.
- Contains the Windigo Lobe, the southern lobe of the Agutua-Windigo Moraine.

Figure 129. Kishikas Lake esker and kettle complex. Bill Crins, MNRF.

Geology and substrates

The subdued, poorly drained topography of Ecodistrict 3S-3 has resulted in the accumulation of a layer of organic material of variable depth throughout the ecodistrict (Figure 130).

Organic deposits have developed over Precambrian bedrock in the south and east, and morainal and glaciolacustrine material in the north and west. Deeper organic deposits occur in the east and in the central part of the Agutua Moraine Ecodistrict.

Glaciofluvial deposits, typically associated with east-west trending eskers, are located throughout the ecodistrict. Deeper morainal deposits are limited. The Windigo Lobe, also referred to as the Brunette Lake Interlobate Moraine (Noble and Kor 1997), occurs in the northern part of the ecodistrict as the southern extension of the Agutua-Windigo Moraine. Drumlins can be found south of McCauley Lake (Prest 1963). The modifying effects of glacial Lake Agassiz, which inundated the area roughly 9,000 years ago (Dyke 2004), are evident along the moraine in the form of relict beaches and beach bluffs (Noble and Kor 1997). The glacial lake also deposited neutral to calcareous glaciolacustrine material in low-lying areas (Harvey et al. 1980). Bedrock outcrops are limited. The underlying Precambrian bedrock is generally acidic; however, base-rich bedrock occurs north of Vollett Lake and a band runs through the southern half of Horseshoe Lake. Aeolian deposits occur east of Kiskikas River (Noble 1998c).

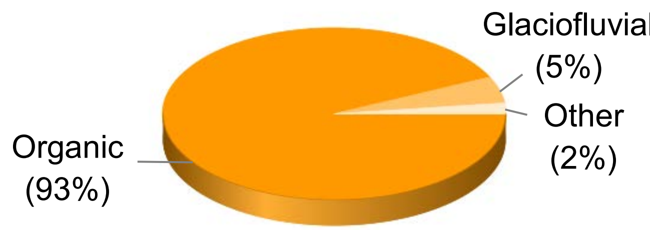


Figure 130. Modes of deposition in Ecodistrict 3S-3.

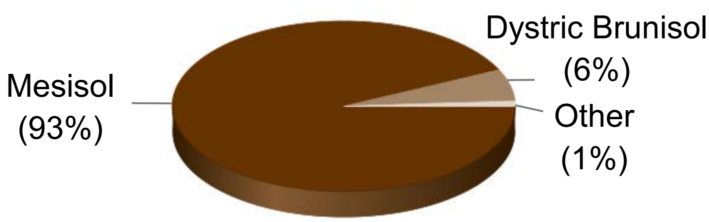


Figure 131. Substrate types in Ecodistrict 3S-3.

Mesisol accumulations dominate the ecodistrict having developed on the poorly drained landscape (Figure 131). Dystric Brunisols occur in better drained areas, typically on deeper glaciofluvial and morainal deposits. Gleysols are common in low-lying, poorly drained areas where organic material has not accumulated. Localized discontinuous permafrost may occur in the north (Smith and Burgess 2004).

Land cover and vegetation

Ecodistrict 3S-3 is associated with the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous Section (B.22a) of the Boreal Forest Region (Rowe 1972). Coniferous forests, generally dominated by black spruce, occur throughout (Figure 132), with more extensive areas occurring near and north of Kishikas Lake. On wetter sites, American larch may also grow, and upland sites may be dominated by jack pine, particularly in areas affected by fire. Sparse and mixed forests may include black spruce, jack pine, balsam fir, trembling aspen, and paper birch. White spruce is a common associate of mixed forests near lakes and rivers.

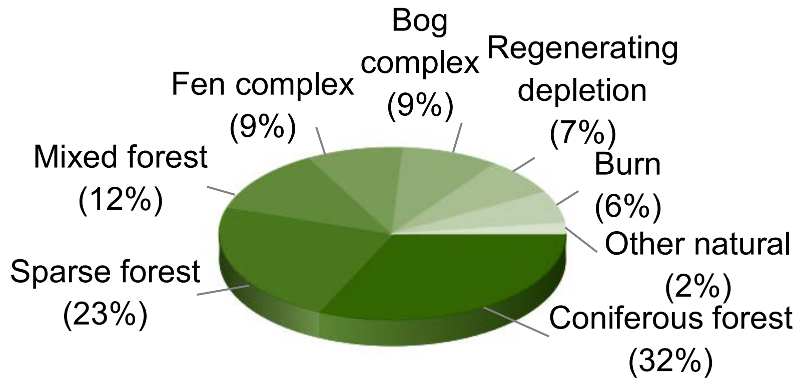


Figure 132. Land cover types in Ecodistrict 3S-3.

Bog and fen complexes occur on deeper accumulations of organic material in the east and central portions of the ecodistrict (Figure 133). Old fires (i.e., regenerating depletion) and recent burns occur west of Horseshoe Lake, south of the Pipestone River, and in the west. Although the substrates are primarily organic, the dry climate creates an environment that is susceptible to fire. The forest fire regime is characterized by small, frequent fires with occasional high intensity surface and stand-replacing crown fires (Van Sleeuwen 2006). Deciduous forest and bare bedrock are limited. Areas of trembling aspen and paper birch occur on well drained, warmer-than-normal slopes typically associated with the Agutua-Windigo Moraine.

Increased plant species richness may occur in areas of calcareous mineral material or base-rich bedrock where substrate nutrient availability is greater. Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area and species that reach their northern limit here include black ash.

Figure 133. Patterned fen in a wetland complex near Kishikas Lake. Bill Crins, MNRF.

Land use

Infrastructure and settlement are limited in Ecodistrict 3S-3 (Figure 134). Major land uses include trapping, hunting, fishing, and the provision of services associated with resource-based activities. Roughly 0.2% of the ecodistrict is designated as protected areas.

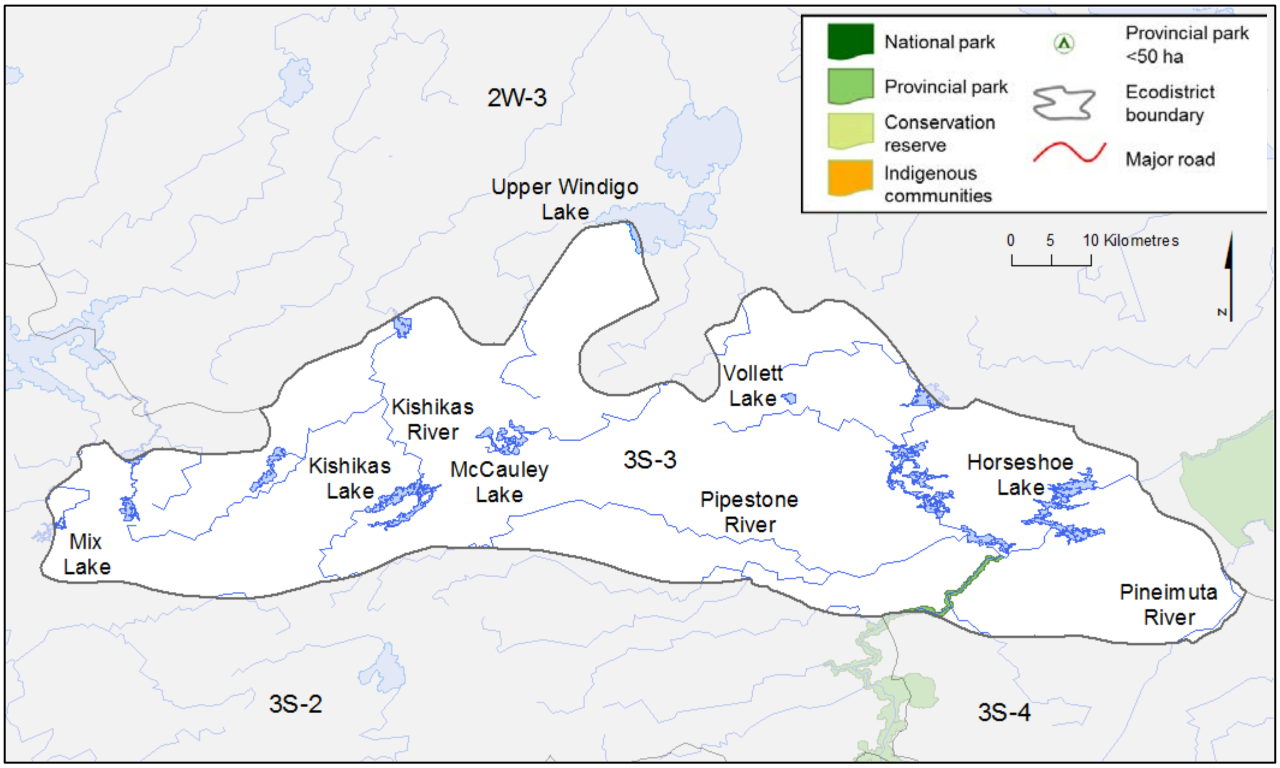


Figure 134. Select natural heritage area, rivers, and lakes in Ecodistrict 3S-3.

Ecodistrict boundary delineation

The ecoregional classification for Ontario developed by Hills (1959) did not distinguish Ecoregion 3S as a distinct landscape. Instead the area was incorporated into Site Region 3W. In 1961, based on a re-examination of climatic variables, primarily humidity, and vegetation response to landform features, the western portion of Site Region 3W was separated to form Site Region 3S (Hills 1961). In 2000, using newer climatic and geological data, Crins and Uhlig (2000) delineated the area into five distinct ecodistricts.

In the north and east, the transition from organic accumulations in Ecodistrict 3S-3 to mineral material in 2W-3, the presence of the Agutua-Windigo Moraine in 2W-3, as well as ecoregional climatic differences (i.e., Ecoregion 3S is warmer and wetter) delineate the boundary between 3S-3 and 2W-3. The southern boundary with 3S-4 and southern and western boundary with 3S-2 reflect the change from organic material in 3S-3 to morainal deposits in 3S-2 and 3S-4. The southern boundary is also defined by a thin band of glaciofluvial material in 3S-3.

Glacial features in Ecoregion 3S

Surficial features of Ecoregion 3S are the result of deglaciation that occurred approximately 8,000 to 10,000 years ago (Dyke 2004). An initial retreat northeastward of the glacier that covered 3S permitted the expansion of glacial Lake Agassiz over much of the area. A significant readvance of the ice sheet built the Lac Seul Moraine (Figure 135). As the glacier retreated, glacial Lake Agassiz again inundated the area, modifying the morainal deposits and leaving behind beach features. Small moraines signify minor halts in the retreating glacier and DeGeer moraines found between the Lac Seul Moraine and the Agutua-Windigo Moraine indicate that the ice sheet was in contact or floating in glacial Lake Agassiz. The Agutua-Windigo Moraine was formed by a minor readvance of the glacier and similar to the Lac Seul Moraine shows evidence (e.g., beach features) of submergence in glacial Lake Agassiz. One of the largest in Ontario, the Agutua-Windigo Moraine marks the boundary between Ecoregion 2W and 3S. Large esker complexes, kettles, kames, and subaquatic fans can also be found across the region (Noble and Kor 1997).

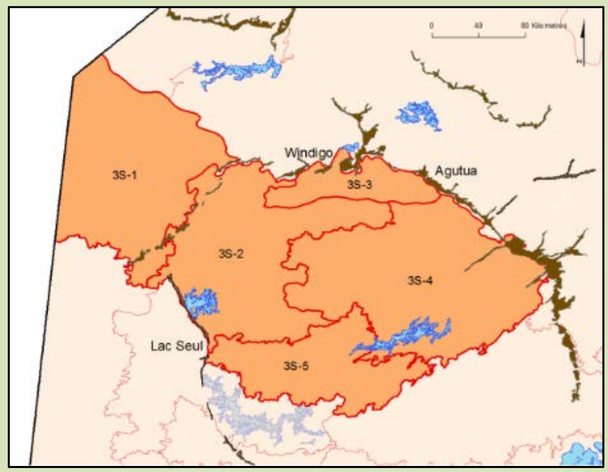


Figure 135. Moraines in Ecoregion 3S (adapted from Sado and Carswell 1987).

Ecodistrict 3S-4

Pickle Lake Drumlin Field Ecodistrict

Ecodistrict 3S-4 extends from Cat Lake in the west to the fork of the Albany and Misehkow rivers in the east, and south from the Pineimuta River to south of Lake St. Joseph. The ecodistrict encompasses 2,036,690 ha (30.7% of the ecoregion, 2.1% of the province). The elevation in this gently rolling landscape ranges from 310 m above sea level in the east along the Albany River to 475 m above sea level east of Cat Lake.

Figure 136. Conifer and mixed forests on esker ridge in Ecodistrict 3S-4. Sam Brinker, MNRF.

Key features

- Coniferous forests dominated by black spruce occur on approximately half of the ecodistrict (Figure 136).
- Coarse-textured morainal materials dominate the area.
- Numerous east-west trending eskers, as well as drumlins, occur across the landscape.

Geology and substrates

The gently rolling landscape is dominated by acidic, coarse-textured, morainal material overlying Precambrian bedrock (Figure 137). The underlying bedrock is typically acidic; however, bands of base-rich bedrock occur in the central and southern portions of the ecodistrict. The morainal materials are typically deep, deposited as the glacial ice moved across the area. Areas of shallow to moderately deep mineral material occur in the north and east. Minor changes in elevation are associated with deeper morainal deposits (i.e., drumlins, DeGeer moraines), particularly around the community of Pickle Lake and south. Portions of the Agutua-Windigo Moraine occur along the northeast boundary. Organic deposits have accumulated in poorly drained low-lying areas, particularly in the east and northwest of Lake St. Joseph. East-west trending eskers associated with glaciofluvial deposits occur throughout the ecodistrict.

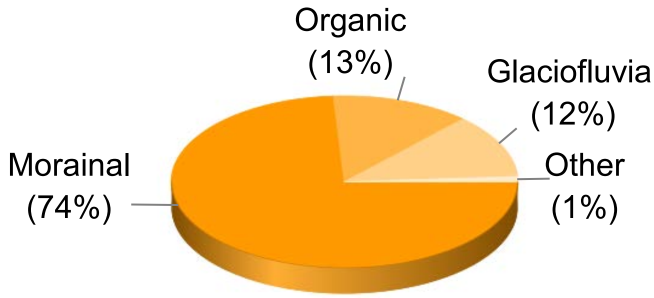


Figure 137. Modes of deposition in Ecodistrict 3S-4.

Approximately 9,000 years ago, much of the ecodistrict was inundated by glacial Lake Agassiz (Dyke 2004). The inundation was brief and little of the morainal material was modified. Most areas were covered by a thin veneer of fine-textured neutral to calcareous glaciolacustrine material; deeper deposits are limited, occurring in the northeast as well as around the Albany River near the boundary with 2W-3. Glacial Lake Agassiz expanded northward as the ice margin retreated. The presence of DeGeer moraines and the relict beaches and beach bluffs along the Agutua-Windigo Moraine are evidence of the continuous contact of the ice margin with the lake (Noble and Kor 1997). Bedrock, exposed at the surface or with a very shallow covering of mineral material, is limited. Alluvial deposits are found adjacent to larger river systems including the Albany River and aeolian material occurs north of Lake St. Joseph (Noble 1998c).

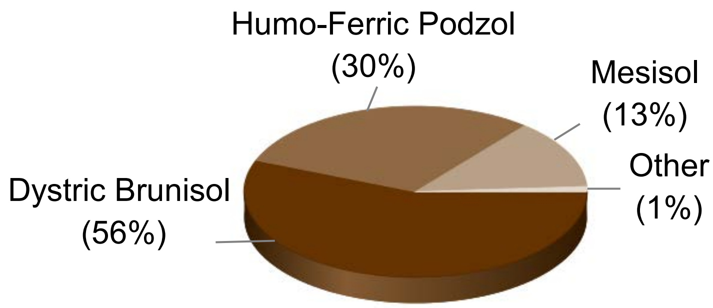


Figure 138. Substrate types in Ecodistrict 3S-4.

The eastern and western portions are characterized by Dystric Brunisols, representing over half of the ecodistrict (Figure 138). Humo-Ferric Podzols have typically developed in better drained sites and are found in a swath through the central part of the ecodistrict. Mesisols have developed in the many low-lying depressions in the east and near Lake St. Joseph. Limited areas of exposed bedrock occur throughout the ecodistrict. Regosols are associated with active mineral sediment (e.g., alluvial material).

Land cover and vegetation

The Pickle Lake Drumlin Field Ecodistrict is associated with the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous (B.22a) (i.e., north of Lake

St. Joseph) and the Central Plateau (B.8) sections of the Boreal Forest Region (Rowe 1972). Approximately half of the ecodistrict is characterized as coniferous forest (Figure 139), particularly in the western and southern portions. Black spruce is common and is often found with jack pine on shallow upland sites (Figure 140) and with American larch in poorly drained areas. Jack pine dominated forests occur on well drained coarse-textured material typically associated with esker complexes.

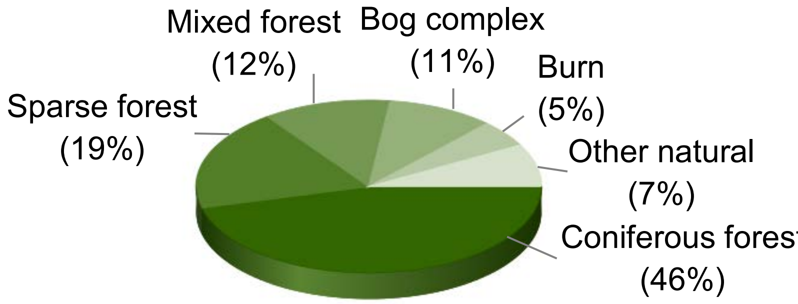


Figure 139. Land cover types in Ecodistrict 3S-4.

Sparse and mixed forests are prominent in the north and east. Bog and fen complexes are scattered throughout the ecodistrict, but are more prevalent along the eastern border in poorly drained areas where organic material has accumulated. Burned areas are limited, occurring more frequently in the north, generally corresponding to areas with shallow morainal material. Fires are typically small and frequent. High intensity surface or stand-replacing crown fires also occur (Van Sleeuwen 2006). Deciduous forests of trembling aspen and paper birch are found on deeper morainal deposits on warmer-than-normal sites. Marshes may occur along rivers and sheltered lake bays.

Figure 140. Black spruce forests on shallow mineral material and lowland complex. Sam Brinker, MNRF.

Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area. Increased plant species richness may occur in areas of base-rich bedrock or calcareous mineral material where substrate nutrient availability is greater. Tree species at their northern limits include American elm, eastern white cedar, and black ash, which may occur on warmer-than-normal sites adjacent to river systems.

Land use

Pickle Lake is the largest community in the ecodistrict (Figure 141). Settlement and infrastructure represent less than 1% of the area. Other land uses include mineral exploration, timber harvesting, aggregate extraction, trapping, hunting, fishing, and the provision of services associated with resource-based activities. The ecodistrict comprises nearly 3.7% protected areas.

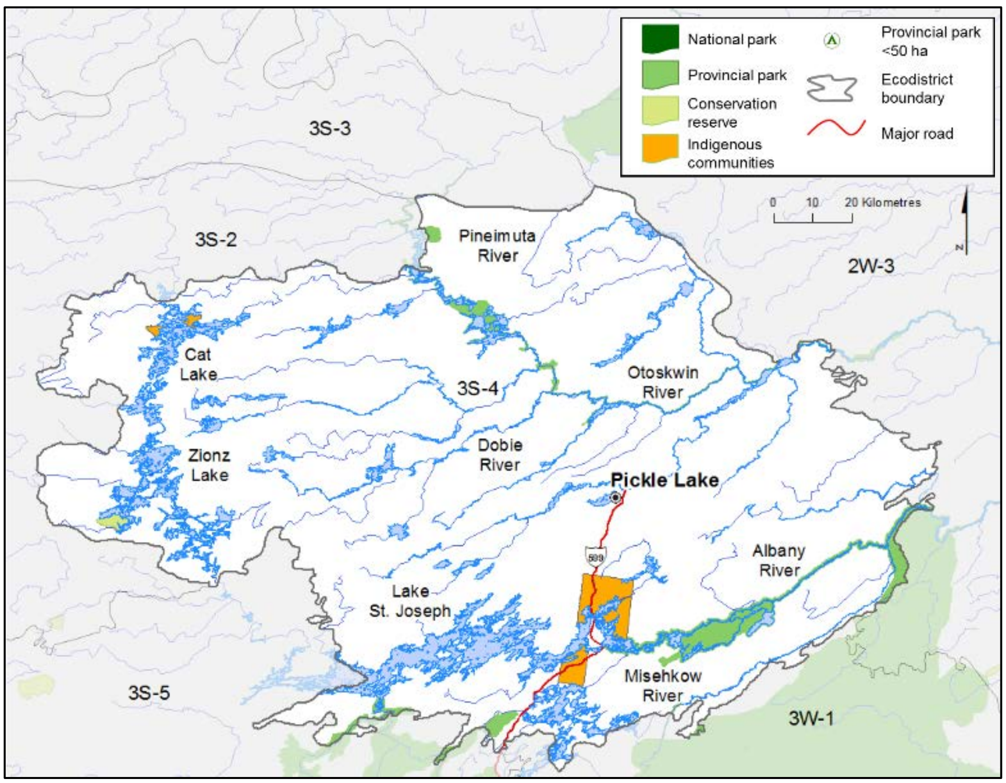


Figure 141. Select community, natural heritage areas, lakes, and rivers in Ecodistrict 3S-4.

Ecodistrict boundary delineation

In 1961, based on climatic variables, in particular humidity, and the response of vegetation to landforms, Hills updated his 1959 site region classification allocating the western portion of Site Region 3W to Site Region 3S (Hills 1959, 1961). Further subdivision of 3S into ecodistricts was completed by Crins and Uhlig (2000), who used newer climatic and geological data to better understand the fundamental influencing ecological attributes.

The western boundary is defined by the change from deep morainal material in Ecodistrict 3S-4 to shallow to moderately deep morainal material in 3S-2. The deeper mineral deposits in 3S-4 also help define the southwest boundary with 3S-5 where it transitions to shallow to moderately deep mineral material. In the north, the boundary reflects the change from morainal deposits in 3S-4 to organic accumulations in 3S-3 and is also defined by a linear band of glaciofluvial deposits in 3S-3. Deep mineral material in 3S-4 compared with very shallow mineral material in 3W-1 along with differences in ecoregional climate (e.g., Ecoregion 3S is drier and cooler than 3W) help define the southeastern boundary. The Agutua-Windigo Moraine and ecoregional climatic attributes delineate the eastern boundary with 2W-3. On average Ecoregion 3S is warmer and wetter than 2W.

Glacial deposits

Ecodistrict 3S-4 is rich in topographic features left by glaciers approximately 9,000 years ago (Dyke 2004). Drumlins, low teardrop shaped hills, deposited at the base of a glacier and then overridden as the ice advanced (Sims and Baldwin 1991), are found across the ecodistrict (Figure 142). A succession of regularly spaced, narrow moraines, or DeGeer moraines, occur on the landscape. These features suggest that the glacier margin was in almost continuous contact or floating in glacial Lake Agassiz (Noble and Kor 1997). Esker ridges are also present, typically composed of sand and gravel, deposited by water that flowed through a tunnel underneath a glacier. Each ridge can be several kilometres long and form a 'snake-like' or sinuous ridge across the landscape.

Figure 142. Forested drumlin east of the community of Pickle Lake. Bill Crins, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3S-5

St. Raphael Lake Ecodistrict

The St. Raphael Lake Ecodistrict extends from Bluffy Lake in the west to Miniss Lake and Highway 599 in the east. The southern boundary roughly coincides with Hooker Lake, and the northern boundary is near the community of Slate Falls and Bamaji Lake. Ecodistrict 3S-5 encompasses 902,386 ha (13.6% of the ecoregion, 0.9% of the province). The gently rolling landscape ranges in elevation from 353 m above sea level along the Root River to 490 m above sea level north of the Wapesi River.

Figure 143. Coniferous forests of Ecodistrict 3S-5. MNRF.

Key features

- Black spruce coniferous forests cover approximately half of the land base (Figure 143).
- Morainal material has been deposited over two-thirds of the ecodistrict.
- Area is a complex pattern of minor moraines, eskers, drumlins, and glaciolacustrine deposits.

Geology and substrates

Ecodistrict 3S-5 is dominated by acidic, morainal material of variable depth overlying Precambrian bedrock (Figure 144). Although typically shallow to moderately deep morainal deposits, deeper sediment can be found in a succession of DeGeer moraines that occur across the landscape. Bedrock, exposed at the surface or with a very shallow layer of mineral material, can be found near the eastern and western boundaries. Typically acidic, a long linear band of base-rich bedrock stretches from Papaonga Lake in the northwest to Lake St. Joseph in the northeast. Bedrock ridges occur along the Papaonga River east of Bluffy Lake and along parts of the Wapesi River. Shallow mineral material and exposed bedrock are a result of fluctuating lake levels and wave action from glacial Lake Agassiz removing much of the sediment as it inundated the area approximately 9,000 years ago (Dyke 2004). In areas west of Bluffy Lake and around the northeast arm of Lac Seul, deeper deposits of fine-textured neutral to calcareous glaciolacustrine material from glacial Lake Agassiz are evident. Small pockets of glaciofluvial material often associated with east-west trending eskers are scattered throughout the landscape and organic deposits are interspersed in poorly drained low-lying areas. Alluvial deposits are restricted to larger river systems.

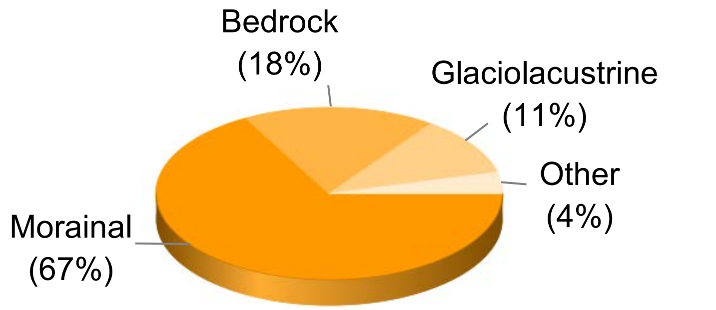


Figure 144. Modes of deposition in Ecodistrict 3S-5.

Dystric Brunisols have developed throughout the ecodistrict, typically in coarse-textured materials (Figure 145). Bedrock occurs in the east around Miniss Lake and in the west from McKenzie Bay to Bluffy Lake. Gray Luvisols are restricted to upland wooded areas in better drained sites primarily on deeper fine-textured glaciolacustrine material. Humo-Ferric Podzols occur in the extreme southeast and Mesisols occur in limited quantities throughout the ecodistrict in low-lying areas. Regosols are associated with alluvial materials.

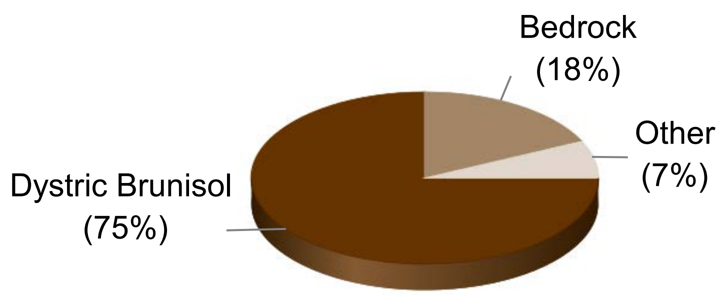


Figure 145. Substrate types in Ecodistrict 3S-5.

Land cover and vegetation

Ecodistrict 3S-5 occurs within the West-Central Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Northern Coniferous (B.22a) and the Upper English River (B.11) sections of the Boreal Forest Region (Rowe 1972). Nearly half of the area is dominated by coniferous forest (Figure 146), which can include black spruce, jack pine, and balsam fir. White spruce is commonly found adjacent to rivers and lakes. Eastern white pine, red pine, and eastern white cedar, which reach their northern limits here, can occur as scattered individuals or isolated forests (Rowe 1972, Cairns 2001), particularly in the southern half of the ecodistrict. American

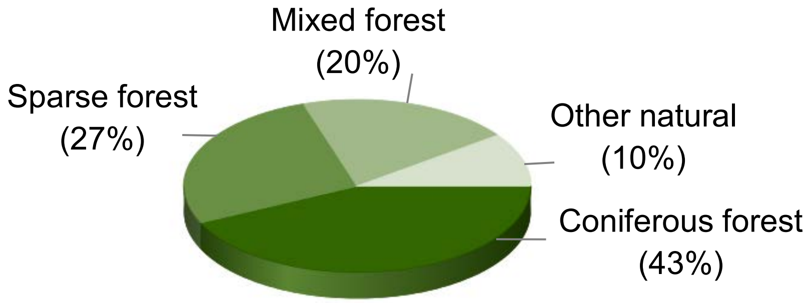


Figure 146. Land cover types in Ecodistrict 3S-5.

larch is a common component with black spruce in low-lying areas, and jack pine frequently occurs on deeper glaciofluvial (e.g., esker) ridges. Sparse forests occur more often in the northwest. Mixed forests that include trembling aspen and paper birch grow along rivers and some lakes (Figure 147). Land cover types that are limited throughout the ecodistrict include burns, bog and fen complexes, marshes, and deciduous forests. When they occur, fires are often high intensity surface or stand-replacing crown fires and small (Van Sleeuwen 2006). Fire frequency increases in areas with very shallow to shallow mineral material. Bog and fen complexes have developed in poorly drained areas and marshes are common along the margins of lakes. Deciduous forests are more common in the south, typically on fine-textured glaciolacustrine materials.

Figure 147. Mixed forest near Hooker Lake. MNRF.

Increased plant species richness may occur in areas of base-rich bedrock or calcareous mineral material where substrate nutrient availability is greater. Vegetation with western boreal affinities (e.g., mountain cranberry, black crowberry) are typical throughout the area. Additional western species generally affiliated with grasslands, including hairy goldenaster, may also occur (Maciver 2001).

Land use

Land devoted to settlement and infrastructure (i.e., the community of Slate Falls) covers less than 1% of the area (Figure 148). Mineral exploration, timber harvesting, aggregate extraction, trapping, hunting, fishing, and the provision of services associated with resource-based activities occur throughout the ecodistrict. Approximately 10.6% of the ecodistrict is designated as protected areas.

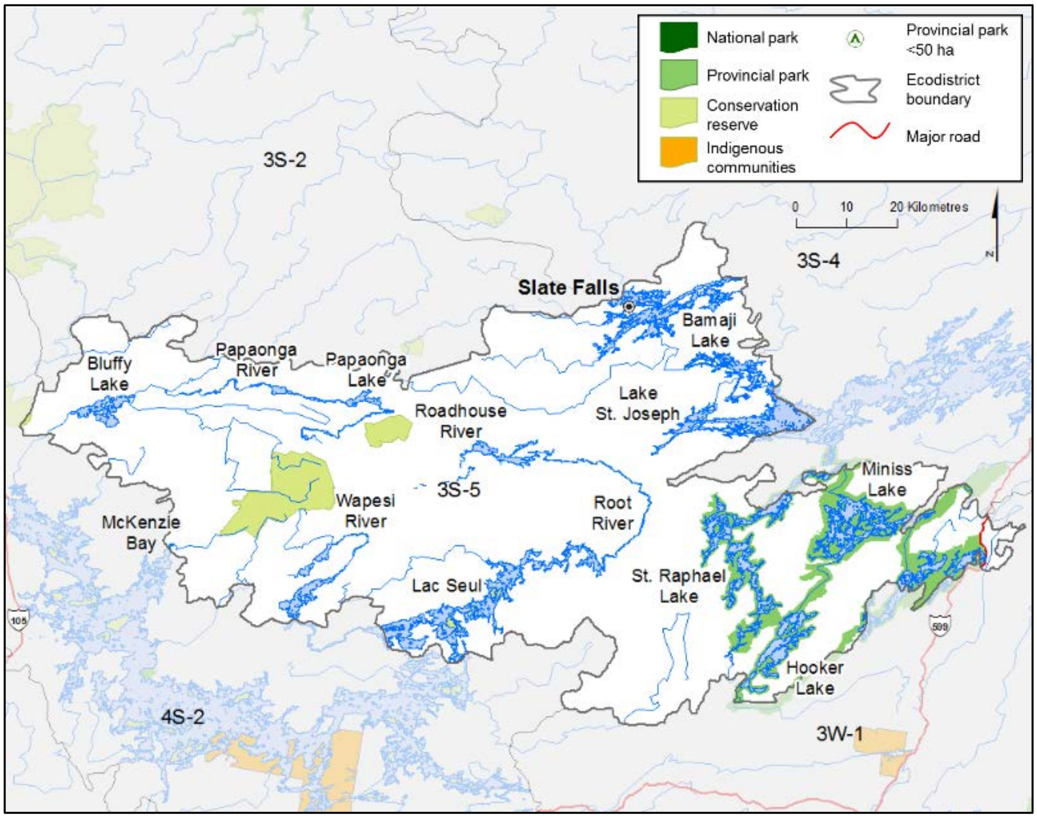


Figure 148. Select community, major road, natural heritage areas, rivers, and lakes in Ecodistrict 3S-5.

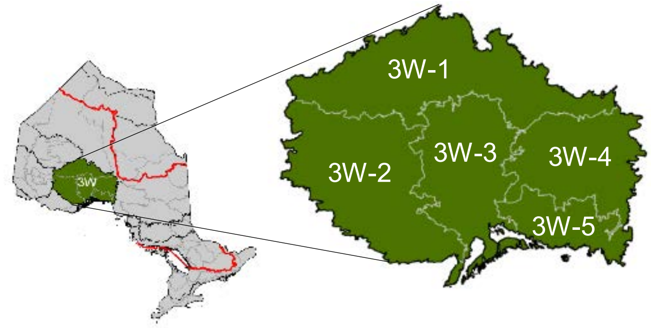
Ecodistrict boundary delineation

Since first presented by Hills in 1959, the site regions have undergone several modifications as new information has afforded a better understanding of the variables that influence the distribution of vegetation across the province. In 1961, the western portion of Site Region 3W was allocated to Site Region 3S (Hills 1961). More recently, the ecoregion was separated into five ecodistricts (Crins and Uhlig 2000).

Along the northern boundary, shallow to moderately deep mineral material in Ecodistrict 3S-5 transitions to deeper mineral deposits in 3S-4 and in the southern part of 3S-2. The southeastern boundary with 3W-1 reflects the change from shallow to moderately deep mineral material in 3S-5 to very shallow mineral material in 3W-1. Ecoregional climatic attributes also define the boundary with 3W, where 3S is cooler and drier. In the southwest, bedrock and climatic variables support the delineation of the 3S-4S boundary. The bedrock in Ecoregion 3S, is less diverse and primarily composed of granite and tonalite, compared with the inclusion of metavolcanics and metasedimentary rock in 4S. Climatically, 3S is cooler and wetter than 4S.

Ecoregion 3W

Lake Nipigon Ecoregion



The Lake Nipigon Ecoregion extends north from Lake Superior, including the peninsulas and islands, to the Agutua-Windigo Moraine. The communities of English River and Caramat represent the approximate western and eastern edges, respectively. The ecoregion encompasses 8,883,560 ha (9.0% of the province) of the Ontario Shield Ecozone and comprises five ecodistricts (Table 6).

Table 6. Ecodistricts in Ecoregion 3W**.**

Ecodistrict	Ecodistrict name
3W-1	Whitewater Lake
3W-2	Savanne
3W-3	Black Sturgeon
3W-4	Geraldton
3W-5	Schreiber

Situated on the Precambrian shield, Ecoregion 3W is underlain by granitic bedrock with basalt, greenstone, siltstone, and shale formations. Steep scarps, high mesas, and cuestas have formed throughout the southern portion, and dramatic cliffs are common along the Nipigon and Ottertooth rivers. Farther north and west, the topography is more subdued. Morainal material is prevalent, with several moraines crossing the central part of the ecoregion. Glaciolacustrine and glaciofluvial deposits occur near Lake Nipigon.

Humo-Ferric Podzols and Dystric Brunisols have developed over half of the land base on well drained, coarse-textured sites. Acidic rock outcrops cover a quarter of the area and organic material, primarily Mesisols, have developed on poorly drained sites.

Located in the Great Lakes watershed, Ecoregion 3W is drained by Lake Nipigon, the largest lake in the ecoregion, and many other lakes (e.g., Dog, Caribou, and Onaman) and rivers (e.g., Nipigon, Black Sturgeon, and Pic).

Land cover types include mixed, coniferous, deciduous, and sparse forests, as well as water. Modifying climatic effects (i.e., warmer temperature and increased precipitation) of lakes Nipigon and Superior influence the southern part of the ecoregion resulting in warmer-than-normal sites supporting the growth of temperate forest species such as eastern white pine, red pine, and sugar maple. Along the shores of Lake Superior, Arctic-alpine species occur on colder-than-normal sites. A more boreal climate prevails in the rest of the ecoregion, which influences the distribution and abundance of black spruce, white spruce, balsam fir, trembling aspen, paper birch, and jack pine. In low-lying areas black spruce and American larch prevail. In river valleys, tree species such as black ash, American elm, eastern white cedar, and balsam poplar grow on richer, fine-textured mineral materials.

American black bear, snowshoe hare, hermit thrush, and black-throated green warbler are some of the characteristic mammal and bird species. Amphibians and reptiles include blue-spotted salamander, spring peeper, and red-bellied snake. Fathead minnow, burbot, and mottled sculpin inhabit many of the lakes in the ecoregion.

Communities in the area include Nipigon, Armstrong, and Geraldton. The primary industry is timber harvesting but resource-based tourism, mining, and mineral exploration also occur.

In total, 14 types of natural heritage areas have been established (Figure 149), including the Lake Superior National Marine Conservation Area, which is the largest fresh water marine conservation area in the world (Gray et al. 2009).

Figure 149. Sleeping Giant Provincial Park. Sam Brinker, MNRF.

Climatic and geological variables delineate the boundaries of Ecoregion 3W. A cooler, drier environment in 3W defines the eastern boundary with 3E. The boundary between ecoregions 3W and 3S reflects the transition from very shallow mineral material in 3W to deeper mineral material in 3S. Warmer, wetter conditions in 3W distinguish it from 2W and 3S, while 3W is cooler and wetter than 4S and 4W.

Ecodistrict 3W-1

Whitewater Lake Ecodistrict

Ecodistrict 3W-1 extends from Marchington Lake in the west to the community of Nakina in the east, and north of Lake Nipigon to just south of the Misehkow River. At 2,593,837 ha, the Whitewater Lake Ecodistrict is the largest ecodistrict in Ecoregion 3W (29.2% of the ecoregion, 2.6% of the province). The gently rolling landscape ranges in elevation from 253 m above sea level in the east along the boundary with Ecodistrict 2W-2 to 521 m above sea level south of the Kopka River.

Figure 150. Coniferous forests of Medugama Bay north of the community of Nakina. MNRF.

Key features

- Nearly half of the land base is covered with coniferous forests (Figure 150).
- Bedrock exposed at the surface or with a very shallow layer of mineral material occurs over approximately half of the ecodistrict.
- Glacial lakes and prominent moraines help to define the landscape.

Geology and substrates

The Whitewater Lake Ecodistrict is largely Precambrian bedrock, exposed at the surface or with a very shallow, acidic, mineral material layer (Figure 151). Approximately 9,000 years ago (Dyke 2004), the final retreat of the glaciers occurred leaving behind a sequence of glacial lakes (e.g., Agassiz, Nakina, and Kelvin; Leverington and Teller 2003). Fluctuating

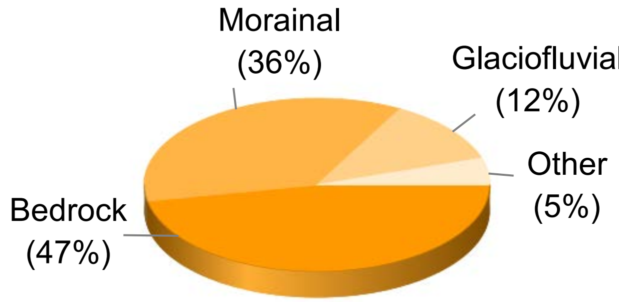


Figure 151. Modes of deposition in Ecodistrict 3W-1.

lake levels and wave action removed much of the overlying mineral material, depositing it into low-lying areas (Cooper 1983a). The bedrock is primarily acidic however, bands of base-rich bedrock can be found between Caribou and Esnagami lakes and near Savant Lake. Faults, including the Miniss River and Kashaweogama Lake and the Pashkokogan fault zone (Bethune et al. 2006), cross the area influencing drainage patterns and the formation of long linear lakes. Morainal deposits are represented by several prominent moraines, including the Whitewater, Nipigon, Crescent, and Nakina (Barnett 1992), drumlins in the west, and level sediment in the west and east. Typically acidic, calcareous mineral material can be found in the northeast corner, a result of the Cochrane readvance that brought calcareous Hudson Bay sediment to the area.

Glaciofluvial deposits are closely associated with the moraines, often forming a significant part of overall deposits (Cooper 1983a). Glaciolacustrine, organic, and aeolian deposits occur in limited quantities throughout the ecodistrict. Larger deposits of glaciolacustrine sediment occur north of Lake Nipigon, west of Esnagami Lake, and east of Greenmantle River and Mojikit Lake. Outflow from glacial Lake Agassiz flowed through the area towards modern day Lake Nipigon, forming large glacial lakes in the areas now occupied by Wabakimi and Smoothrock lakes (Leverington and Teller 2003). Wave-washed terraces on the Nakina Moraine are further evidence of glacial lake activity in the area (Zoltai 1967). Organic deposits have primarily developed in the central portion of the ecodistrict, typically accumulating on glaciolacustrine material (Cooper 1983a). Aeolian mineral material with intervening organic deposits are scattered throughout much of the area (Cooper 1983a, b).

Nearly half of Ecodistrict 3W-1 is bedrock, exposed at the surface or with a very shallow layer of mineral material (Figure 152). Dystric Brunisols are generally found in the central portion as a discontinuous layer separated by bedrock outcrops (Sado et al. 1994). In the west, Humo-Ferric Podzols have developed in acidic, well drained, deeper morainal and glaciofluvial material. Mesisols occur in poorly drained areas and Eutric Brunisols have developed in the northeast on calcareous, fine-textured mineral materials transported from the Hudson Bay Lowlands by glaciers.

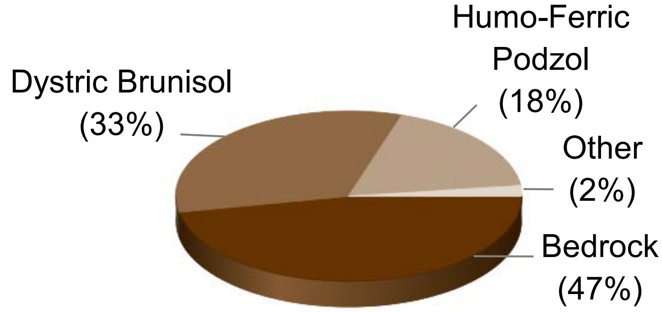


Figure 152. Substrate types in Ecodistrict 3W-1.

Land cover and vegetation

Ecodistrict 3W-1 is part of the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) mapped the eastern portion of Ecodistrict 3W-1 as part of the Central Plateau Section (B.8) and the western portion as part of the Upper English River Section (B.11) of the Boreal Forest Region. Coniferous forests dominate the landscape (Figure 153). Forests led by black spruce occur on a variety of site conditions. Jack pine forests mainly grow on well drained, deeper mineral material. On sites with shallow mineral material, jack pine and black spruce commonly occur together. In low-lying areas, coniferous forests support black spruce, American larch, and some eastern white cedar. White spruce and balsam fir occur as minor associates, typically associated with lakes and river systems. Warmer-than-normal shorelines in the south may support red pine (Noble and Zoladeski 1990). Mixed forests of trembling aspen, paper birch, balsam fir, black spruce, white spruce, and balsam poplar often grow on better-drained, deeper, upland sites and along the shorelines of rivers and lakes (Rowe 1972). On wetter, nutrient rich sites, black ash and American elm may occur. Sparse forests, generally on very shallow substrates, occur throughout the ecodistrict including a large area west of Whitewater Lake. Deciduous forests are scattered across the landscape occurring on deep, well drained sites. Bog and fen complexes occur in wet depressions where organic material has accumulated, particularly in the central portion and in the east (Figure 154). Marshes are limited. Ecodistrict 3W-1 is prone to frequent, small forest fires due to a climatic regime with significant dry periods during the summer and very shallow to bare bedrock conditions. High intensity surface fires or stand-replacing crown fires may also occur (Van Sleeuwen 2006).

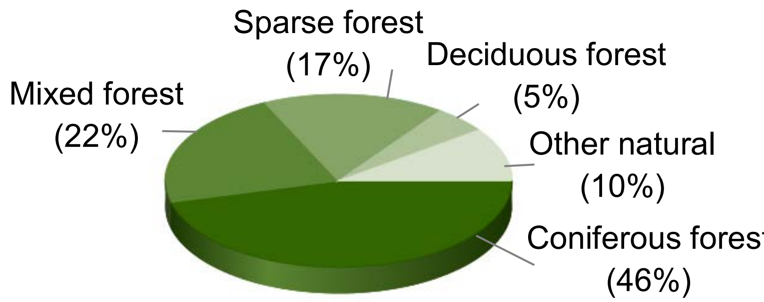


Figure 153. Land cover types in Ecodistrict 3W-1.

Increased plant species richness may occur in areas of base-rich bedrock or calcareous mineral material where the availability of substrate nutrients is greater. American mountain-ash can be found near its northern limit in Ecodistrict 3W-1. Marl accumulations may occur as groundwater flows through calcareous rich substrates into a lake. Marl lakes in the south (Speed et al. 1985) and east may support calciphiles including Fries' pondweed and greenish sedge (Harris and Foster 2005).

Figure 154. Patterned fen, Wabakimi Provincial Park. Bill Crins, MNRF.

Land use

Mineral exploration, timber harvesting, trapping, hunting, fishing, aggregate extraction, and services associated with resource-based activities occur throughout the ecodistrict. The communities of Armstrong, Greenstone, and Nakina (Figure 155) cover less than 1% of the total area. Protected areas encompass approximately 36% of the ecodistrict.

Ecodistrict boundary delineation

The Whitewater Lake Ecodistrict in Hills' (1959) earlier classification was known as Site District 3W-2. The northeast boundary with Ecodistrict 2W-3 is defined by the change from coarse-textured Nakina Moraine deposits in 3W-1 to fine-textured morainal material in 2W-3. The boundary with 2W-2 reflects the transition from very shallow mineral material with bedrock in 3W-1 to deeper, typically glaciolacustrine sediment in 2W-2. At the ecoregional scale, 3W is warmer and wetter than 2W. In the south, deeper substrates in 3W-2 and 3W-4 differ from the very shallow to exposed bedrock landscape of 3W-1. The southern boundary with 3W-3 reflects the change from coarse-textured materials in 3W-1 to fine-textured materials in 3W-3. In the west, the boundary with 4S-2 is based on climatic variables at the ecoregional scale where 3W is cooler and wetter than 4S. The northwest boundary with 3S-4 and 3S-5 is defined by the change from very shallow mineral material in 3W-1 to deep mineral material in 3S-4, and shallow to moderately deep mineral material in 3S-5. In addition, differences in ecoregional climatic attributes are used to define the two regions where 3W is warmer and wetter than 3S.

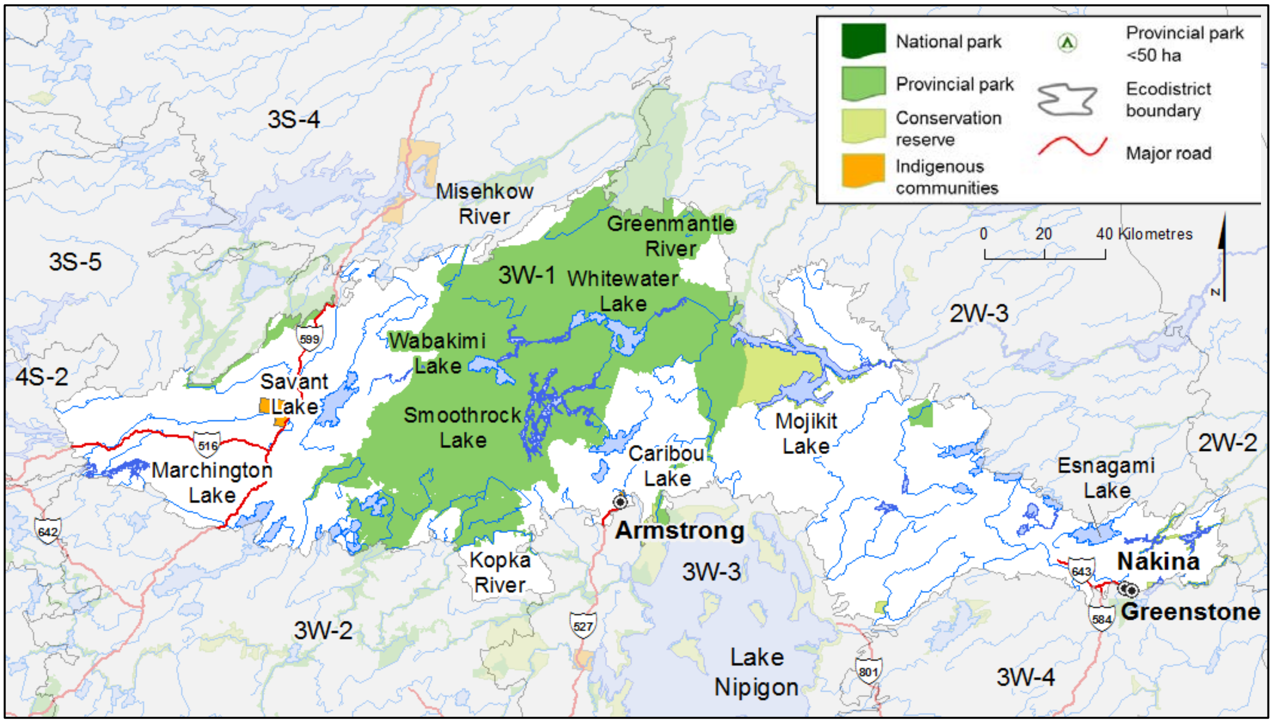


Figure 155. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3W-1.

Wabakimi Provincial Park

Covering an area of approximately 892,000 ha, Wabakimi Provincial Park is the second largest park in Ontario. Expanded in 1997, it includes over 1,500 km of identified canoe routes including whitewater canoeing opportunities, several pictograph sites, and shoreline features from glacial Lake Agassiz (Ontario Parks 1999). It is home to two of Ontario's threatened species, woodland caribou (Figure 156) and lake sturgeon (northwestern Ontario population).

Figure 156. Woodland caribou. Ontario Parks.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 3W-2

Savanne Ecodistrict

The Savanne Ecodistrict extends west from Black Bay in Lake Superior to Paguchi Lake, and north from Lappe to Sturgeon Lake. The ecodistrict covers 2,358,197 ha (26.6% of the ecoregion, 2.4% of the province). The gently rolling landscape ranges in elevation from 204 m above sea level in the southeast corner near Black Bay to 580 m above sea level west of Pakashkan Lake.

Figure 157. Coniferous and mixed forests of Ecodistrict 3W-2. Gerry Racey, MNRF.

Key features

- Mixed forests with spruces, jack pine, trembling aspen, paper birch, and balsam fir cover approximately one-third of the ecodistrict (Figure 157).
- Morainal material and bedrock dominate the landscape.
- The northern limits of eastern white pine and red pine occur.

Geology and substrates

Mineral material, generally acidic, coarse-textured morainal deposits, dominates the Savanne Ecodistrict (Figure 158). Discontinuous morainal materials of variable depths are found throughout the ecodistrict, typically separated by bedrock outcrops (Sado et al. 1995). Deeper deposits can be found in conjunction with drumlins southeast of Sturgeon Lake and Lac des Mille Lacs and the Sioux Lookout, Kaiashk, Hartmann, Lac Seul, and Dog Lake moraines. The last four moraines converge south of Pakashkan Lake forming an extensive area of sand, gravel, and boulders (Noble 1979). Exposed bedrock, including knobs and ridges, often covered with a very shallow layer of morainal material are located throughout the ecodistrict. Larger areas of bedrock can be found in the southeast and north. The bedrock is typically acidic but bands of base-rich bedrock occur along the eastern boundary. Faults, including the east-west trending Quetico fault that runs through Dog Lake (Williams 1991), define drainage patterns and add relief to the undulating landscape. Glaciofluvial materials are associated with the numerous moraines that can be found across the area. Several northeast-southwest trending eskers occur across the landscape, including larger features southeast of Sturgeon and Holinshead lakes.

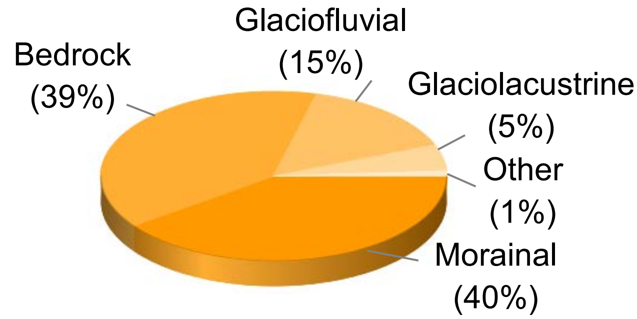


Figure 158. Modes of deposition in Ecodistrict 3W-2.

Small pockets of fine-textured glaciolacustrine material, remnants of glacial lakes, occur south of Dog Lake, southwest of Sturgeon Lake, and east of Holinshead Lake. Approximately 9,000 years ago (Dyke 2004), glacial Lake Kaministikwia, bordered by the Dog Lake and Marks moraines (Zoltai 1965b), inundated a small area south of Dog Lake. At the same time, glacial Lake Agassiz reached its eastern limit near Sturgeon Lake. Overflow from glacial Lake Agassiz followed the Roaring and Gull river valleys entering into glacial Lake Kelvin east of Holinshead Lake (Leverington and Teller 2003). A large concentration of abandoned shorelines from glacial Lake Agassiz can be found northwest of Sturgeon Lake. Glaciolacustrine material associated with glacial Lake Agassiz may be calcareous, a result of sediment from Manitoba being deposited in the area. Organic deposits can be found in poorly drained areas throughout the ecodistrict, especially north and east of Lac des Mille Lacs. Alluvial deposits occur along larger river systems including the English, Firesteel, Gull, and Dog rivers. Northeast of the community of Upsala, aeolian deposits can be found (Mollard and Mollard 1980b).

The dominant substrate type in Ecodistrict 3W-2 is bedrock followed closely by Humo-Ferric Podzols (Figure 159) that have developed in acidic, coarse-textured mineral materials that extend from the eastern boundary to beyond the northwestern corner. Swaths of Dystric Brunisols have developed along the northern border. Isolated pockets of Gray Luvisols occur in fine-textured, often calcareous sites including west of the community of Lappe. Limited quantities of organics, typically Mesisols, have accumulated on mineral material or on bedrock in low-lying areas.

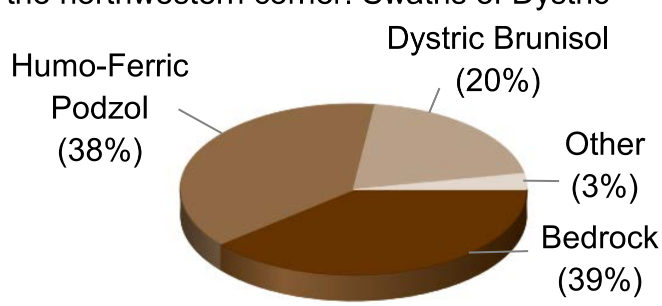


Figure 159. Substrate types in Ecodistrict 3W-2.

Land cover and vegetation

Found in the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018), Ecodistrict 3W-2 is dominated by mixed forests (Figure 160). The ecodistrict was primarily located within the Upper English River Section (B.11) of the Boreal Forest Region with the southeast portion, including Dog Lake, part of the Superior Section (B.9) (Rowe 1972). Common tree species include black spruce, jack pine, trembling aspen, paper birch, white spruce, and balsam fir. Black ash, American elm, and balsam poplar occur but are limited to fresh to moist, nutrient rich sites adjacent to rivers and lakes. Coniferous forests, typically composed of black spruce or jack pine, are scattered throughout the ecodistrict. Jack pine forests occur on dry, well drained level areas, moraines, and rocky uplands, while black spruce is more common in poorly drained areas associated with American larch and eastern white cedar. Red pine and eastern white pine, including old growth forests (OMNR 2009b), are scattered throughout the ecodistrict. As these species are at their northern distribution limits (Rowe 1972), they occur on warmer-than-normal bedrock ridges and along rivers and lakeshores.

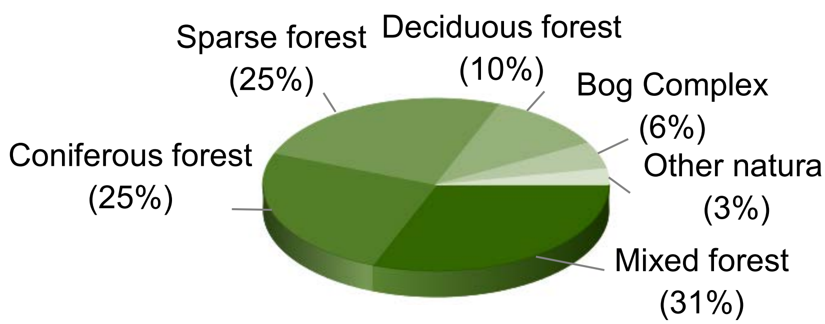


Figure 160. Land cover types in Ecodistrict 3W-2.

Sparse forests typically occur on bedrock, exposed at the surface or with a very shallow layer of mineral material. Deciduous forests, generally trembling aspen and paper birch, dominate in the south occasionally with tree species more commonly found in the temperate forest including red and sugar maple (OMNR 2009a). Bog and fen complexes have developed in poorly drained, low-lying areas (Figure 161). Larger complexes occur southeast of the community of English River, north of Lac des Mille Lacs, and along the Savanne River. Marshes have developed in quiet bays adjacent to rivers and lakes. Fires are frequent, but small, contributing to the erosion of thin upland substrates and promoting the establishment and growth of deciduous, early successional species and pioneer forests. High intensity surface fires or stand-replacing crown fires may also occur (Van Sleeuwen 2006). Exposed bedrock and agricultural fields are limited.

Increased plant species richness may occur in areas of calcareous substrates or base-rich bedrock where nutrient availability is higher. Along the Ottertooth Canyon, west of Obonga Lake, cooler-than-normal cliff habitats support Arctic-alpine species that include multi-rayed goldenrod and alpine woodsia (Bakowsky 2016, MNRF, pers. comm.). Plant species with western affinities found in the area include Ross' sedge (Foster and Harris 2005).

Figure 161. Black spruce dominated fen. Wasyl Bakowsky, MNRF.

Land use

Settlement and associated infrastructure including the communities of Lappe and English River (Figure 162) cover less than 1% of the total land base. Nearly 5.5% of the ecodistrict is designated as protected areas. Timber harvesting, mining, mineral exploration, aggregate extraction, hydroelectric and wind power generation, trapping, hunting, fishing, and services associated with resource-based activities occur throughout. Agricultural practices are limited, occurring in the south near the community of Lappe.

Ecodistrict boundary delineation

Earlier classification work by Hills (1959) identified Ecodistrict 3W-2 as Site District 3W-3. Deeper mineral material in Ecodistrict 3W-2 defines the boundary with 3W-1. Along the eastern boundary, morainal deposits and bedrock ridges of 3W-2 shift to glaciolacustrine deposits in 3W-3. In the south and southwest, the boundary with Ecoregion 4W is based on ecoregional climatic attributes where 3W is cooler and wetter than 4W. The boundary with 4W-2 is also defined by the age and composition of the underlying bedrock. Bedrock in 3W-2 is typically from the Neo- to Mesoarchean era (2.5 to 3.4 billion years ago), composed of tonalite, granitic, or metasedimentary rocks; the bedrock in 4W-2 is younger, from the Mesoproterozoic (0.9 to 1.6 billion years ago) or Paleoproterozoic (1.6 to 2.5 billion years ago) eras, and composed of sedimentary or mafic and related intrusive rocks. The western boundary with 4W-1 reflects the change from a gently rolling landscape and deeper mineral material in 3W-2 to a hilly topography with shallower mineral material in 4W-1. Climatic ecological variables define the northwestern boundary between 3W and 4S (i.e., Ecoregion 3W is cooler and wetter than 4S). The boundary with 4S-5 delineates the transition from deeper mineral material in 3W-2 to shallower mineral material in 4S-5. The 3W-2/4S-3 boundary reflects the change from a gently rolling to a more hilly landscape.

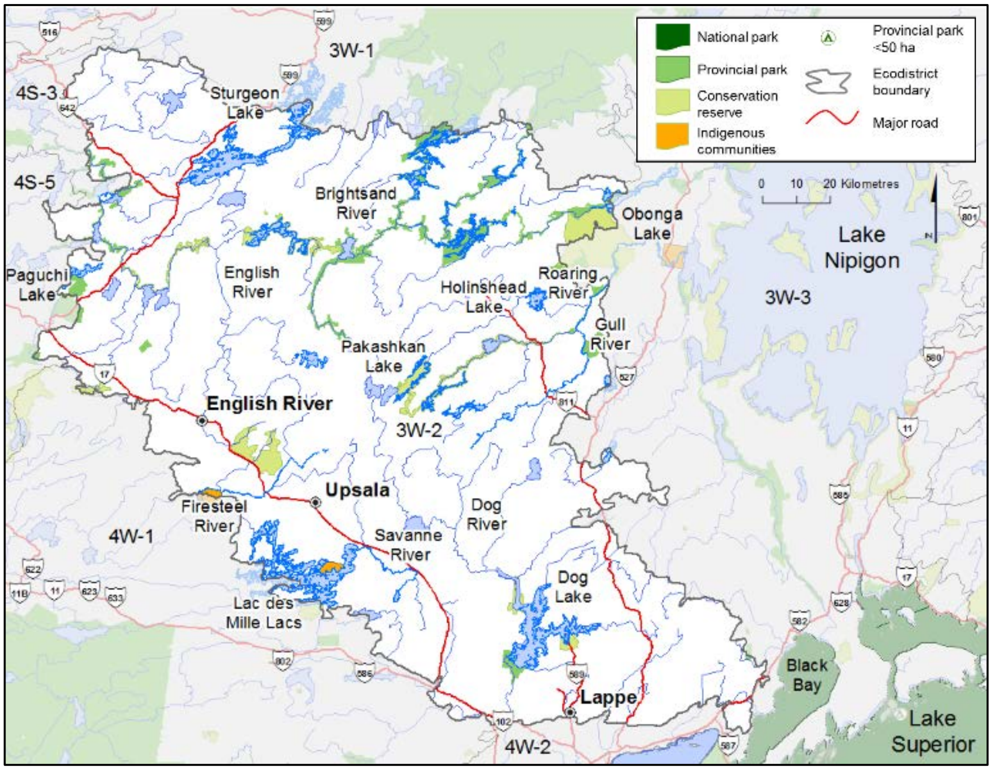


Figure 162. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3W-2.

Ecodistrict 3W-3

Black Sturgeon Ecodistrict

Encompassing 1,703,523 ha (19.2% of the ecoregion, 1.7% of the province), the Black Sturgeon Ecodistrict extends from north of Lake Nipigon south to Lake Superior and includes the Sibley Peninsula and the archipelago islands. The western and eastern boundaries extend approximately 5 to 20 km from the shoreline of Lake Nipigon. At 179 m above sea level, the lowest elevation occurs on the shore of Lake Superior, while rock ridges east of the community of Nipigon reach the area's maximum elevation of 584 m above sea level.

Figure 163. Mixed forests in Sleeping Giant Provincial Park. Sam Brinker, MNRF.

Key features

- Mixed forest with spruces, jack pine, trembling aspen, paper birch, and balsam fir can be found over one-third of the ecodistrict (Figure 163).
- Over half of the landscape is characterized as bedrock.
- High vertical cliffs with extensive talus slopes are found along the shores of lakes Superior and Nipigon.

Geology and substrates

The Black Sturgeon Ecodistrict is characterized by a gently rolling to hilly terrain, dominated by Precambrian, bedrock overlain with a very shallow to shallow layer of mineral material (Figure 164). Large areas of base-rich bedrock can be found around Lake Nipigon, including west of the lake to the boundary with 3W-2, as islands in the lake, and south of the lake. Acidic bedrock occurs north and west of Lake Nipigon and in the south. Scattered throughout the ecodistrict, particularly along portions of the Lake Superior and Lake Nipigon shorelines, rugged topography created by flat-topped ridges, cliff faces, valleys, and deep canyons occur. These formations result from the weathering of stratified rock layers with different rates of erosion. Additional relief occurs through a series of fault lines, including two larger faults occupied by the Black Sturgeon and Nipigon rivers.

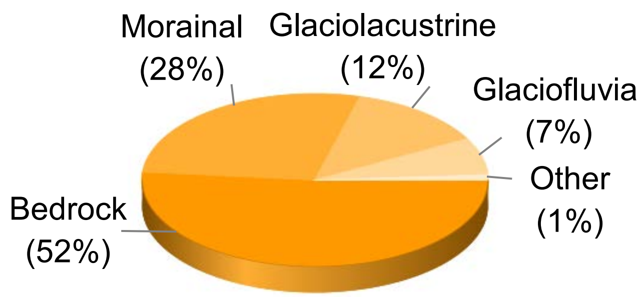


Figure 164. Modes of deposition in Ecodistrict 3W-3.

Morainal deposits generally occur west and south of Lake Nipigon. The deposits consist of a variable depth of coarse-textured material overlying bedrock or deeper deposits associated with the Mackenzie, Nipigon, and Kaiashk moraines.

Approximately 9,000 years ago (Dyke 2004), glacial Lake Kelvin, the precursor to Lake Nipigon, occupied much of the area that today defines the boundaries of Ecodistrict 3W-3. At its highest point, the lake was nearly 80 m above the current level of Lake Nipigon (Zoltai 1965b). Areas of deep, fine-textured glaciolacustrine material surround Lake Nipigon and extend south following larger river systems including the Nipigon and Black Sturgeon rivers towards Lake Superior. Major drainage routes, including the Kopka and Pikitigushi rivers, carried water from glacial Lake Agassiz in the west into glacial Lake Kelvin and to a series of south flowing rivers to Lake Superior (Leverington and Teller 2003). South of Lake Nipigon, deposits of calcareous glaciolacustrine sediment can be found, a result of material being carried to the area from Manitoba through glacial Lake Agassiz. In the south, glacial Lake Minong expanded from the east, flooding areas along the north shore of Lake Superior depositing fine-textured glaciolacustrine materials. Relict beaches and shoreline bluffs of glacial lakes Kelvin and Minong remain. Large volumes of water, including catastrophic releases from glacial lakes Agassiz and Kelvin eroded valley walls creating escarpments (OMNR 2004b) and depositing glaciofluvial material, including cobbles and boulders in larger river valleys (Leverington and Teller 2003). In addition, pockets of glaciofluvial material can be found west of Lake Nipigon and on the neck of the Black Bay Peninsula. Organic deposits are scattered throughout the western portion of the ecodistrict and are prevalent on the neck of the Black Bay Peninsula. Lacustrine deposits can be found along the shorelines of lakes Superior and Nipigon. Aeolian features occur north of Gull River and adjacent to the shore of lakes Superior and Nipigon. Alluvial deposits occur along the larger river systems (e.g., Gull and Kabitotikwia rivers; Mollard and Mollard 1983a) and colluvial material (i.e., talus) is associated with cliff systems.

Bedrock, exposed at the surface or with a very shallow to shallow layer of mineral material, covers more than half of the ecodistrict (Figure 165). Humo-Ferric Podzols occur along the central and southern portions of the ecodistrict. Dystric Brunisols have developed in coarse-textured mineral material on the western and northern edges of Lake Nipigon. Gray Luvisols occur in fine-textured mineral material on better drained sites, including much of the Black Bay Peninsula. In low-lying areas with imperfect to poor drainage, Gleysols have developed in mineral material and Mesisols can be found where organic deposits have accumulated. Regosols are associated with active mineral material (e.g., aeolian, lacustrine, alluvial).

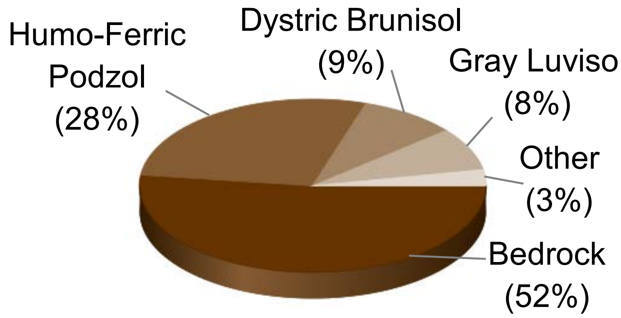


Figure 165. Substrate types in Ecodistrict 3W-3.

Land cover and vegetation

Ecodistrict 3W-3 is associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Nipigon (B.10) and Superior (B.9) sections of the Boreal Forest Region (Rowe 1972). A small area in the northwest is included in the Central Plateau Section (B.8) (Rowe 1972). Mixed forests, characterized by trembling aspen, paper birch, black spruce, white spruce, and balsam fir grow in nearly half of the ecodistrict (Figure 166). Sparse forests are prominent in the south. Conifer forests dominated by jack pine are characteristic of dry uplands, while black spruce grows on a variety of site conditions. In areas of poor drainage, black spruce is often associated with American larch and eastern white cedar. White spruce and balsam fir grow on well drained sites that have not been subjected to recurrent fires (Noble 1979). Red pine and eastern white pine grow on well drained sites, particularly on the Lake Nipigon islands or on better drained sites with a mix of coniferous and deciduous tree species. Old growth eastern white pine forests occur northeast of Wolfpup Lake and on the Sibley Peninsula (OMNR 2009b).

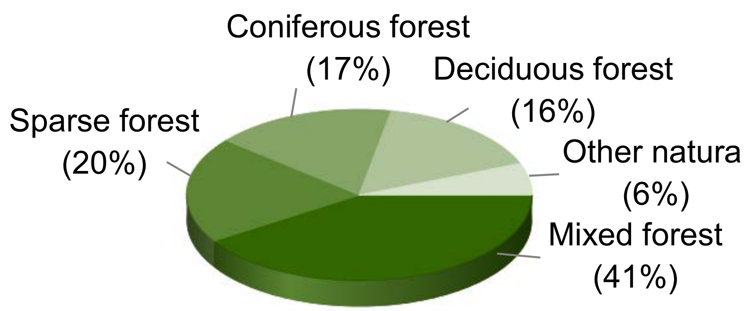


Figure 166. Land cover types in Ecodistrict 3W-3.

Deciduous forests of trembling aspen and paper birch can be found in the south and west. Associates including balsam poplar, American elm, and black ash, typically occur adjacent to rivers on fresh to moist, nutrient rich sites. Fires are limited across the landscape, occurring less frequently in Ecodistrict 3W-3 than in adjacent ecodistricts due to the proximity to lakes Nipigon and Superior. When fires do occur they tend to be small and may be high intensity surface fires or stand-replacing crown fires (Van Sleeuwen 2006). Bog and fen complexes and marshes are scattered throughout the landscape. Areas of exposed bedrock are often associated with bedrock ridges or adjacent to lakes Superior and Nipigon (Figure 167). In the south, near the communities of Dorion and Red Rock, a few small patches of land have been converted to agriculture.

Figure 167. Cliffs along the Lake Superior shoreline. Sam Brinker, MNRF.

The moderating effect of lakes Nipigon and Superior and the varied topography in the Black Sturgeon Ecodistrict provides an assortment of habitats for vegetation. Adjacent to the shorelines, white spruce and balsam fir are more abundant due to a more humid climate (Noble 1979). Along the southern shore of the ecodistrict, warmer winters caused by the modifying effect of Lake Superior support the growth of species more common in the south, including sugar and red maple (OMNR 2009a). Arctic-alpine species (e.g., showy locoweed, glaucous bluegrass, and arctic pyrola) can be found on cool, moist bedrock shorelines, strongly broken uplands (OMNR 2004b), and cooler-than-normal canyon floors (e.g., Ouimet Canyon west of the community of Dorion). Western species, including Ross' sedge and Pennsylvania cinquefoil may also occur (Foster and Harris 2005). Increased plant species richness may occur in areas of base-rich bedrock or calcareous mineral material where more nutrients are available from the substrate. Marl lakes supporting calciphiles, including Wolfpup Lake (Speed et al. 1985), occur south of Lake Nipigon. Calciphytic communities that include northeastern sedge and elliptic spikerush, occur on calcareous glaciolacustrine sediment including the southwest shore of Black Sturgeon Lake (OMNR 2004b). Plant species adapted to sand beaches and active aeolian sites, including sea lymegrass and American beachgrass (Henson and Brodribb 2005), can be found along the Lake Superior shoreline.

Land use

Less than 1% of the total land base is settled. Communities include Nipigon, Red Rock, Dorion, and Gull Bay (Figure 168). The ecodistrict comprises about 17.9% protected areas. In addition, roughly 613,124 ha of water are protected in the Lake Superior National Marine Conservation Area. Timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities occur throughout. Limited agricultural practices occur in the south.

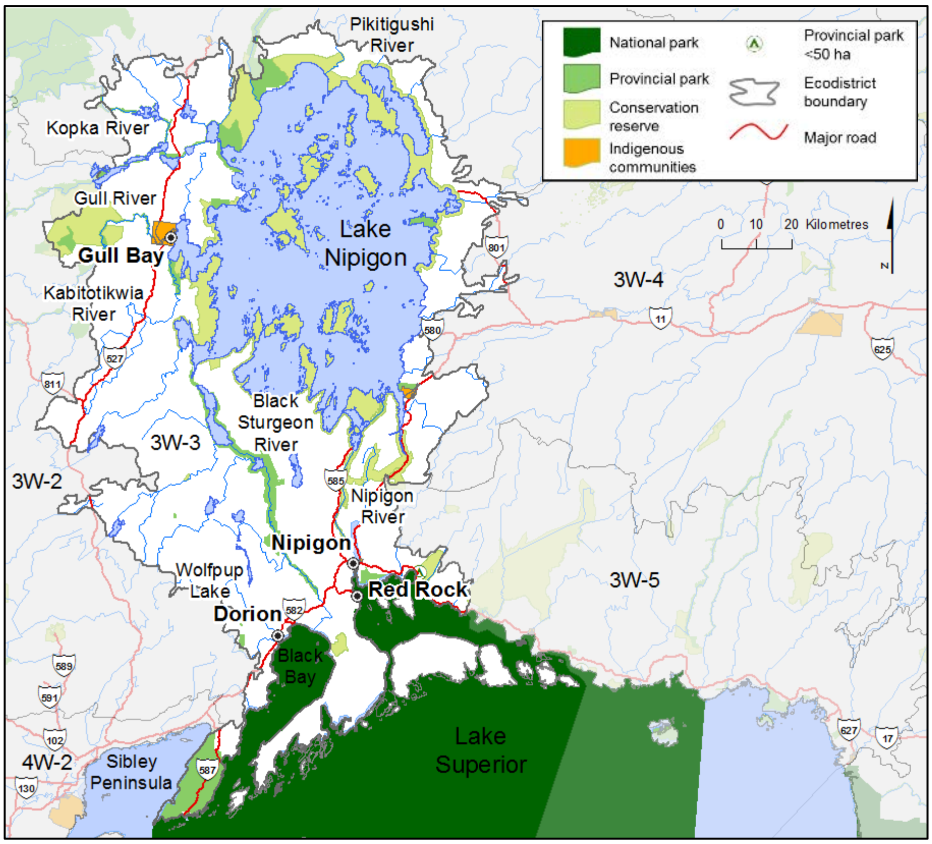


Figure 168. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3W-3.

Ecodistrict boundary delineation

In Hills' (1959) classification, Ecodistrict 3W-3 was referred to as Site District 3W-4. The western boundary with Ecodistrict 3W-2 reflects the change from glaciolacustrine deposits in 3W-3 to morainal deposits and bedrock ridges in 3W-2. The northern boundary is defined by the transition from fine-textured materials in 3W-3 to coarse-textured materials in 3W-1. The eastern boundary with 3W-4 and 3W-5 reflects the change from bedrock with a very shallow to shallow layer of mineral material in 3W-3 to deeper materials in 3W-4 and bedrock with a very shallow layer of mineral material in 3W-5. Ecoregional climatic attributes define the southwestern boundary with 4W. Ecoregion 3W is typically cooler and wetter than Ecoregion 4W. Lake Superior defines the southern boundary.

Figure 169. Lake Superior National Marine Conservation Area. Ontario Parks.

Lake Superior National Marine Conservation Area

Created in 2007, Ontario's second National Marine Conservation Area extends from Thunder Cape in the west at the tip of the Sibley Peninsula to Bottle Point east of Terrace Bay, and south to the Canada-United States border (Figure 169). It is the largest fresh water marine conservation area in the world, protecting cultural, wildlife, and natural values (Gray et al. 2009) including habitat that supports Arctic-alpine species.

Ecodistrict 3W-4

Geraldton Ecodistrict

The Geraldton Ecodistrict extends from the eastern shore of Lake Nipigon east to Flint Lake. The northern boundary at the community of Nakina extends south to the southern shore of Long Lake. The ecodistrict covers 1,492,655 ha (16.8% of the ecoregion, 1.5% of the province). The lowest elevation (203 m above sea level) can be found along the southern portion of the Pic River, and the highest elevation (558 m above sea level) occurs west of Barbara Lake.

Figure 170. Black spruce forest, Drowning River. Sam Brinker, MNRF.

Key features

- Mixed and coniferous forests occur over half of the ecodistrict (Figure 170).
- Shallow to deep morainal materials dominate the landscape.
- The Nakina and Onaman moraines characterize the northern part of the ecodistrict.

Geology and substrates

Ecodistrict 3W-4 is a gently rolling landscape of Precambrian bedrock overlain with coarse-textured, morainal material of various depths (Figure 171). These deposits are generally acidic; however, carbonate content increases from south to north to approximately the community of Geraldton and along moraines. North of the community of Geraldton the presence of calcareous sediment is sporadic (Zoltai 1967). In the north, deeper morainal materials are associated with the Nakina and Onaman moraines and in the northeast corner

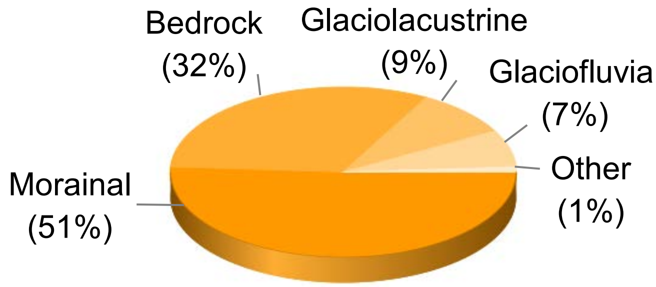


Figure 171. Modes of deposition in Ecodistrict 3W-4.

calcareous, fine-textured sediment associated with the Cochrane readvance can be found. In the south, the terrain is more rugged and morainal material is typically shallower. Drumlins, composed of calcareous, fine-textured morainal material, occur south of Wildgoose Lake (Gartner 1979a) and west of Long Lake (Gartner 1979b). A series of faults occurs in the central and southern parts of the ecodistrict. West-east trending faults, including Blackwater River and Paint Lake (Williams 1989), occur on either side of Highway 11 in the west. The Gravel River-Kamuck River Fault that starts near the shore of Lake Superior stretching to Long Lake is one of a series of southwest-northeast trending faults.

Bedrock exposures, typically acidic, and areas with very shallow mineral material are common in the southeast. Thin bands of base-rich bedrock occur in the west, through the central portion, and adjacent to Kallala Lake. Glaciolacustrine fine-textured deposits that occur in the northwest result from sediment deposits into glacial Lake Kelvin (Gartner 1979a) that occupied the area over 9,000 years ago (Dyke 2004). To the east, glacial Lake Nakina formed at the edge of the glacier adjacent to the Nakina moraine. Deposits from this glacial lake occur north of the community of Longlac. Glaciofluvial features are often associated with morainal material. Larger features include an outwash extending from the community of Jellicoe to Beardmore that represents an ancient spillway that drained glacial Lake Nakina to the west (Gartner 1979a), a second outwash east of the community of Longlac, and a series of eskers scattered across the landscape. Organic deposits have accumulated in low-lying poorly drained areas, including near the community of Geraldton and east of Onaman Lake. Alluvial deposits occur adjacent to larger rivers including the Pic River.

Primarily found in coarse-textured morainal and glaciofluvial deposits, Humo-Ferric Podzols occur across approximately two-thirds of the ecodistrict (Figure 172). Bedrock is more prevalent in the south. Gleysols have developed in poorly drained glaciolacustrine deposits that extend from Ecodistrict 3W-3 to Lake Onaman. In areas of calcareous mineral material Eutric Brunisols have developed, and limited areas of Dystric Brunisols occur in acidic, coarse-textured mineral deposits. Mesisols have developed in poorly drained areas with little relief, including bedrock depressions or between drumlins.

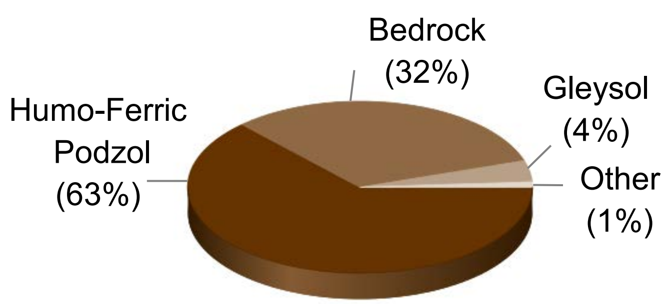


Figure 172. Substrate types in Ecodistrict 3W-4.

Land cover and vegetation

The Geraldton Ecodistrict is associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Central Plateau Section (B.8) of the Boreal Forest Region (Rowe 1972). Mixed forests of trembling aspen, white spruce, black spruce, paper birch, and balsam fir grow on nearly one-third of the ecodistrict, particularly in the south (Figure 173). Along river banks and lake shores associates may include balsam poplar, American elm, and black ash.

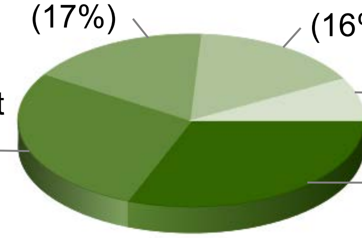


Figure 173. Land cover types in Ecodistrict 3W-4.

Lowland sites are dominated by coniferous forests of black spruce, often associated with eastern white cedar and American larch. On upland sites, conifer forests consist of jack pine, black spruce, white spruce, and balsam fir (Figure 174). Red pine, occasionally with eastern white pine, occurs on warmer-than-normal bedrock ridges. Sparse and deciduous forests are scattered throughout the ecodistrict. Sparse forests are prominent on very shallow mineral material in the south. Fen and bog complexes are limited, occurring more often in the northern portion of the ecodistrict associated with kettles along moraines. Due to the high calcareous content of the moraines, fens are more common than bogs (Riley and Michaud 1989). Fire has played an important role in the successional development of forest types in northwestern Ontario, favouring jack pine and pioneer species such as trembling aspen and paper birch. Fires are generally small but stand-replacing crown and high intensity ground fires do occur (Van Sleeuwen 2006). Exposed bedrock is limited, typically occurring in the south. Quiet bays associated with lakes and rivers often support marshes.

Increased plant species richness may occur in areas of calcareous mineral material or base-rich bedrock where substrate nutrient content is higher. A number of marl lakes occur in a band between the communities of Longlac and Beardmore and along the Nakina and Onaman moraines (Harris and Foster 2005). Marl lakes support calciphiles including greenish sedge and Kalm’s lobelia. Plant species near their northern limits in Ecodistrict 3W-4 include grassleaf mud-plantain and white-stemmed pondweed (Harris and Foster 2003e).

Figure 174. Coniferous forests near the Jackpine Rapids, Drowning River. MNRF.

Land use

Large communities in the ecodistrict, including Geraldton, Nakina, Beardmore, Caramat, and Jellicoe, account for less than 1% of the total land base (Figure 175). Nearly 1.7% of the ecodistrict is designated as protected areas. Timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities occur throughout. In the middle of the last century, the largest volume of timber products in Ontario was harvested in the Geraldton area, and most of the logging operations were carried out in the ecodistrict, reflecting the availability and high productivity of pulpwood in the area (Figure 176; Lynn and Zoltai 1965, Noble 1979).

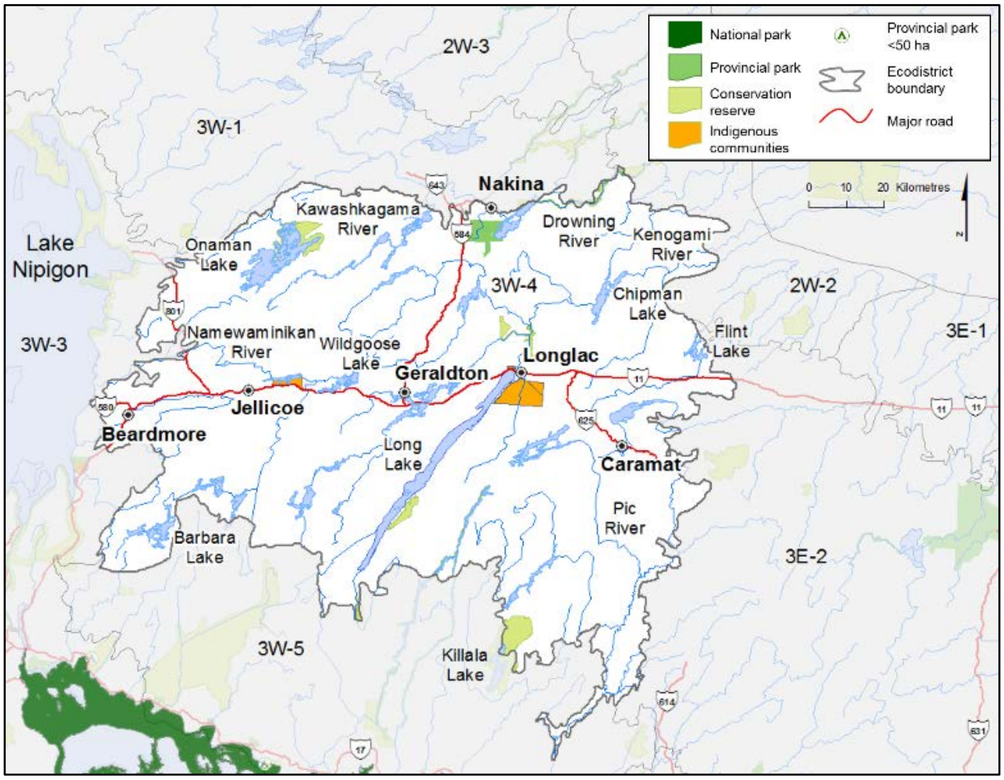


Figure 175. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3W-4.

Figure 176. Men cutting wood, Nakina, Ontario, September, 1935. Canada Department of National Defence Library and Archives Canada.

Ecodistrict boundary delineation

The Geraldton Ecodistrict was referred to by Hills (1959) as Site District 3W-5. The deeper morainal material in Ecodistrict 3W-4 contrasts with the very shallow to exposed bedrock in 3W-1 to the north and 3W-5 to the south. The western boundary is also defined on deeper morainal material in 3W-4 compared with very shallow to shallow mineral material in 3W-3. The eastern boundary with Ecoregion 3E reflects variation in climate at the ecoregional scale, where 3W is cooler and drier. The northeastern boundary with 2W-2 is defined by the transition from morainal deposits in 3W-4 to glaciolacustrine deposits in 2W-2, as well as differences in ecoregional climatic attributes where Ecoregion 3W is warmer and wetter than Ecoregion 2W. The northeastern boundary with 3E-2 was shifted eastward to better incorporate the bands of mafic metavolcanics found in the area.

Ecodistrict 3W-5

Schreiber Ecodistrict

Ecodistrict 3W-5 lies along the northern edge of Lake Superior between Jackfish River in the west, and Swede Creek in the east. Extending inland for approximately 25 to 35 km, the northern boundary of the ecodistrict corresponds approximately to the north shore of Steel Lake. It includes Pic Island and the Slate Islands archipelago. The smallest ecodistrict in Ecoregion 3W, it is 735,347 ha (8.3% of the ecoregion, 0.8% of the province). The elevation increases from 179 m above sea level at the Lake Superior shoreline to 582 m above sea level east of Pays Plat River.

Figure 177. Mixed forests in the Gravel River Conservation Reserve. Phil Kor, MNRF.

Key features

- Spruces, paper birch, trembling aspen, and balsam fir mixed forests cover over one-third of the ecodistrict (Figure 177).
- Very shallow mineral material to bare bedrock dominates the area.
- A colder-than-normal climate along the shore of Lake Superior supports Arctic-alpine species.

Geology and substrates

The Schreiber Ecodistrict is characterized by a rolling to rugged, bedrock controlled topography consisting of Precambrian bedrock that is bare or covered by a layer of very shallow, acidic mineral material (Figure 178). As the glaciers advanced, a very thin, discontinuous layer of mineral material was deposited throughout the area (Gartner 1979c).

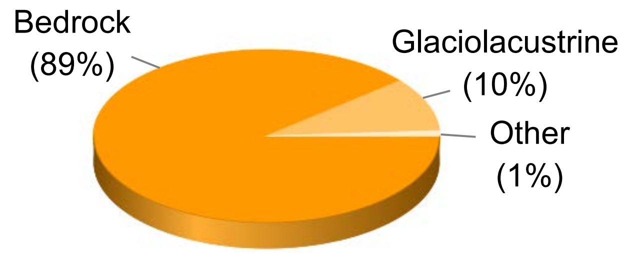


Figure 178. Modes of deposition in Ecodistrict 3W-5.

Approximately 9,600 years ago as the glaciers receded, glacial Lake Minong expanded from the east flooding areas along the north shore of Lake Superior (Dyke 2004). Wave action and fluctuating water levels from the glacial lake removed much of the overlying mineral material from the bedrock, depositing fine-textured glaciolacustrine sediment into low-lying areas. Additional glaciolacustrine deposits occur in the east in the Pic, Little Pic, and Black river valleys that were inundated by glacial lake water (Gartner and McQuay 1979a), at the mouth of larger rivers (e.g., Gravel, Aquasabon, and Pic) as they empty into Lake Superior, and as relict shorelines and cobble beaches adjacent to shore (Gartner 1979d). Glaciofluvial deposits are limited, typically confined to river valleys that carried glacial meltwater. Areas of calcareous mineral material may occur in association with glaciolacustrine and glaciofluvial deposits (Sado et al. 1994). Small amounts of morainal deposits occur in the north. Organic deposits can be found in low-lying areas including bedrock depressions or overlying mineral material where water has accumulated. Alluvial deposits occur along larger river systems including the Gravel, Steel, and Little Pic rivers, while lacustrine and aeolian sediments are evident adjacent to the Lake Superior shoreline.

Several prominent faults crisscross the area, strongly influencing the topography, drainage, and lake patterns, which tend to be linear, angular, and steep. Associated river valleys are often steep-walled. The northeast trending Gravel River-Kamuck River fault starts near the shore of Lake Superior and crosses the ecodistrict towards Long Lake in Ecodistrict 3W-4. In sections, the fault is 60 m wide with valley walls up to 150 m tall (Carter 1975).

Bedrock exposed or with a very shallow mineral material layer dominates Ecodistrict 3W-5 (Figure 179). The bedrock is primarily acidic but bands of base-rich bedrock occur in the south and the east. Gleysols have developed in river valleys in the east (e.g., Pic River), where imperfectly to poorly drained conditions can be found. Humo-Ferric Podzols occur in deeper morainal material in the north and Gray Luvisols in deep, well drained, fine-textured glaciolacustrine deposits in the east. Organic deposits, typically Mesisols, are limited. Large organic deposits occur in the east associated with rivers or overlying poorly drained glaciolacustrine material. Regosols can be found in alluvial, aeolian, and lacustrine sediment.

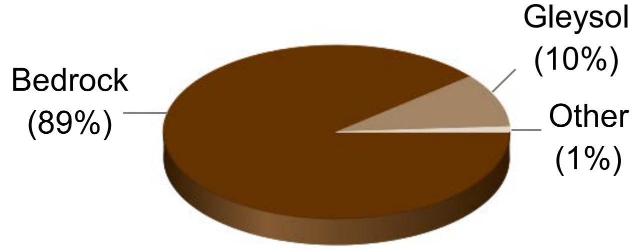


Figure 179. Substrate types in Ecodistrict 3W-5.

Land cover and vegetation

Associated with the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Superior Section (B.9) of the Boreal Forest Region, the forests of Ecodistrict 3W-5 are extremely variable ranging from mixed forests to coniferous forests dominated by a single species (Rowe 1972). Mixed forests of trembling aspen, paper birch, balsam fir, and white spruce account for one-third of the forests (Figure 180) and are often found in river valleys particularly along the Steel, Little Pic, and Pays Plat rivers. Coniferous forests of black spruce, often with American larch and eastern white cedar, grow in low-lying areas with imperfect drainage. Black spruce and jack pine forests occur on upland sites, while eastern white pine and red pine occur on warmer-than-normal sites including bedrock ridges (Rowe 1972). Sparse forests, typically coniferous, are more common in the west, growing on higher, rocky areas with very shallow soils.

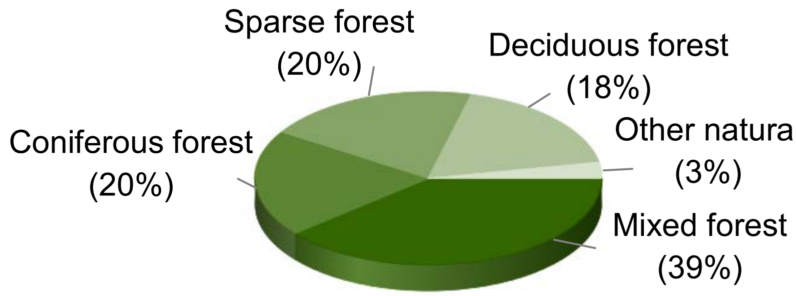


Figure 180. Land cover types in Ecodistrict 3W-5.

Deciduous forests occur more frequently in the east. On wetter, nutrient rich sites the forests consist of black ash, balsam poplar, and American elm. Sugar maple and yellow birch may occur on warmer-than-normal sites including the top of hills near Lake Superior (Rowe 1972). Bog and fen complexes are limited throughout the ecodistrict. Marshes may occur in sheltered bays adjacent to rivers and lakes including Lake Superior. Exposed bedrock is more prominent in the south, especially along the shore of Lake Superior (Figure 181). The proximity to Lake Superior decreases the occurrence and severity of fire. When they do occur, fires are often small. Larger fires typically occur to the north and may include high intensity ground fires or stand-replacing crown fires (Van Sleeuwen 2006).

Plant species found in the Schreiber Ecodistrict are influenced by the moderating effects of Lake Superior. Higher amounts of precipitation, fog, cooler-than-normal summers, and warmer-than-normal winters result in the prevalence of white spruce and balsam fir. Arctic-alpine species, including bird's-eye primrose and common butterwort, grow in cool, moist sites along the Lake Superior shoreline (Ontario Parks 2004a). Species endemic to the Great Lakes, including pointed moonwort and false northwestern moonwort, occur in the area (Henson and Brodribb 2005). Shoreline species specifically adapted to the harsh conditions adjacent to Lake Superior (e.g., wind, ice) include eastern ninebark. Active aeolian deposits along the shoreline of Lake Superior support woolly beach-heath and American beachgrass (Ontario Parks 2004a), species adapted to grow in areas with shifting mineral material.

Figure 181. Slate Islands Provincial Park. Ontario Parks.

Land use

Less than 1% of the area is settled, including the towns of Marathon, Terrace Bay, and Schreiber (Figure 182). The ecodistrict comprises 11.2% protected areas. An additional 397,385 ha of water are protected in the Lake Superior National Marine Conservation Area. Timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, fishing, hunting, and services associated with resource-based activities occur throughout the ecodistrict.

Ecodistrict boundary delineation

In an earlier classification by Hills (1959), Ecodistrict 3W-5 was referred to as Site District 3W-6. The northern and western boundaries reflect the transition from bedrock, exposed at the surface or with a very shallow layer of mineral material in Ecodistrict 3W-5, to deeper morainal material in 3W-3 and 3W-4. Differences in ecoregional climatic attributes define the boundaries between Ecoregion 3W and 3E. Ecoregion 3W is cooler and receives less precipitation than 3E. The southern boundary is defined by Lake Superior.

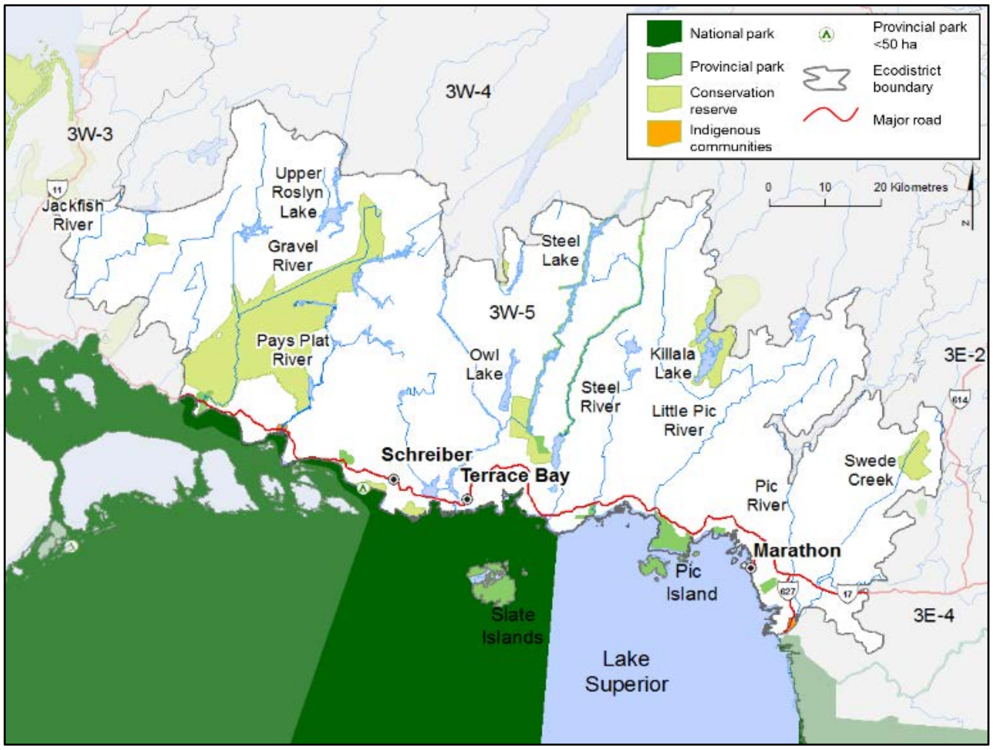


Figure 182. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 3W-5.

Port Coldwell Alkalic Complex

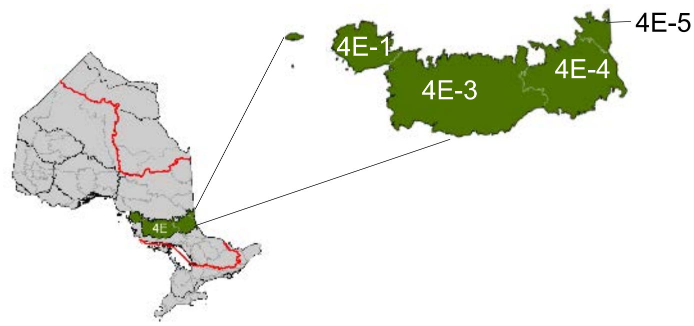
The Port Coldwell Alkalic Complex, located along Lake Superior west of Marathon, is the largest alkaline intrusion (580 km^2; Walker et al. 1993) associated with the Midcontinent Rift System in North America (Heaman and Machado 1992). The complex was formed nearly 1,100 million years ago when lava pushed up from the earth's surface into gaps between older bedrock. The lava was more base-rich than the older bedrock and in some instances contains a substantial amount of carbonate materials. Relatively rare in Ontario, large instrusions also occur north of Killala Lake and in Ecodistrict 3E-1 and 3E-5. These complexes produce magnetic anomalies, may contain rare elements, and increase vegetation diversity by supplying additional nutrients in a generally acidic environment.

Figure 183. Port Coldwell Alkalic Complex. Ron Schott.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecoregion 4E

Lake Temagami Ecoregion



The Lake Temagami Ecoregion extends from Lake Superior east to the Québec border. The northern boundary occurs south of the community of Wawa and extends to north of the Montreal River. Located in the Ontario Shield Ecozone, it encompasses 4,057,806 ha (4.1% of the province) including Michipicoten Island in Lake Superior. The area is divided into four ecodistricts (Table 7).

Table 7. Ecodistricts in Ecoregion 4E.

Ecodistrict	Ecodistrict name
4E-1	Michipicoten
4E-3	Mississagi
4E-4	Temagami
4E-5	New Liskeard

Most of the ecoregion is underlain with granitic and gneissic bedrock of the Precambrian shield. Morainal deposits are the primary surficial material, although several north-south trending river systems with glaciofluvial deposits and localized areas with aeolian and lacustrine material also occur. In better drained sites, Humo-Ferric Podzols occur and in poorly drained areas, Mesisol and Gleysols have developed.

A notable feature on the eastern edge of the ecoregion is an area of fine-textured mineral material referred to as the Little Clay Belt (Ecodistrict 4E-5). A remnant of glacial lakes Barlow and Ojibway, it is underlain by Paleozoic limestone and is richer in calcium content than substrates in adjacent ecodistricts.

Forests (mixed, coniferous, and deciduous) dominate the typically rolling landscape. They include the hardiest of the temperate forest species such as eastern white pine, red maple, and yellow birch that commonly occur on warmer-than-normal sites and in the south. Components of the boreal forest (e.g., jack pine, black spruce) are prominent in the north. Transitional forests cover the remainder of the area as Ecoregion 4E represents a significant ecological gradation between 3E and 5E.

Situated just south of the divide between the Hudson Bay and Great Lakes watersheds, the ecoregion is well to rapidly drained by numerous lakes and rivers. Major rivers include the Garden, Mississagi, and Spanish. Lakes include Temagami, Lady Evelyn, and Wanapitei.

Characteristic mammal and bird species include moose, American marten, winter wren, and barred owl. Spring peeper, snapping turtle, and ring-necked snake also occur. Fish species include northern pike, emerald shiner, and rock bass.

New Liskeard, Earlton, Temagami, and Haileybury are a few of the major communities found in the Lake Temagami Ecoregion. Timber harvesting, mineral exploration, agriculture, and resource-based activities are common land uses.

In total, 14 types of natural heritage areas have been established in Ecoregion 4E (Gray et al. 2009), including Lake Evelyn Smoothwater Provincial Park (Figure 184) which includes the highest point in Ontario — Ishpatina Ridge — at 693 m above sea level (NRCan 2002).

Figure 184. Lady Evelyn Smoothwater Provincial Park. Ed Morris, Ontario Parks.

The boundaries of Ecoregion 4E are defined by Lake Superior in the west and Québec in the east. Climatic variables, in part, delineate the northern and southern boundaries. Ecoregion 4E is typically warmer and wetter with a longer growing season than 3E. Compared with Ecoregion 5E, 4E is cooler, is at a higher elevation, and the underlying bedrock is typically from the Archean Eon (more than 2.5 billion years old), whereas in 5E the bedrock is from the Proterozoic Eon (less than 2.5 billion years old).

Ecodistrict 4E-1

Michipicoten Ecodistrict

Situated along the shore of Lake Superior, the Michipicoten Ecodistrict encompasses 495,697 ha (12.2% of the ecoregion, 0.5% of the province). The northern boundary includes the Michipicoten River and extends south to just north of the Montreal River. The east-west boundary stretches from Puswawa Lake to Lake Superior and includes Michipicoten, Caribou, and Montreal islands. The rolling landscape changes in elevation from 179 m above sea level along the Lake Superior shoreline and islands to 646 m above sea level east of the Agawa River.

Figure 185. Forests of Lake Superior Provincial Park. Mike Francis, MNRF.

Key features

- Deciduous forests occur over half of the ecodistrict (Figure 185).
- Precambrian bedrock, exposed or with a shallow mineral material layer, dominates.
- Relict shorelines of glacial lakes occur.
- Includes several narrow steep-walled valleys such as the Agawa Canyon.

Geology and substrates

Varied topography, a relatively thin ice sheet, and the rapid retreat of glaciers left behind a landscape dominated by bedrock with a discontinuous shallow layer of acidic, morainal material (Figure 186). In areas of rugged topography exposed bedrock may occur. The Precambrian bedrock is generally acidic but base-rich bedrock can be found from Maquon Lake west to Lake Superior, on Michipicoten Island, and east of Anjigami and

Kinniwabi lakes. A series of faults including the Old Woman River, Red Rock, and Agawa Canyon (Manson and Halls 1997) formed pre-glacial valleys that influence relief and drainage patterns. These valleys were further carved out by the glaciers and glacial meltwater leaving behind deeply incised steep-walled valleys.

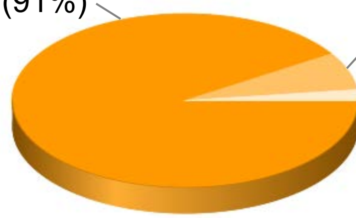


Figure 186. Modes of deposition in Ecodistrict 4E-1.

Glaciofluvial deposits (e.g., outwash) are generally associated with larger river valleys and several eskers occur throughout the area including a large esker complex southwest of Anjigami Lake (McQuay 1980b). Along the eastern boundary a shift from bedrock to deeper glaciofluvial and morainal deposits occurs.

Approximately 9,600 years ago (Dyke 2004), the retreating ice sheet had exposed most of the Michipicoten Ecodistrict. At that time, ice continued to cover Lake Superior and along the southeastern edge of the ice margin, glacial Lake Minong formed, inundating the eastern Lake Superior shoreline (Barnett 1992) and depositing glaciolacustrine sediment. As the glacier retreated, glacial Lake Minong expanded to the north and west, flooding the north shore of Lake Superior (Barnett 1992). Following glacial Lake Minong, a series of glacial lakes, including glacial lake Houghton and the Nipissing Great Lakes, occupied the Lake Superior basin. As glacial lake levels lowered shorelines were exposed, some of which can be seen today (Saarnisto 1975). Lacustrine deposits can be found along the shore of Lake Superior and on many of the associated islands. Alluvial deposits occur along rivers and at the mouth of major rivers, including the Sand and Agawa. Aeolian deposits can be found along the Lake Superior shoreline and organic material has developed in low-lying, poorly drained areas. Adjacent to cliffs, colluvial deposits (i.e., talus) may be found.

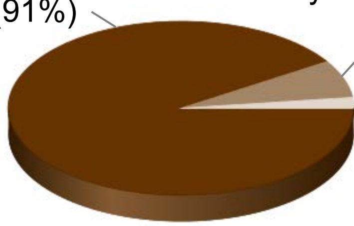


Figure 187. Substrate types in Ecodistrict 4E-1.

The dominant substrate type in Ecodistrict 4E-1 is bedrock covered by a discontinuous shallow layer of mineral material (Figure 187). Dystric Brunisols have typically developed in coarse-textured glaciofluvial material. On better drained sites, Humo-Ferric Podzols can be found. Organic materials, typically Mesisols, occur in localized areas with poor drainage and Regosols are associated with active mineral material (e.g., aeolian, alluvial) along rivers and the shore of Lake Superior.

Land cover and vegetation

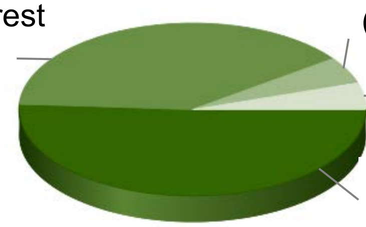


Figure 188. Land cover types in Ecodistrict 4E-1.

The Michipicoten Ecodistrict is a mosaic of ecosystems comprising plant species associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018), the Algoma Section (L.10) of the Great Lakes-St. Lawrence Forest Region, and the Missinaibi-Cabonga Section (B.7) of the Boreal Forest Region (Rowe 1972). Deciduous forests are more frequent in the west, consisting primarily of sugar maple and yellow birch (Figure 188). Associates may include red maple, American elm, black ash, northern red oak, and balsam poplar. To the north and east, paper birch and trembling aspen forests are more common.

Figure 189. Mixed forests found along the Agawa River. Roger Mulligan, MNRF.

Mixed forests may include maples, yellow birch, northern red oak, pines, and spruces (Figure 189). Trembling aspen, paper birch, balsam fir, spruces, and eastern white cedar occur on shallow sites, particularly in the north. Coniferous forests of eastern white pine and red pine grow on bedrock ridges. Old growth eastern white pine is found near Tikamaganda Lake (OMNR 2001a). White spruce, black spruce, eastern white cedar, American larch, and balsam fir occur on middle and lower slopes. Jack pine may dominate a forest or occur as individual trees on well drained mineral material (Beechey 1972). White spruce and balsam fir forests are notable along river terraces. Sparse forests are associated with areas of very shallow substrates particularly at higher elevations in the east. Fen and bog complexes are limited to areas where organic matter has accumulated. Marshes may develop adjacent to ponds, lakes, and river systems. Exposed bedrock is found in rugged topography and along the Lake Superior shoreline along with cobble beaches. Inland, relict cobble beaches of glacial lakes support lichen-bryophyte communities.

In the ecodistrict, the climate transitions rapidly from the moderating influence of Lake Superior eastward to a cooler climate. Increased rates of precipitation, cooler-than-normal summers, and warmer-than-normal winters influence the distribution of plant species. To the north and east, boreal forest species including black spruce, jack pine, paper birch, and trembling aspen are more common with isolated patches or scattered individuals of temperate tree species (Rowe 1972). Mountain holly and black holly reach their northern limits here (Soper and Heimburger 1982), while boundary meadow-rue can be found at its southern extent (Flora of North America Editorial Committee 1993+). The fire regime is variable. Fires occur less frequently than in ecodistricts to the east due to the lake modified climate. When they do occur, low intensity surface fires over short intervals are common while stand-replacing high intensity fires occur over long intervals (Van Sleeuwen 2006).

Stunted trees occur adjacent to Lake Superior, an adaptation to growing in the harsh environment. Along the Lake Superior shoreline, Arctic-alpine vegetation including black crowberry and alpine woodsia grow and shoreline flora specific to the temperate vegetation zone (e.g., bird’s-eye primrose) can be found. Plant species (e.g., American beachgrass and beach pea; White 2004) adapted to sand beaches and active aeolian materials where the movement of sand buries vegetation and exposes roots occur along Lake Superior (Beechey 1972). Increased plant species richness may occur in areas of base-rich bedrock where the availability of nutrients in the substrate is greater, including the Lake Superior shoreline where Beechey (1972) noted the basophiles, common butterwort and bulblet fern.

Land use

The western part of the ecodistrict along the shore of Lake Superior is protected in Lake Superior Provincial Park. Less than 1% of the area is devoted to settlement and associated infrastructure (Figure 190). No organized communities exist in Ecodistrict 4E-1. Land uses include timber harvesting, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities. Approximately 32.5% of the ecodistrict has been designated as protected areas. An additional 45 ha of water are protected in the Lake Superior National Marine Conservation Area (not shown in Figure 190).

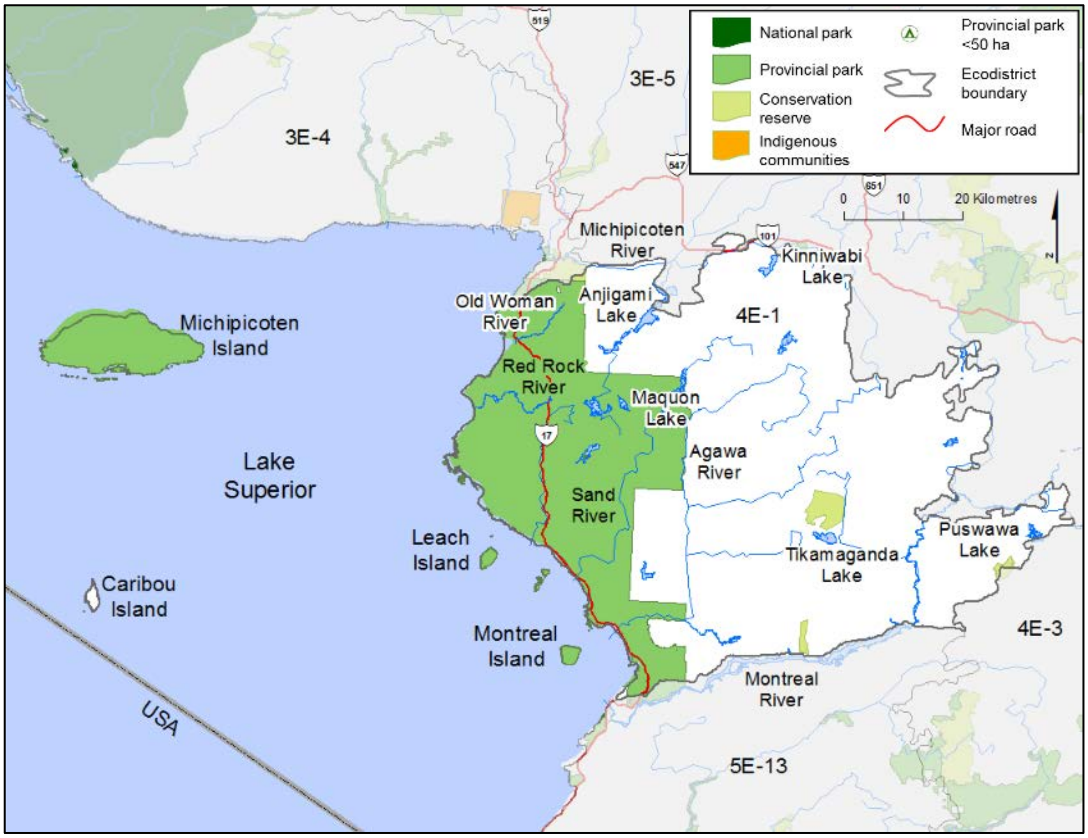


Figure 190. Select major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4E-1.

Ecodistrict boundary delineation

Ecoregional differences initially distinguish Ecodistrict 4E-1 from 3E-4 and 3E-5. Ecoregion 4E is warmer with more precipitation. The northern boundary is also defined by the transition from a rolling landscape in 4E-1 to an undulating topography in 3E-4 and 3E-5. The western boundary includes Lake Superior and associated islands including Michipicoten, Caribou, Leach, and Montreal. The southeastern boundary with 4E-3 represents the transition from bedrock with a shallow layer of mineral material in 4E-1 to deeper morainal deposits in the northwest corner of 4E-3. The southern boundary with 5E-13 generally coincides with the Montreal River but is also associated with lower overall temperature in 4E-3 and the transition from the suite of gneissic tonalite bedrock to the suite of foliated tonalite, metasedimentary, and metavolcanic bedrocks in 5E-13.

Figure 191. Agawa Canyon. Roger Mulligan,

Agawa Canyon

Approximately 1.1 billion years ago, the Agawa Canyon (Figure 191) was created when a block of land shifted down along two parallel faults producing a valley (Geofirma Engineering Ltd. 2013). The canyon was further carved out by ice and meltwater associated with the glaciers, creating one of the largest canyons in Ontario. The water currently flowing through the Agawa River and over the canyon's waterfalls represents only a fraction of the large volume of water that passed through the area as ice sheets melted. Only accessible by train and hiking trails, the Agawa Canyon and surrounding areas were painted by some members of the Group of Seven.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4E-3

Mississagi Ecodistrict

The Mississagi Ecodistrict extends from the community of Shining Tree in the north to Quirke Lake in the south. The western extent includes the northern portion of the Goulais River, and in the east the boundary is near the Vermillion River. It is the largest ecodistrict in Ecoregion 4E encompassing 2,267,027 ha (55.9% of the ecoregion, 2.3% of the province). The elevation ranges from 212 m above sea level in the southwest corner to 637 m above sea level north of Ranger Lake.

Figure 192. Mixed forests near Ranger Lake. Mike Francis, MNRF.

Key features

- Mixed forests occur over approximately half of the ecodistrict (Figure 192).
- Two-thirds of the landscape is Precambrian bedrock, exposed or with a variable layer of mineral material.
- Rolling bedrock defines the landscape with numerous lake and river systems.

Geology and substrates

The Mississagi Ecodistrict is a rolling landscape characterized by bedrock with a discontinuous layer of morainal material (Figure 193). Generally shallow but highly variable, the primarily acidic mineral material was deposited by glaciers that retreated from the area nearly 10,000 years ago (Dyke 2004). The bedrock controlled topography is evident in the shape, size, and patterns of the many lakes and rivers throughout the area (Noble 1982b).

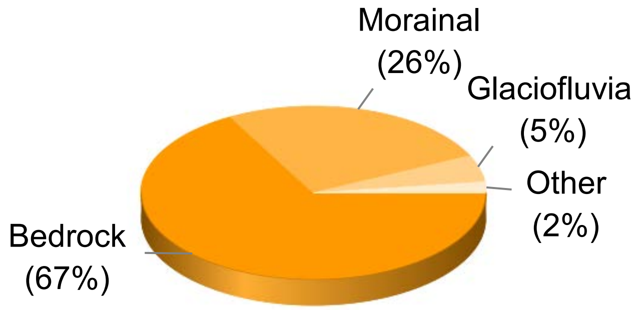


Figure 193. Modes of deposition in Ecodistrict 4E-3.

The landscape is further influenced by numerous folds and faults, including portions of the northwest-southeast trending Onaping Fault System in the east (Buchan and Ernst 1994), and the Penokean Fold Belt (Bennett et al. 1991) and the Flack Lake fault (Jackson 2001) in the south. The Precambrian bedrock is primarily acidic however, areas of base-rich bedrock can be found in the northwest near the Batchawana River and southeast of Onaping Lake. Unique to the vicinity of Quirke Lake is the presence of calcareous metasedimentary bedrock (Bennett et al. 1991).

Approximately one-quarter of the ecodistrict is classified as morainal material. Deeper deposits occur in two major morainal systems — the Chapleau moraines along the northern boundary and the Cartier moraines near the southern boundary (Boissoneau 1968, Barnett 1992). Glaciofluvial materials (i.e., outwash) can be found in major river valleys including the Spanish and Onaping rivers (Gartner 1980a). Glaciofluvial sediment was also deposited along the Mississagi and Wenebegon rivers that developed into major spillways (Van Dine 1980b) during deglaciation. Large esker complexes occur in the north, particularly northwest of Frechette Lake. Aeolian deposits can be found along the northern boundary. Generally limited in extent, organic material has developed in low-lying areas including extensive organic deposits west of Biscotasi Lake, east of Flack Lake, and north of Rocky Island Lake. Alluvial sediment can be found along most river systems and abundant bedrock exposures occur in more rugged terrain. Restricted amounts of glaciolacustrine sediment from glacial Lake Sultan occur along the northern boundary near Wakami and Wenebegon lakes. Colluvial material (i.e., talus) can be found adjacent to cliffs.

The substrate type is primarily bedrock with a discontinuous typically shallow layer of acidic mineral material (Figure 194). In the northern and western portions, particularly on better drained slopes, Humo-Ferric Podzols have developed. Dystric Brunisols occur in coarse-textured material typically associated with glaciofluvial deposits. Mesisols have accumulated in low-lying, poorly drained areas that facilitate the development of organic material. Regosols are restricted to active areas generally associated with rivers (e.g., alluvial material).

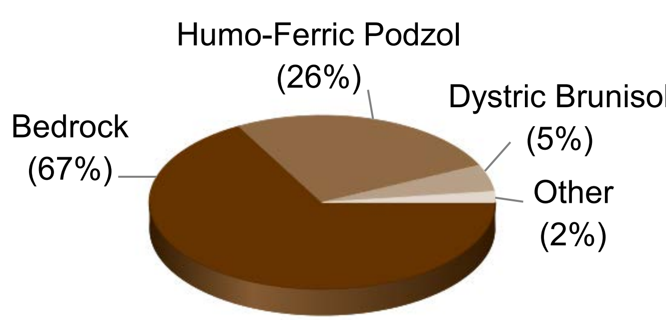


Figure 194. Substrate types in Ecodistrict 4E-3.

Land cover and vegetation

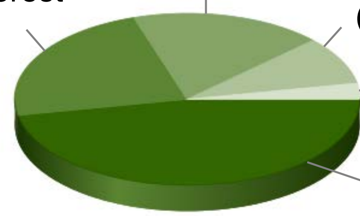


Figure 195. Land cover types in Ecodistrict 4E-3.

Ecodistrict 4E-3 is primarily associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018), the Timagami Section (L.9) of the Great Lakes-St. Lawrence Forest Region and the Missinaibi-Cabonga Section (B.7) of the Boreal Forest Region (Rowe 1972). Characterized by two broad forest regions, the vegetation is a transition between species with temperate and boreal affinities. Mixed forests grow on approximately half of the landscape (figures 195, 196). In the south, tree species typically found in mixed forests include eastern white pine, red pine, large-toothed aspen, yellow birch, eastern hop-hornbeam, sugar maple, and red maple. Less common associates include bur oak, black cherry, and silver maple (OMNRF 2016c, d). Farther north, white spruce, paper birch, trembling aspen, balsam fir, and black spruce are more common.

Dry, sandy areas and bedrock ridges support coniferous forests of jack pine, eastern white pine, and red pine, including areas of old growth eastern white and red pine (Arbex Forest 1991). Black spruce, American larch, and eastern white cedar grow in poorly drained depressions. Deciduous forests are more common in the southwest and northeast. On fresh to moist sites, black ash, American elm, and balsam poplar may grow. The southern portion of the ecodistrict represents the northern range limits of characteristic temperate species such as eastern hemlock, northern red oak, and American beech (Crins 1996). Sparse forests of eastern white pine, red pine, and jack pine with some black spruce are scattered throughout the ecodistrict, generally on very shallow to bare bedrock. Bog and fen complexes can be found in depressions on cooler sites (Crins 1996), while marshes may occur in quiet bays adjacent to rivers and lakes. Exposed bedrock including cliffs and talus slopes occur in areas with more rugged topography.

The transitional nature of Ecodistrict 4E-3 (i.e., a higher proportion of conifer-led forests) and the typically shallow mineral material precipitate a more intense fire regime relative to that in Ecoregion 5E to the south. In general, the Mississagi Ecodistrict has a variable fire regime with a combination of frequent, low intensity surface fires punctuated by stand-replacing high intensity fires that occur intermittently (Van Sleeuwen 2006). Increased plant species diversity may occur in areas of base-rich bedrock where nutrient availability in the substrate is greater. Plant species found near their northern ranges in the Mississagi Ecodistrict include swamp rose (Soper and Heimburger 1982) and Hickey's tree-clubmoss (Flora of North America Editorial Committee 1993+).

Figure 196. Mixed forests near Christman Lake, Mississagi Provincial Park. Ed Morris, Ontario Parks.

Land use

Land uses in Ecodistrict 4E-3 include mineral exploration, timber harvesting, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities. Less than 1% of the area is devoted to settlement and associated infrastructure. Communities include Levack, Onaping, Cartier, Ranger Lake, and Shining Tree (Figure 197). Protected areas occur over 13.3% of the ecodistrict.

Ecodistrict boundary delineation

Relative to Hills` (1959) original site district classification, the northern boundary with 3E-5 has been shifted south. This adjustment combines the deep glaciolacustrine and glaciofluvial deposits that were split across 4E-3 and 3E-5 into one ecodistrict (i.e., 3E-5), allowing for the better characterization of 4E-3. The northern and southern boundaries of the Mississagi Ecodistrict are defined by ecoregional variables. Ecoregion 4E is typically warmer and wetter than 3E to the north. Variables that delineate 4E from 5E are climate — 4E is cooler, elevation — 4E in general has a higher elevation, and bedrock — the primary bedrock in 4E is from the Archean Eon (more than 2.5 billion years old) compared with 5E where the primary bedrock is from the Proterozoic Eon (less than 2.5 billion years old). The boundary with 4E-1 is defined by the transition from deep morainal material in the northwestern corner of 4E-3 to shallow mineral material over bedrock in 4E-1. Geological differences help to delineate the eastern boundary with 4E-4. Ecodistrict 4E-3 is dominated by gneiss and granitic bedrock while 4E-4 is primarily composed of conglomerate, wacke, and quartz arenite of the Cobalt group.

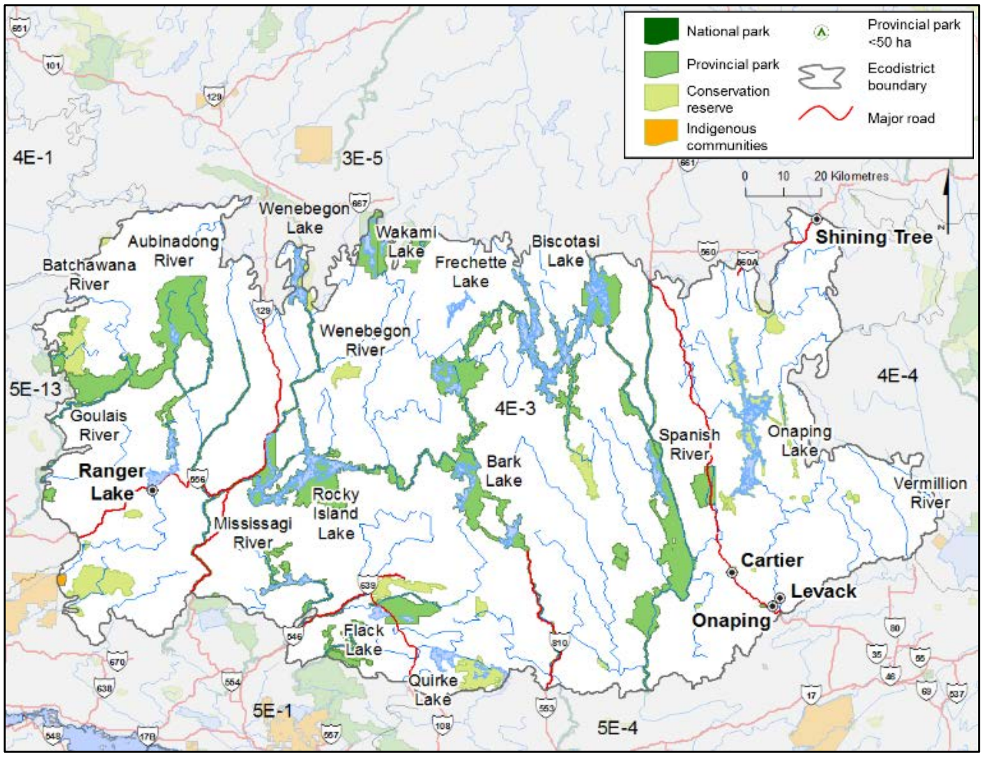


Figure 197. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4E-3.

Endikai Lake Perched Delta

A provincially significant earth science feature that reflects the area's glacial history can be found northwest of Quirke Lake. The Endikai Lake Perched Delta (Figure 198) was created as glacial meltwaters came in contact with glacial Lake Algonquin, depositing sand and gravel. As the lake levels of the glacial lake decreased, the delta was abandoned and left 'perched' in the hills (OMNR 2007a), approximately 60 km north of the current shore of Lake Huron.

Figure 198. Endikai Lake Perched Delta. David Webster, MNRF.

Ecodistrict 4E-4

Temagami Ecodistrict

Ecodistrict 4E-4 is located along the Ontario-Québec border and encompasses 1,119,159 ha (27.6% of the ecoregion, 1.1% of the province). It extends from the community of Skead in the south, northward to the Makobe River. The western boundary is near Thor Lake and extends to Lake Timiskaming, the Ottawa River, and the border with Québec. The elevation ranges from 180 m above sea level along the shore of Lake Timiskaming to 693 m above sea level southwest of Smoothwater Lake.

Figure 199. Mixed forests of Ecodistrict 4E-4. Will Byman, MNRF.

Key features

- Mixed forests of aspen, paper birch, spruce, and pines occur over nearly half of the landscape (Figure 199).
- Precambrian bedrock, exposed at the surface or with a shallow mineral material layer, is common.
- Rolling landscape accentuated by cliffs and single high hills include the highest point in Ontario — the Ishpatina Ridge (693 m) (NRCan 2002).

Geology and substrates

The Temagami Ecodistrict is characterized by a rolling landscape covered by a discontinuous layer of generally shallow, acidic morainal material (Figure 200). Strongly influenced by the underlying bedrock, the area is deeply dissected by numerous canyons and steep sided slopes (Roed 1979b, Gartner 1980c). Typically acidic, areas of base-rich bedrock occur around Lake Temagami and the community of Latchford. Single high hills, often referred to as mountains (e.g., Maple Mountain northwest of Lady Evelyn Lake) are the weathered and eroded remains of the oldest mountain ranges found on the Canadian Shield. Faults including the Vermillion River and Wanapitei in the west and the Latchford, Montreal River, and Cross Lake in the east (Card and Lumbers 1977) cross the area, influencing drainage patterns and the size and shape of lakes and rivers. The eastern faults form a section of the Lake Timiskaming fault system, the northwestern trending portion of the Ottawa-Bonnechere Graben (Sage 1992).

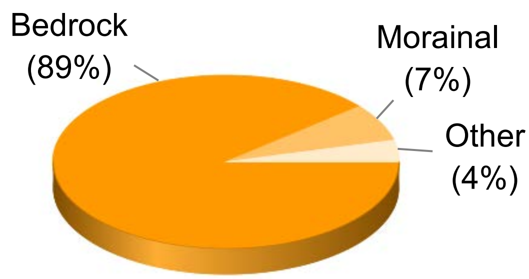


Figure 200. Modes of depositions in Ecodistrict 4E-4.

As the glaciers moved across the landscape, they further carved out valleys and removed much of the overburden. Localized areas of deeper morainal materials can be found northwest and southwest of the community of Latchford and near the junction of the Sturgeon and Obabika rivers where the Obabika Moraine (Barnett 1992) occurs. Glaciofluvial deposits include outwash sediment, generally associated with river valleys and a large esker stretching from the northeast arm of Lady Evelyn Lake south to Lake Temagami. The material was deposited by glacial meltwater that retreated from the area nearly 10,000 years ago (Dyke 2004). Glaciolacustrine deposits, the southern extent of glacial Lake Barlow (Barnett 1992), can be found in the northwest corner adjacent to Lake Timiskaming and the southern part of the Montreal River. The fine-textured mineral materials are typically calcareous (Roed 1979a) originating from Hudson Bay. Small patches of organic material typically occur in low-lying areas with poor drainage. Larger areas can be found north of Lady Evelyn Lake, northwest of the community of Latchford, and along the Sturgeon River. Exposed bedrock is more common in rugged areas especially on bedrock ridges and cliffs. Accumulations of colluvial material (i.e., talus) may be found at the base of cliffs. Alluvial deposits can occur along rivers and streams including the Wanapitei, Sturgeon, and Montreal rivers. Lacustrine features can be found along the shore of lakes including Florence (OMNR 2005c) and Lady Evelyn.

Over three-quarters of Ecodistrict 4E-4 is classified as bedrock (Figure 201). These areas are typically covered with a discontinuous layer of shallow mineral material separated by exposed bedrock outcrops. Mineral substrates are

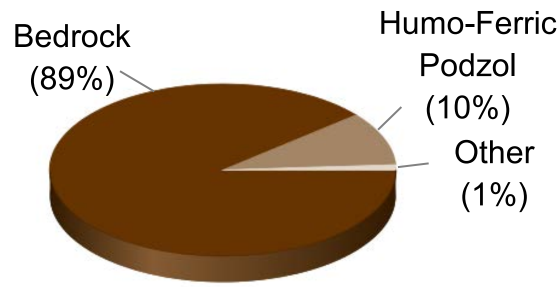


Figure 201. Substrate types in Ecodistrict 4E-4.

dominantly Humo-Ferric Podzols that have developed in deeper morainal deposits on better drained upland sites. On poorly drained sites, Gleysols occur in mineral material and organic accumulations composed of Mesisols can be found. Regosols are associated with active areas (i.e., alluvial deposits, lacustrine) including the shorelines of lakes and rivers.

Land cover and vegetation

Ecodistrict 4E-4 is found in the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) generally associated the Temagami Ecodistrict with the Timagami Section (L.9) of the Great Lakes-St. Lawrence Forest. The southwestern portion including Lake Wanapitei eastward to Thistle Lake is part of the Georgian Bay Section (L.4d). Mixed forests of eastern white pine, red pine, paper birch, aspen, spruce, and balsam fir are characteristic (figures 202, 203). On warmer-than-normal sites, eastern white pine, red pine, sugar maple, red maple, and yellow birch can be found. On drier, upland rocky and sandy sites, coniferous forests of red pine, jack pine, and eastern white pine are common. These areas also support old growth forests of eastern white and red pine. Colder-than-normal forests in depressions support American larch, black spruce, and eastern white cedar. Deciduous forests are generally composed of trembling aspen and paper birch. Sugar maple, northern red oak, large-toothed aspen, and yellow birch are present, but occur less frequently relative to areas in the south. Trees near their northern limits include eastern hop-hornbeam, American beech, eastern hemlock, American basswood (OMNRF 2016b), and silver maple (White 1990). On fresh to moist sites, black ash, balsam poplar, and American elm may be present. In the southeast near the shore of Lake Timiskaming, green ash and bur oak may also be found (White 1990). Very shallow to bare bedrock supports sparse forests of eastern white pine, red pine, and jack pine with some black spruce. Bog and fen complexes have developed in depressions on cooler sites and marshes may occur in quiet embayments adjacent to lakes and rivers.

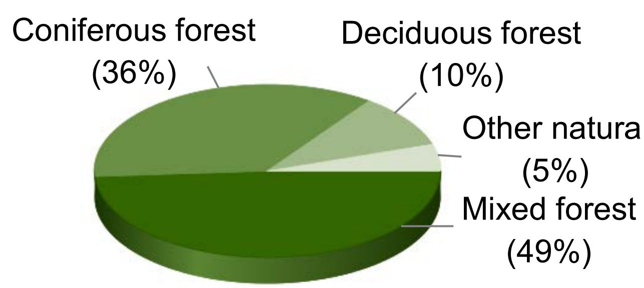


Figure 202. Land cover types in Ecodistrict 4E-4.

Ecosystems in the Temagami Ecodistrict are transitional between the boreal and temperate vegetation zones. Species with boreal affinities are more common in the north with only scattered occurrences of temperate tree species such as sugar maple and yellow birch (Rowe 1972). Dominant tree species (e.g., eastern white pine, red pine, and jack pine) are a result of periodic, extensive fires aided by shallow substrates and droughty conditions. Surface fires are typically low in intensity, occurring over short intervals, while stand-replacing fires are less frequent (Van Sleeuwen 2006). In general, Ecoregion 4E experiences a more intense fire regime than 5E. Areas of base-rich bedrock or calcareous mineral material may support an increase in plant species diversity due to the greater availability of nutrients. Southern milk-vetch, a calciphile, occurs along the shore of Lake Timiskaming (Bakowsky, 2015, MNRF, pers. comm.). Swamp rose (Soper and Heimburger 1982) and squarrose goldenrod (Semple et al. 1999) are found at their northern limits in this ecodistrict.

Figure 203. Coniferous and mixed forests of Lady Evelyn-Smoothwater Provincial Park. Ed Morris, Ontario Parks.

Land use

Timber harvesting, mineral exploration, hydroelectric generation, aggregate extraction, hunting, fishing, and services associated with resource-based activities occur throughout Ecodistrict 4E-4. Historically, the Temagami area has been a tourism destination for Americans and Canadians. Lodges, youth camps, cottages, and wilderness canoeing and camping have occurred on Lake Temagami since the early 1900s (Figure 204). Protected areas encompass 15.8% of the ecodistrict. Less than 1% of the area is devoted to settlement and associated infrastructure, including the communities of Temagami, Skead, Latchford, and Cobalt (Figure 205).

Figure 204. Lady Evelyn House, Temagami, ca.1907. Archives of Ontario, RG 13-30-1-7.

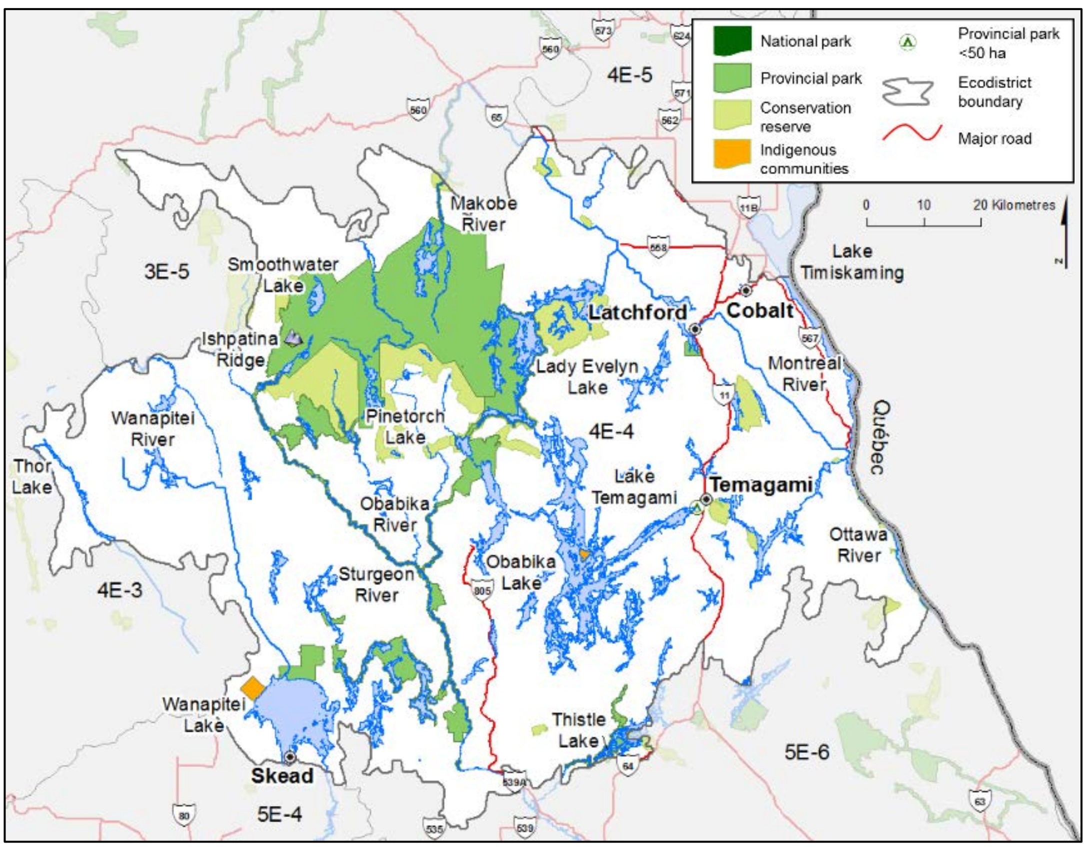


Figure 205. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4E-4.

Ecodistrict boundary delineation

The northern boundary with Ecoregion 3E is based on climatic differences. Ecoregion 4E is warmer with more precipitation than 3E. The northeast boundary with Ecodistrict 4E-5 reflects the change from a landscape characterized by bedrock with a shallow layer of mineral material in 4E-4 to deep fine-textured glaciolacustrine deposits in 4E-5. The eastern boundary of 4E-4 is defined by Lake Timiskaming, the Ottawa River, and the border with Québec. In the west, geological differences define the boundary between 4E-4 and 4E-3. Ecodistrict 4E-4 is primarily composed of conglomerate, wacke, and quartz arenite of the Cobalt group compared with the gneiss and granitic bedrock of 4E-3. Ecoregional differences distinguish 4E-4 from 5E-4 and 5E-6. Ecoregion 4E is cooler and typically has a higher elevation than 5E.

Old growth forests and Indigenous communities

The Temagami Ecodistrict is home to some of the largest remaining forests of old growth red and eastern white pine in Ontario (Figure 206). Old growth forests can be found at Obabika and Pinetorch lakes (OMNR 2005c).

Throughout Ontario, a rich history of Indigenous culture can be seen. In the Temagami area, a diverse array of heritage locations including traditional use sites and pictographs (Figure 207) mark the places used by the Teme-Augama Anishnabai over thousands of years (OMNR 2005c).

Figure 206. Eastern white pine. Ed Morris, Ontario Parks.

Figure 207. Pictograph on Lake Anima-Nipissing. Peter Uhlig, MNRF.

Ecodistrict 4E-5

New Liskeard Ecodistrict

Located along the Ontario-Québec border, Ecodistrict 4E-5 encompasses an area of 175,924 ha (4.3% of the ecoregion, 0.2% of the province). The smallest ecodistrict in Ecoregion 4E, it extends northward from the community of North Cobalt, to approximately 10 km north of the community of Englehart. The western boundary is near Wabun Creek and extends east to the Ontario-Québec border. The undulating topography ranges in elevation from 174 m above sea level in the southeast near Québec to 369 above sea level east of Wabun Creek.

Figure 208. Agricultural and forested areas of Ecodistrict 4E-5. Mike Francis, MNRF.

Key features

- Over one-third of the area has been converted to agricultural land (Figure 208).
- Mixed forests dominate the natural cover.
- Glaciolacustrine deposits cover more than three-quarters of the ecodistrict.
- Paleozoic bedrock outliers occur here.

Geology and substrates

The New Liskeard Ecodistrict is located in a fault-controlled valley overlain with glaciolacustrine deposits from glacial lakes Barlow and Ojibway. The Cross Lake and Blanche River faults (Lovell and Caine 1970, Card and Lumbers 1979) contribute to the area’s undulating topography. These faults are components of the Lake Timiskaming fault system, a section of the Ottawa-Bonnechere Graben (Sage 1992). Approximately 9,600 years ago glacial Lake Barlow formed (Dyke 2004). The reversal of the upper Ottawa River drainage due to isostatic rebound and possibly an obstruction resulted in the ponding of glacial meltwater and the formation of the glacial lake. As the glacier retreated north, glacial Lake Ojibway, the northern successor to glacial Lake Barlow, was formed (Dyke 2004). As the glacial lakes followed the advance and retreat of the ice sheet, wave action and fluctuating lake levels shifted, modified, and deposited mineral material. Over three-quarters of Ecodistrict 4E-5 is covered by a layer of deep, calcareous, glaciolacustrine material (Figure 209). Additional glaciolacustrine features include relict beaches and shoreline cliffs (Morton et al. 1979). In some areas, deep valleys have been cut through the glaciolacustrine deposits by streams and rivers.

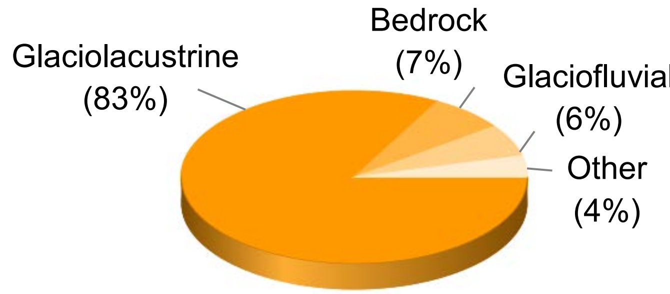


Figure 209. Modes of deposition in Ecodistrict 4E-5.

The landscape is underlain with Precambrian and — unique to the Ontario Shield Ecozone — a large area of Paleozoic bedrock. Encompassing 500 km^2 (Grant and Owsiacki 1987), the southern limit of the Paleozoic outlier occurs along the shore of Lake Timiskaming and extends north to the community of Englehart. The outlier, along with base-rich Precambrian bedrock, underlies most of the ecodistrict. Acidic Precambrian bedrock is more common in the northwest and along the border with Québec. Bedrock, typically with a discontinuous layer of morainal material, is scattered throughout the ecodistrict. Exposed rock, including bedrock and colluvial deposits (i.e., talus), may occur in areas of more rugged topography including escarpments along the shore of Lake Timiskaming and river valleys including St. Jean Baptiste Creek and the Blanche and Englehart rivers. Glaciofluvial material can be found west of St. Jean Baptiste Creek and morainal deposits extend from Lake Timiskaming to the community of Earlton. Extensive organic deposits occur in depressions, especially on either side of the Blanche River. Alluvial sediment occurs in larger river valleys including Blanche River and Wabi Creek, while lacustrine deposits have developed along the shore of Lake Timiskaming (Morton et al. 1979).

The poorly drained landscape of Ecodistrict 4E-5 has facilitated the development of Gleysols throughout most of the area (Figure 210). Associated with glaciolacustrine deposits, Gleysols are generally fine-textured and indicate a

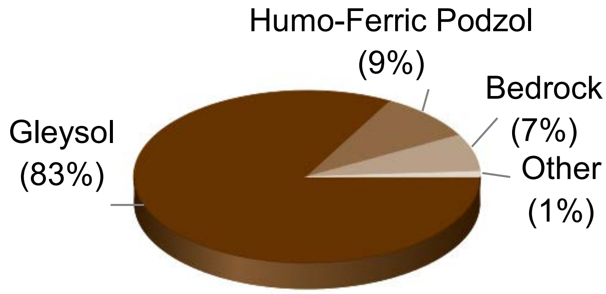


Figure 210. Substrate types in Ecodistrict 4E-5.

prolonged period of water saturation. Humo-Ferric Podzols have developed in coarse-textured glaciofluvial and morainal deposits with better drainage. Bedrock is more common in the northwest and organic deposits, typically Mesisols and Humisols, occur in the east. Regosols are associated with active areas (i.e., alluvial sediment) including shorelines and river banks.

Land cover and vegetation

The New Liskeard Ecodistrict is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and Haileybury Clay Section (L.8) of the Great Lakes-St. Lawrence Forest Region. The area northwest of St. Jean Baptiste Creek is associated with the Missinaibi-Cabonga Section (B.7) of the Boreal Forest Region (Rowe 1972). Over one-third of the ecodistrict has been cleared for agriculture (Figure 211).

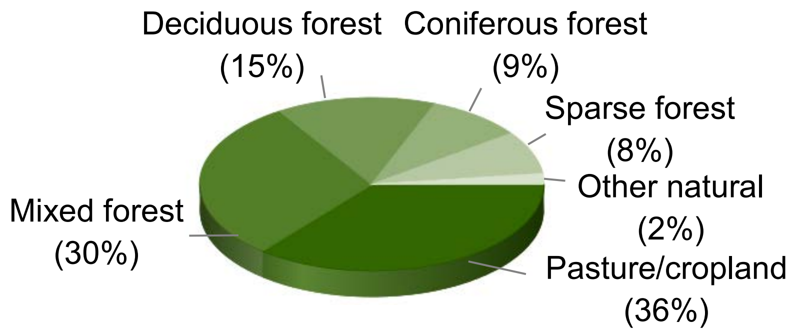


Figure 211. Land cover types in Ecodistrict 4E-5.

The remaining natural areas are transitional with a mixture of species with boreal and temperate affinities. Mixed forests of trembling aspen, paper birch, jack pine, black spruce, and balsam fir predominate. Deciduous forest of trembling aspen and paper birch occur more frequently in the north. The prominence of trembling aspen and paper birch is generally due to fire as well as the lack of mature forests due to agricultural development (Rowe 1972). The natural fire regime in 4E-5 consists of low intensity surface fires at short intervals with higher intensity, stand-replacing fires over longer intervals (Van Sleeuwen 2006). In general, the moderating effect of Lake Timiskaming (i.e., warmer-than-normal summers and cooler-than-normal winters) and the deeper, wetter soils of 4E-5 decreases the frequency and severity of fire relative to Ecodistrict 4E-4. Yellow birch, sugar maple, northern red oak, and red maple occur in the south. Near the shore of Lake Timiskaming, green ash, silver maple, and bur oak may be found (White 1990). Forests containing balsam poplar, American basswood, black ash, and American elm may occur on fresh to moist sites, particularly along river banks. Coniferous forests of jack pine occur in the west and black spruce, often mixed with eastern white cedar and American larch, is common in depressions associated with wet areas. White spruce, red pine, and eastern white pine are not abundant, with white spruce restricted to lake shores on well drained sites. Red pine and eastern white pine are scattered around lakes on shallow, coarse-textured sites especially in the northeast. Sparse forests are typically found on drier sites and include jack pine and black spruce on shallow bedrock ridges. Fen and bog complexes occur in low-lying areas, particularly along the St. Jean Baptiste Creek and Blanche River. Marshes may develop in embayments along lakes and rivers.

In areas where base-rich bedrock (Precambrian and Paleozoic) are at the surface or calcareous mineral material is present, the availability of substrate nutrients is high, potentially leading to an increase in plant species diversity. Limestone oak fern, a calciphile, is found along the Lake Timiskaming shoreline on Paleozoic bedrock along with fragrant wood fern (White 1990), which grows best on base-rich to calcareous bedrock (Choberka et al. 2000). The local warming effect of Lake Timiskaming and the presence of several escarpments provide a variety of habitats (Figure 212). Canada plum and staghorn sumac are near their northern limits, and the southern ranges of tea-leaved willow and Arctic raspberry occur here (Soper and Heimburger 1982).

Figure 212. Mani-doo Aja-bikong (Devil's Rock), Lake Timiskaming. Peter Uhlig, MNRF.

Land use

In Ecodistrict 4E-5, land uses include agriculture, timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, hunting, fishing, and services associated with resource-based activities. Approximately 5% of the ecodistrict is designated as protected areas. Less than 1% of the total area is devoted to settlement and associated infrastructure. Communities found in the ecodistrict include New Liskeard, Haileybury, Englehart, North Cobalt, and Earlton (Figure 213). The towns of New Liskeard and Haileybury, and the township of Dymond amalgamated in 2004 to form the city of Temiskaming Shores.

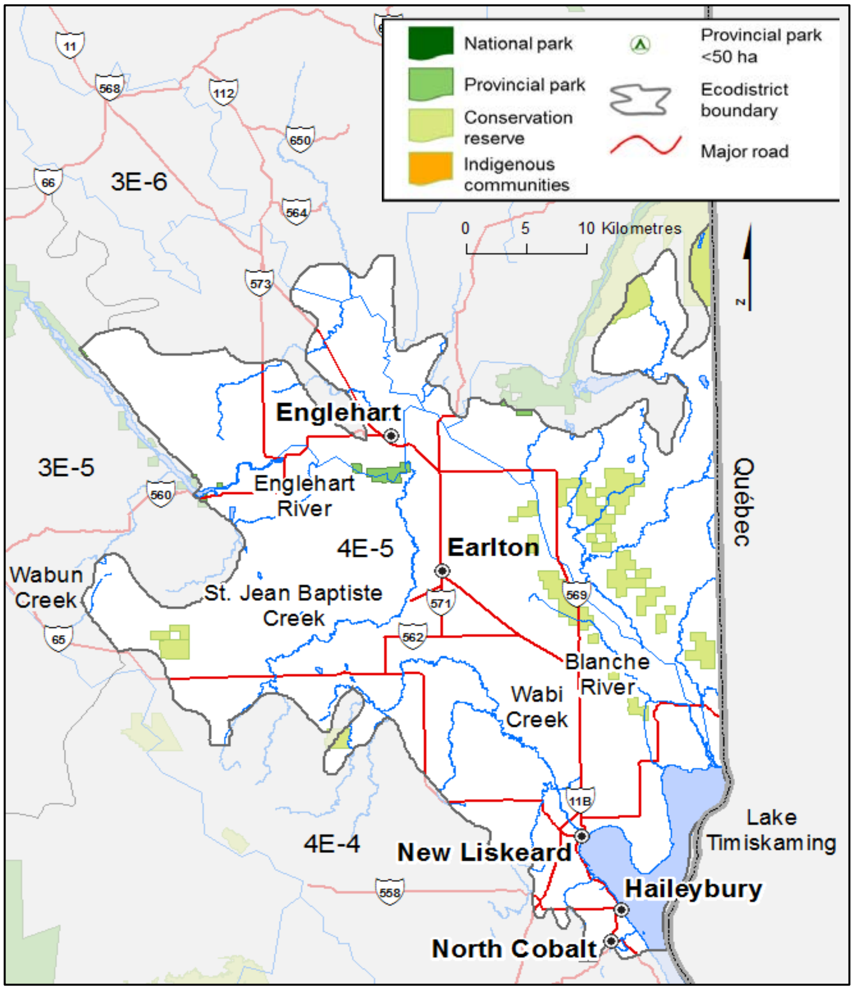


Figure 213. Select communities, major roads, natural heritage areas, and waterways in Ecodistrict 4E-5.

Ecodistrict boundary delineation

The deep, fine-textured glaciolacustrine material that dominates Ecodistrict 4E-5 helps differentiate it from 4E-4, which is characterized by bedrock with a typically shallow layer of mineral material. The eastern boundary is defined by the Ontario-Québec border. Climatic differences distinguish 4E-5 from 3E-5 and 3E-6; on average Ecoregion 4E is warmer and wetter than Ecoregion 3E.

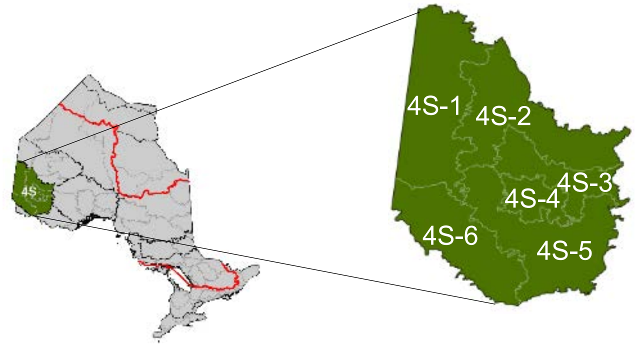
Glacial lakes Barlow and Ojibway

Approximately 9,600 years ago (Dyke 2004) as the glaciers retreated north, an ice-contact lake, glacial Lake Barlow formed. Increased melting of the glacier and limited drainage into the Ottawa River resulted in an expansion of the glacial lake to the north, creating glacial Lake Ojibway nearly 9,000 years ago (Dyke 2004). Glacial Lake Ojibway eventually expanded west joining glacial Lake Agassiz in the northwest. The two lakes formed a continuous body of water from east to west across Ontario and extended into Québec and Manitoba. Approximately 8,000 years ago, both lakes drained into Hudson Bay. The remaining lake bed forms the present day clay belt, an area rich in agriculture, in northeastern Ontario and western Québec (Figure 214)

Figure 214. Agricultural areas on the clay belt near the community of Englehart. Mike Francis, MNRF.

Ecoregion 4S

Lake Wabigoon Ecoregion



Ecoregion 4S extends from the Bloodvein River south to the northern portion of Lake of the Woods. The western boundary is at the Ontario-Manitoba border and stretches east to Lac Seul and the community of Ignace. Located in the Ontario Shield Ecozone, the ecoregion comprises six ecodistricts (Table 8).

Table 8. Ecodistricts in Ecoregion 4S.

Ecodistrict	Ecodistrict name
4S-1	Sydney Lake
4S-2	Lac Seul
4S-3	English River
4S-4	Dryden
4S-5	Manitou
4S-6	Sioux Narrows

Gneiss, granite, and metavolcanic Precambrian bedrock dominate the ecoregion. Bedrock exposures with limited overburden occur in the west, while in the east the bedrock is covered by varying depths of morainal material or glaciolacustrine material associated with glacial Lake Agassiz. A large glaciolacustrine clay deposit occurs near the community of Dryden. Dystric Brunisols account for over half of the ecoregion, occurring mainly in upland morainal deposits. Mesisols and Gleysols have developed in low-lying acidic sites, and Gray Luvisols are found in calcareous fine-textured glaciolacustrine deposits. Nearly one third of the Lake Wabigoon Ecoregion is classified as exposed bedrock.

The vegetation communities in Ecoregion 4S reflect a steep climatic gradient and represent a rapid ecological transition from ecosystems with grassland species in the west to boreal and temperate systems in the east. In the north, jack pine, black spruce, balsam fir, trembling aspen, and paper birch are common. Warmer and drier sites over much of the central and southern portions of the ecoregion support American elm, eastern hop-hornbeam, bur oak (Figure 215), large-toothed aspen, eastern white pine, and red pine. Forests dominate the landscape. An intense fire regime, dry climate, and shallow substrate promote sparsely vegetated communities. The ecodistrict is significantly influenced by adjacent grassland conditions in Manitoba and the United States. The climate is relatively dry and cool, with periods of summer drought.

The Lake Wabigoon Ecoregion is generally well drained to the west through the Nelson Watershed. Several large lakes and rivers occur including Lac Seul, Eagle Lake, Lake of the Woods (northern portion), and the English and Winnipeg rivers.

Characteristic mammal and bird species include moose, northern gray wolf, snowshoe hare, bald eagle, hermit thrush, and yellow-rumped warbler. Amphibians and reptiles include blue-spotted salamander, green frog, western painted turtle, and red-sided gartersnake. Fish species with southern or western affinities such as goldeye and pumpkinseed occur with lake trout and northern redbelly dace.

Figure 215. Bur oak woodland on Lake of the Woods. Sam Brinker, MNRF.

The communities of Dryden, Kenora, Ignace, and Sioux Lookout are located in Ecoregion 4S. Timber harvesting dominates the economy, however, mining and mineral exploration occur and agriculture can be found in areas with fertile, fine-textured substrates.

Twelve types of natural heritage areas have been established in the Lake Wabigoon Ecoregion, including the Bloodvein Canadian Heritage River that originates in Ontario and flows into Lake Winnipeg in Manitoba (Gray et al. 2009).

The northern boundary with Ecoregion 3S is differentiated by geological and climatic differences. The bedrock in Ecoregion 4S is generally metavolcanic and metasedimentary, while 3S is underlain by granite and tonalite bedrock. Ecoregion 4S is also warmer and drier than 3S as well as 3W. A cooler, drier climate in Ecoregion 4S separates it from 4W. Compared with Ecoregion 5S in the southwest, 4S is cooler and wetter, is found at a higher elevation, and the surficial geology is characterized by a rolling, bedrock controlled landscape with morainal material. Ecoregion 5S is dominated by glaciolacustrine deposits and is typically level.

Ecodistrict 4S-1

Sydney Lake Ecodistrict

The Sydney Lake Ecodistrict is situated along the Manitoba border extending east to Confusion Lake. In the south, the boundary is below the community of Minaki, and stretches north to the Bloodvein River. The largest ecodistrict in Ecoregion 4S, it encompasses 1,463,831 ha (24.6% of the ecoregion, 1.5% of the province). The elevation ranges from 298 m above sea level around the Winnipeg River to 457 m above sea level southeast of Confusion Lake.

Figure 216. Forest of Woodland Caribou Provincial Park in the northwestern portion of Ecodistrict 4S-1. Doug Gilmore, Ontario Parks.

Key features

- Sparse forests with a mixture of jack pine, black spruce, paper birch, and trembling aspen are common (Figure 216).
- Bedrock dominated landscape with varying depths of acidic, morainal material.
- Includes the Wanipigow-Wallace lakes and the Sydney Lake-Lake St. Joseph faults.

Geology and substrates

Hills (1959, 1976) described Ecodistrict 4S-1 as an undulating to rolling bedrock landscape. Faults, including the Wanipigow-Wallace lakes and Sydney Lake-Lake St. Joseph faults (Stott and Corfu 1991, Ontario Parks 2004c), strongly influence the topography and drainage, creating linear, steep-sided lakes and river systems. The Precambrian bedrock is bare or covered by a very shallow layer of mineral material and occurs over nearly half of the ecodistrict (Figure 217). Nearly 10,000 years ago as the glaciers retreated, the area was submerged under glacial Lake Agassiz (Dyke 2004). Variations in lake level, currents, and wave action removed most of the previously deposited mineral material from the bedrock.

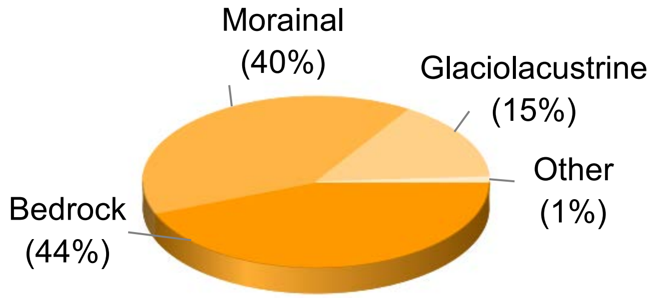


Figure 217. Modes of deposition in Ecodistrict 4S-1.

Deeper deposits of morainal material occur east of Larus Lake and as scattered pockets throughout the ecodistrict, typically in bedrock depressions. Glaciolacustrine deposits associated with glacial Lake Agassiz are commonly found in the south, surrounding large lakes, and in bedrock controlled valleys (Morris 1999). Glaciolacustrine materials deposited in the deeper portion of the glacial lake are generally fine-textured and calcareous, a result of the inflow of calcareous sediments from Manitoba. Relict shorelines of glacial Lake Agassiz are also more common in the south. Glaciofluvial material is limited to larger river valleys. Organic deposits are restricted to low-lying areas with poor drainage and alluvial materials have accumulated adjacent to larger river systems.

The western portion of the ecodistrict is dominated by bedrock. The Precambrian bedrock is typically acidic ; however, areas of base-rich bedrock can be found near Eagle Lake and north of the community of Whitedog. In the east, Dystric Brunisols have developed in morainal and glaciofluvial material (Figure 218). Gray Luvisols are characteristic in better drained, fine-textured deposits in the south and along larger river systems including the Bloodvein River. Organic accumulations, typically Mesisols, have developed on glaciolacustrine sediment in areas with poor drainage (Noble 1978). Regosols are associated with active mineral deposits including alluvial sediment.

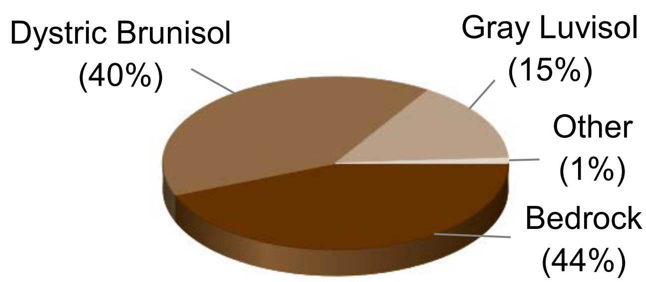


Figure 218. Substrate types in Ecodistrict 4S-1.

Land cover and vegetation

The Sydney Lake Ecodistrict occurs within the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). It is also associated with three forest sections identified by Rowe (1972), two in the Boreal Forest Region and one in the Great Lakes-St. Lawrence Forest

Region. The northern portion is associated with the Northern Coniferous Section (B.22a) and the central portion with the Lower English Section (B.14) of the Boreal Forest Region. The southern portion is associated with the Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region. Very shallow substrates, particularly in the west, limit forest cover and support sparse forests of coniferous and/or deciduous species that dominate the area (Figure 219). Coniferous forests are more common as large associations in the central and northern portions of the ecodistrict. Jack pine and black spruce grow on well drained sites, and American larch and black spruce are common on poorly drained sites. Eastern white cedar may occur in the south. Approximately one-quarter of the ecodistrict is represented by mixed forests of trembling aspen, paper birch, balsam poplar, black and white spruce, and balsam fir. These forests along with deciduous forests generally occur on sheltered or warmer-than-normal sites. On fresh to moist, nutrient rich sites, black ash, green ash, and occasionally American elm may occur. Bur oak may also occur on south-facing rocky shores (Harris et al. 2001). Fen and bog complexes have developed over a limited area in low-lying areas often associated with black spruce. Due to very shallow substrates and periodic drought, Ecodistrict 4S-1 is susceptible to frequent, small fires that favour tree species such as jack pine and paper birch. Fires may also be high intensity surface fires or stand-replacing crown fires (Van Sleeuwen 2006). Bare bedrock is typically associated with bedrock ridges. Marshes may occur adjacent to lakes and larger river systems.

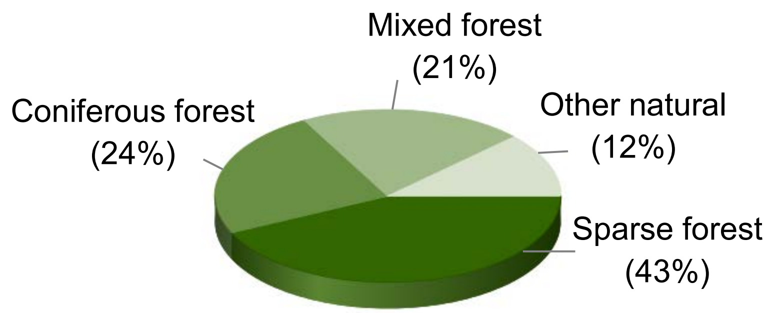


Figure 219. Land cover types in Ecodistrict 4S-1.

The flora of Ecodistrict 4S-1 is quite diverse. Species with grassland, temperate, and boreal affinities may be found across the landscape. Meadow and woodland ecosystems typically found farther west in Manitoba and central United States are limited (Figure 220). Plants in these ecosystems that occur at their eastern limit include blue giant hyssop, prairie onion, and prairie buttercup (Harris et al. 2001). Temperate species such as eastern white pine, red pine, and large-toothed aspen occur in the south. Old growth eastern white pine trees occur north of Dogtooth Lake (OMNR 2009a). Plants with western boreal affinities include northern firmoss and species at their western limits include Mackay's bladder fern and brown beakrush (Brunton 1986b). Increased plant species richness may occur in areas of base-rich bedrock or calcareous mineral material where substrate nutrient availability is higher.

Figure 220. Jack pine woodland with big bluestem, a grassland species. Sam Brinker, MNRF.

Land use

The communities of Whitedog and Minaki and associated infrastructure encompass less than 1% of the ecodistrict (Figure 221). Major land uses include timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities. Protected areas encompass approximately 38.9% of the ecodistrict.

Ecodistrict boundary delineation

The northern boundary of Ecodistrict 4S-1 with Ecoregion 3S is strongly correlated with geological differences, elevation, precipitation, and temperature. In particular, 4S encompasses more diverse and richer bedrock types than 3S. Ecoregion 4S includes metavolcanic and metasedimentary bedrock types while 3S is mostly composed of granite and tonalite bedrock. Ecoregion 4S is also typically warmer and drier than 3S. The western boundary of Ecodistrict 4S-1 is defined by the border with Manitoba. The eastern boundary with 4S-2 and 4S-5 and the southern boundary with 4S-6 reflect the transition from bedrock, exposed at the surface or with a very shallow layer of mineral material, in 4S-1 to deeper mineral material.

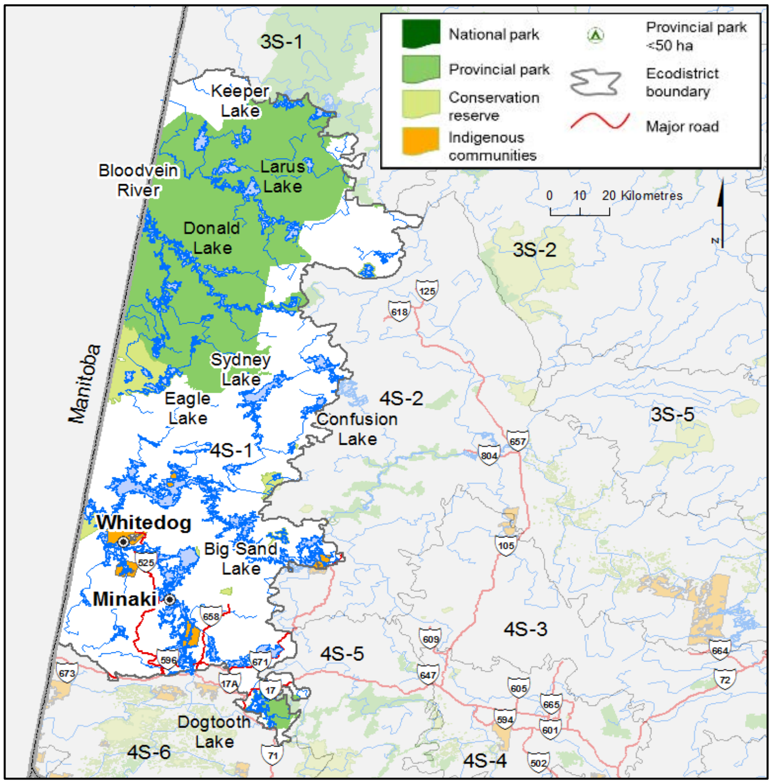


Figure 221. Select communities, roads, natural heritage areas, rivers, and lakes in Ecodistrict 4S-1.

Faults

Across Ontario, a large network of faults influence topography, drainage, and lake patterns. Faults may separate bedrock with distinct rock types, mineral deposits, structure, ages, and metamorphic conditions. In the northern part of Ecodistrict 4S-1, the Wanipigow-Wallace lakes fault (Figure 222) is a notable feature. Immediately south of Sydney Lake, the Sydney Lake-Lake St. Joseph fault can be found (Stott and Corfu 1991).

Figure 222. Wanipigow-Wallace lakes fault. Christine Hague, Ontario Parks.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4S-2

Lac Seul Ecodistrict

The Lac Seul Ecodistrict extends from Little Vermillion Lake in the north to Red Deer Lake in the southwest and Lost Lake in the southeast. It encompasses 1,291,624 ha (21.7% of the ecoregion, 1.3% of the province). The gently rolling to hilly landscape changes in elevation from 322 m above sea level in the southwest to 480 m above sea level east of Tully Lake.

Figure 223. Lac Seul Islands Conservation Reserve. MNRF.

Key features

- Spruces, jack pine, trembling aspen, balsam fir, and paper birch commonly occur in mixed forests throughout the ecodistrict (Figure 223).
- Consists mainly of moderately deep to deep morainal material over Precambrian bedrock.
- Includes Lac Seul – the second largest body of fresh water entirely in Ontario.

Geology and substrates

The Lac Seul Ecodistrict is characterized by gently rolling topography in the south, grading to a hilly landscape dominated by bedrock ridges in the north (Zoltai 1965a). A series of faults, including the Sandy Lake-Lake St. Joseph fault (Stott and Corfu 1991) south of Pakwash

Lake and the Wanipigow-Wallace lakes fault (Ontario Parks 2004c) in the north, add relief across the area. The underlying Precambrian bedrock is predominantly covered by a layer of moderately deep to deep, acidic, coarse-textured morainal material (Figure 224). Moraines, including portions of the Lac Seul, Hartmann, and Eagle-Finlayson, occur across the landscape.

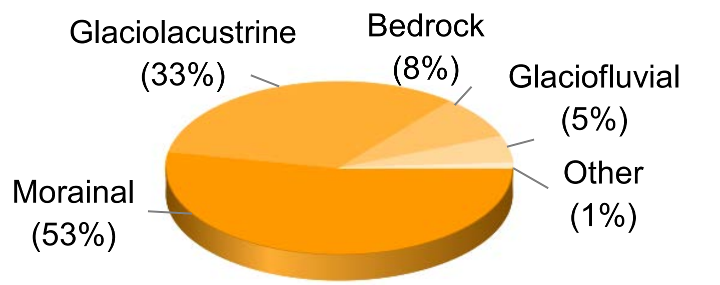


Figure 224. Modes of deposition in Ecodistrict 4S-2.

Along Lac Seul fine-textured glaciolacustrine deposits occur in the east. Approximately 9,500 years ago (Dyke 2004), glacial Lake Agassiz inundated the area following the retreat of the glaciers. The inundation was brief and little of the morainal material was modified. Glaciolacustrine materials deposited in the deeper parts of the glacial lake include calcareous sediments originating in Manitoba. These sediments typically can be found surrounding larger lakes or as small pockets amongst bedrock ridges. Relict shorelines from glacial Lake Agassiz occur in the west, and relict beaches can be found along the moraines. Bedrock, exposed at the surface or with a very shallow layer of mineral material is limited, typically occurring in the north. Glaciofluvial deposits are scattered throughout the landscape. Larger areas of glaciofluvial material can be found west of Lac Seul associated with the Lac Seul Moraine and south and east of Gullrock Lake. Organic deposits are restricted to poorly drained areas including sites east of Pakwash Lake. Alluvial materials occur along larger rivers and lacustrine deposits can be found on the shore of Lac Seul.

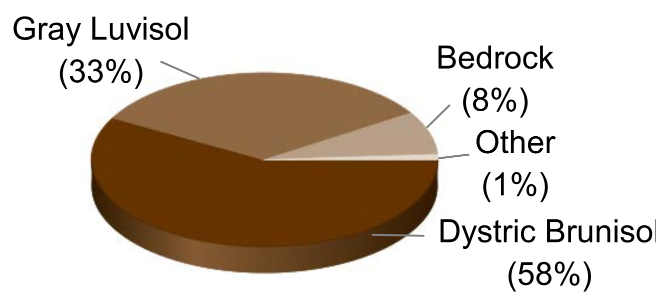


Figure 225. Substrate types in Ecodistrict 4S-2.

In over half of the ecodistrict, Dystric Brunisols have developed in morainal and glaciofluvial material (Figure 225) and are generally more common in the northern and central portions of the ecodistrict. Gray Luvisols are associated with better drained, fine-textured glaciolacustrine material surrounding larger lakes (e.g., Seul, Pakwash, and Maynard). Exposed bedrock is more common in the north. The bedrock is typically acidic, but several linear, base-rich bands occur north of Pakwash Lake. Organic accumulations, usually Mesisols, occur in wet depressions. Lacustrine and alluvial deposits are typically Regosols.

Land cover and vegetation

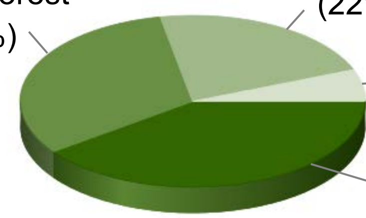


Figure 226. Land cover types in Ecodistrict 4S-2.

The Lac Seul Ecodistrict is part of the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) mapped the northwest portion of Ecodistrict 4S-2 as part of the Northern Coniferous Section (B.22a), the central and southwest portion as the Lower English River Section (B.14), and the eastern portion as the Upper English River Section (B.11). All three sections are part of the Boreal Forest Region.

The principal land cover type is mixed forests with a variety of tree species that may include black spruce, jack pine, paper birch, white spruce, balsam fir, trembling aspen, and on fresh to moist, nutrient rich sites balsam poplar, American elm, and black ash (Figure 226). Sparse forests are generally associated with areas of very shallow substrates and include dry bedrock ridges supporting jack pine. Upland conifer forests of black spruce and jack pine (Figure 227), and lowland forests of black spruce, eastern white cedar, and American larch occur over approximately one-quarter of the ecodistrict. Forests of eastern white pine and red pine, including old growth areas (OMNR 2005b), may be found on warmer-than-normal sites, typically adjacent to lakes, from Pakwash Lake south. Eastern white pine occurs mostly on islands or on bedrock ridges, while red pine grows on deeper mineral material (Noble 1978). Deciduous forests, typically trembling aspen and paper birch, are more common south of Red Lake and fen and bog complexes are scattered throughout the ecodistrict in low-lying areas. Exposed bedrock is limited and marshes may occur along the shores of rivers and lakes. Burns represent a very small component of the landscape. Compared with ecodistricts farther east, Ecodistrict 4S-2 is more susceptible to fire due to drier winters and warmer and drier summers. When they do occur, fires are typically small but may include high intensity surface fires or stand-replacing crown fires (Van Sleeuwen 2006).

Flora in the Lac Seul Ecodistrict is diverse with influences from the boreal, temperate, and grassland vegetation zones. In addition to eastern white pine and red pine, large-toothed aspen and red maple may occur (Noble 1978). Species with grassland affinities that occur in the area include prairie buttercup and prairie onion (Ontario Parks 2004b). Purple clematis and Kalm’s brome are at their western limits (Bakowsky 2015, MNRF, pers. comm.). Plant species richness may increase in areas of base-rich bedrock and calcareous mineral material where the availability of substrate nutrients is greater.

Figure 227. Coniferous forest along the shore of Lac Seul. MNRF.

Land use

The communities of Red Lake, Balmertown, and Ear Falls occur in Ecodistrict 4S-2 (Figure 228). These communities and associated infrastructure account for less than 1% of the total area. Protected areas occur over 4.1% of the ecodistrict. Timber harvesting, mining, mineral exploration, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities occur throughout the ecodistrict.

Ecodistrict boundary delineation

The boundary between Ecoregion 4S and 3S is strongly correlated with geological differences, precipitation, and temperature. Richer metavolcanic and metasedimentary bedrock in 4S transitions to granite and tonalite bedrock in 3S. Ecoregion 4S is also typically warmer and drier than 3S. The northern boundary of 4S-2 with 3S-2 is also defined by a portion of the Lac Seul Moraine. In the east, the boundary with 3W-1 reflects ecoregional climatic attributes. Ecoregion 4S is warmer and drier than 3W. The southern boundary with 4S-3 signifies the transition from deep, fine-textured mineral material in the southern part of 4S-2 to shallow to deep, coarse-textured mineral material in 4S-3. In addition, felsic igneous and metamorphic bedrock predominate in 4S-2, while in 4S-3 mafic metavolcanic and metasedimentary rock are more common. The southwest and western boundaries with 4S-1 and 4S-5 reflect the transition from deeper, mineral material in 4S-2 to bedrock, exposed at the surface or with a very shallow layer of mineral material, in 4S-1 and very shallow to shallow mineral material in 4S-5.

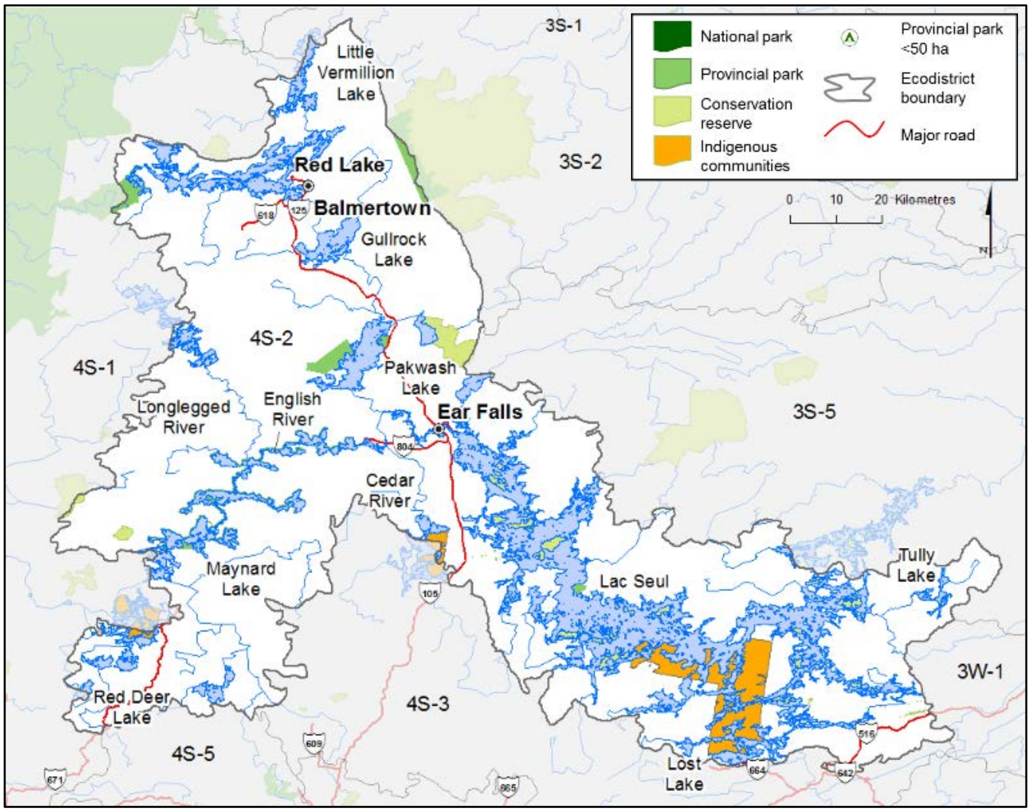


Figure 228. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4S-2.

Ecodistrict 4S-3

English River Ecodistrict

Encompassing 552,270 ha (9.3% of the ecoregion, 0.6% of the province), the English River Ecodistrict extends from Anishinabi Lake in the north to Adair Lake in the south. The western limit is near Clay Lake, while in the east the boundary occurs close to Press Lake. The hilly landscape ranges in elevation from 326 m above sea level at Clay Lake to 504 m above sea level north of Melgund Lake.

Figure 229. Mixed forests of Melgund Lake Conservation Reserve. Irene Schneider, MNRF.

Key features

- Mixed forests occupy nearly half of the ecodistrict (Figure 229).
- Area is characterized by shallow to deep, acidic morainal material over Precambrian bedrock.
- Includes portions of the Lac Seul, Hartmann, and Sioux Lookout moraines.

Geology and substrates

The geology and substrates in the English River Ecodistrict are the result of glaciers removing and depositing morainal material and the influence of glacial Lake Agassiz that inundated the area nearly 9,500 years ago (Dyke 2004). Glacial Lake Agassiz modified and removed mineral material through fluctuating lake levels and wave action. Morainal deposits of variable

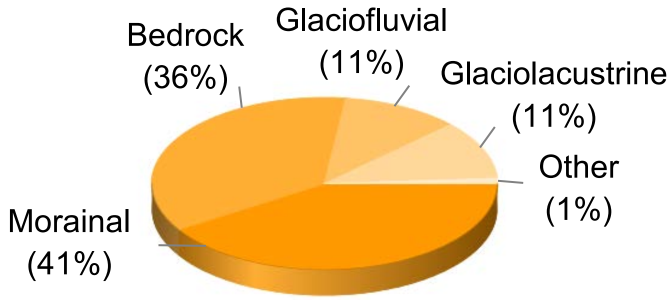


Figure 230. Modes of deposition in Ecodistrict 4S-3.

depths can be found over nearly half of the ecodistrict (Figure 230). In the east and southwest, a discontinuous layer of shallow to deep morainal material separated by bedrock exposures can be found (Sado et al. 1995). Level, deep, acidic morainal deposits occur in the east and west and three large northwest-southeast trending moraines are located in the ecodistrict. The Lac Seul moraine occurs north of Thaddeus Lake and continues past the southwest arm of Minnitaki Lake. The Hartmann Moraine begins north of Clay Lake, continuing through Ecodistrict 4S-4 to north of the Wabigoon River. The northwestern extent of the Sioux Lookout Moraine begins east of Minnitaki Lake.

Bedrock outcrops, exposed at the surface or with a very shallow layer of mineral material, are found interspersed between pockets of deeper mineral material. In the east, a series of southwest-northeast trending faults occur. Two of the larger faults include the Little Vermillion fault from Crosseco Lake to Botsford Lake and the Wabigoon fault, which in Ecodistrict 4S-3 starts south of Big Sandy Lake and ends in the southeast bay of Minnitaki Lake (Blackburn et al. 1991). In some instances, the faults signify the intrusion of linear bands of base-rich bedrock in the typically acidic Precambrian bedrock. Also associated with the faults are several long linear lakes (e.g., Botsford) and rivers. Glaciofluvial eskers occur east of Clay Lake and outwash deposits are scattered throughout the area. The central and eastern portions of the ecodistrict are characterized by glaciolacustrine sediment that was deposited in the deeper portions of glacial Lake Agassiz. The glaciolacustrine material is generally calcareous, resulting from the inflow of calcareous mineral material from Manitoba. Relict shorelines are more common in the west and are evident on moraines. Organic materials have developed in limited, poorly drained areas, generally in depressions overlying mineral material or in valleys (Zoltai 1965a). Aeolian deposits typically associated with glaciolacustrine deposits occur at Adair Lake and to the west (Noble 1995a). Along larger river systems including the English and Wabigoon rivers, alluvial material may be found.

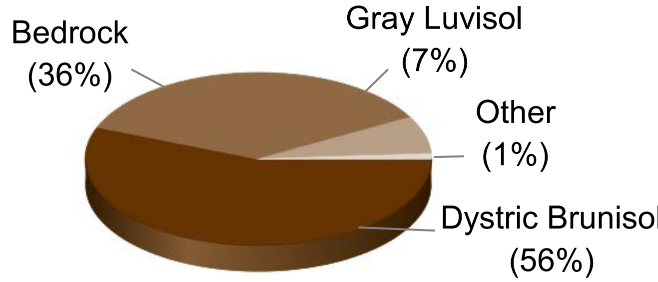


Figure 231. Substrate types in Ecodistrict 4S-3.

Dystric Brunisols dominate the landscape, having developed in coarse-textured mineral material associated with morainal and glaciofluvial deposits (Figure 231). Bedrock with a discontinuous, very shallow layer of mineral material can be found in the east and southwest. Gray Luvisols have developed in better drained, fine-textured, typically calcareous sites. Organic substrates, generally Mesisols, occur in poorly drained areas. One of the larger organic accumulations in the ecodistrict is located in Adair Lake Conservation Reserve. Regosols are generally associated with active mineral material including alluvial sediment.

Land cover and vegetation

Ecodistrict 4S-3 occurs in the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018). The eastern portion of the ecodistrict is associated with the Lower English River Section (B.14) and the western portion is associated with the Upper English River Section (B.11) of the Boreal Forest Region (Rowe 1972). Black spruce, jack pine, trembling aspen, white spruce, balsam fir, and paper birch predominate in the mixed forests, which cover nearly half of the ecodistrict (Figure 232). On fresh to moist, nutrient rich sites, balsam poplar, American elm, and black ash may occur as associates.

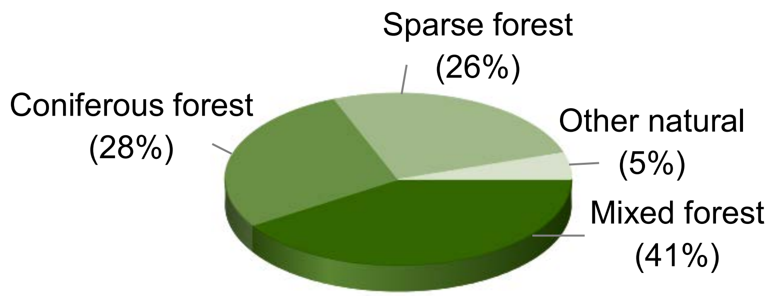


Figure 232. Land cover types in Ecodistrict 4S-3.

Coniferous forests of jack pine are extensive on drier, deep mineral material and rocky uplands. Black spruce, occasionally with American larch and eastern white cedar, dominate in poorly drained depressions. Very shallow substrates generally support sparse forests. Deciduous forests, typically trembling aspen and paper birch, are more common in the east. Bog and fen complexes (Figure 233), marshes, and exposed bedrock occupy a small part of the landscape. Areas showing evidence of recent fire are limited. In general, Ecodistrict 4S-3 has a high fire frequency due to drier, warmer summers and lower winter precipitation compared with ecodistricts farther east. Smaller fires are more common; however, large stand-replacing crown fires and high intensity surface fires do occur (Van Sleeuwen 2006).

The English River Ecodistrict represents a transition between the temperate and boreal vegetation zones. Species commonly found in the temperate forest, such as eastern white pine, red pine, and red maple reach their northern limits in Ecodistrict 4S-3, occurring in isolated patches on warmer-than-normal sites often adjacent to lakes. Old growth forests of eastern white and red pine, including a stand south of Minnitaki Lake, can also be found (OMNR 2009b). Several plant species including twig rush and livid sedge are near the western edge of their ranges (Harris and Foster 2003a). Plant species diversity many increase on base-rich bedrock sites and calcareous mineral material, where substrate nutrient availability is higher.

Figure 233. Bog and fen complex in Adair Lake Conservation Reserve. MNRF.

Land use

The communities of Sioux Lookout and Perrault Falls occur in the English River Ecodistrict (Figure 234). These communities and associated infrastructure account for less than 1% of the total area. Approximately 3.3% of the ecodistrict is designated as protected areas. Tourism, including sport fishing and hunting, timber harvesting, mineral exploration, aggregate extraction, trapping, and services associated with resource-based activities occur throughout.

Ecodistrict boundary delineation

Climatic variables at the ecoregional level help to differentiate the eastern boundary of 4S-3 from 3W-2. In general, Ecoregion 4S is warmer and drier than 3W. In addition, the topography in 4S-3 is hilly compared with gently rolling in 3W-2. The boundaries with 4S-2, 4S-4, and 4S-5 reflect the transition from shallow to deep coarse-textured mineral material in 4S-3 to deep, fine-textured mineral material found in the southern part of 4S-2 and throughout 4S-4 and very shallow to shallow mineral material in 4S-5. The boundary between 4S-3 and 4S-2 is also based on geological differences, where common bedrock types in 4S-3 include mafic metavolcanic and metasedimentary bedrock compared with predominately felsic igneous and metamorphic bedrock in 4S-2.

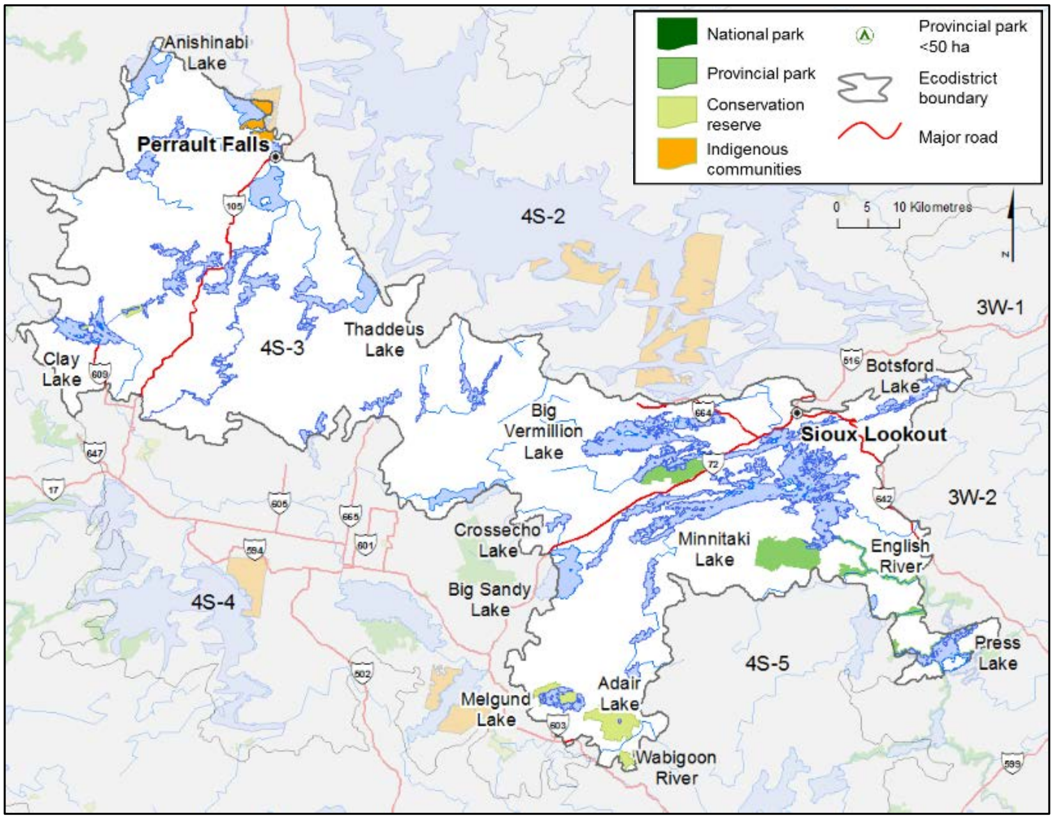


Figure 234. Select communities, major roads, rivers, lakes, and natural heritage areas in Ecodistrict 4S-3.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4S-4

Dryden Ecodistrict

The Dryden Ecodistrict extends from the community of Vermilion Bay in the west, eastward to Big Sandy Lake. The northern boundary encompasses most of Rugby Lake and extends south to Rock Lake. The smallest ecodistrict in Ecoregion 4S, it covers an area of approximately 312,209 ha (5.2% of the ecoregion, 0.3% of the province). Elevation ranges from 335 m above sea level in the northwest to 500 m above sea level northwest of the Lola Lake.

Figure 235. Mixed forests near the community of Dryden. Irene Schneider, MNRF.

Key features

- Over half of the ecodistrict is covered by mixed forests of jack pine, black spruce, white spruce, paper birch, trembling aspen, and balsam fir (Figure 235).
- The gently rolling to hilly landscape is mostly covered by calcareous, glaciolacustrine deposits.
- The northern most area supporting agriculture in northwestern Ontario.

Geology and substrates

A significant portion of Ecodistrict 4S-4 was covered by glacial Lake Agassiz. Fed by glacial meltwaters, glacial Lake Agassiz was a large, shallow lake that occupied most of Manitoba, northwestern Ontario, and extended into the United States nearly 9,500 years ago (Dyke

2004). As the water drained, the lake bed was exposed leaving behind fine-textured glaciolacustrine sediment over a gently rolling to hilly landscape (Figure 236). The glaciolacustrine deposits are typically calcareous, a result of sediment flowing from Manitoba into the region. Remnant features of glacial Lake Agassiz across the ecodistrict include relict shorelines and larger lakes (e.g., Wabigoon Lake) (Noble 1995a).

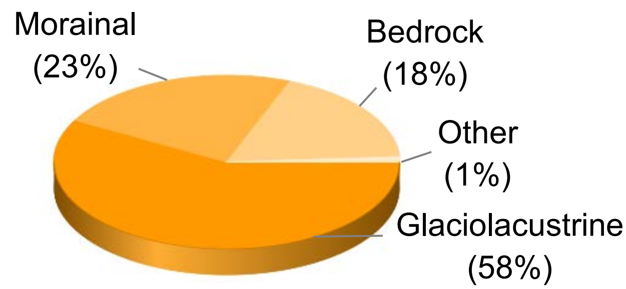


Figure 236. Modes of deposition in Ecodistrict 4S-4.

Morainal deposits are generally acidic. Parts of the Eagle-Finlayson and Hartmann moraines occur in two northwest-southeast bands, the first south of Wabigoon Lake and the second north. Deep areas of more level morainal material occur south of Gullwing Lake. Bedrock, exposed at the surface or with a very shallow layer of morainal material frequently interrupts the glaciolacustrine deposits (Noble 1995a), particularly in the southwest. Glaciofluvial deposits generally occur adjacent to the moraines, especially in the northeast. Alluvial, organic, and aeolian deposits are limited throughout the ecodistrict. Alluvial deposits occur along major river systems such as Gullwing Creek and the Wabigoon River. Organic deposits are generally small having developed on fine-textured mineral material in poorly drained areas. Aeolian features, associated with glaciolacustrine deposits, occur near Lola Lake (Noble 1995a).

Gray Luvisols have developed in calcareous, fine-textured, well drained, glaciolacustrine deposits that occur throughout most of the area (Figure 237). In the north and south, Dystric Brunisols have developed in coarse-textured material associated with morainal deposits. South and east of Eagle Lake, bedrock prevails. Acidic and base-rich bedrock types occur in the Dryden Ecodistrict. In general, base-rich bedrock occurs in the south, separated from acidic bedrock in the north by the Wabigoon fault (Blackburn et al. 1991). Poorly drained areas support the development of organic deposits. Larger areas of organic material, typically Mesisols, occur near Lola Lake, adjacent to the Wabigoon River, and south of Eagle Lake. Regosols are associated with alluvial deposits.

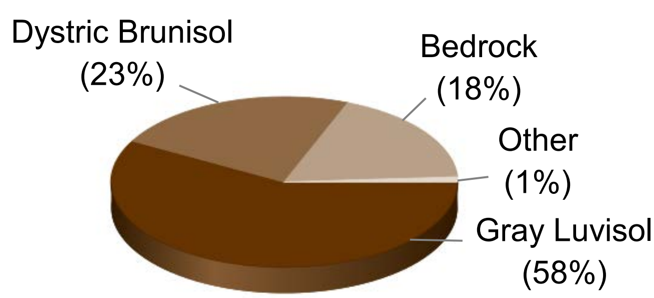


Figure 237. Substrate types in Ecodistrict 4S-4.

Land cover and vegetation

The Dryden Ecodistrict forms part of the Eastern Boreal Forest Vegetation Zone (Baldwin et al. 2018) and the Lower English River Section (B.14) of the Boreal Forest Region and Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Spanning two forest regions, this ecodistrict is covered primarily by mixed forests (Figure 238) with a variety of boreal and temperate tree species including white and black spruce, balsam fir, trembling aspen, jack pine, paper birch, eastern white pine, and red pine. Old growth red and eastern white pine forests are prevalent on the islands of Eagle Lake (OMNR 2009b).

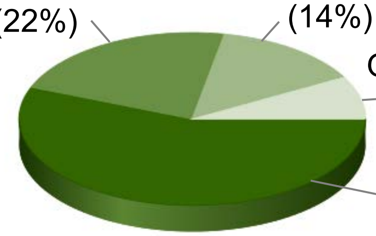


Figure 238. Land cover types in Ecodistrict 4S-4.

Sparse forests (e.g., jack pine, red pine, eastern white pine) generally occur on very shallow substrates (Figure 239). Coniferous sites dominated by jack pine occur on drier, warmer-than-normal sites along the moraines. Lowland coniferous forests of black spruce, American larch, and eastern white cedar grow throughout the ecodistrict. Deciduous forests, typically trembling aspen and paper birch, are common north of Wabigoon Lake. Balsam poplar, American elm, and black ash often inhabit very fresh to moist, nutrient rich sites found in riparian areas and warmer-than-normal sites may support red maple. Bog and fen complexes are associated with organic deposits in wet depressions and marshes may occur adjacent to lakes and rivers. Burns are limited across the landscape, even though the area is more susceptible to repeated fires than areas farther east, due to the dry, warm climate. When fires do occur they tend to be small; however, large high intensity or stand-replacing fires may also occur (Van Sleeuwen 2006). Small patches of bare bedrock occur, especially south of Eagle Lake. Due to the prevalence of calcareous, deep, fine-textured mineral material, a small proportion of the landscape is maintained as agricultural fields.

Flora in Ecodistrict 4S-4 is reflective of boreal, temperate, and grassland vegetation zones. Noble (1995a) identified several plant species in 4S-4 that were more commonly found farther west including Saskatoon, mountain cranberry, and Richard’s alumroot, a species with grassland affinities. Additional grassland species include bur oak and Norwegian cinquefoil (Foster and Harris 2003). Smooth sumac (Ontario Parks 1985), Douglas’ knotweed (Noble 1995a), and downy arrowwood (OMNR 2003a) are near their northern extents in the area and plant species found at their southern extent include northern firmoss (Noble 1995a). Calcareous mineral material and areas of base-rich bedrock where the availability of substrate nutrients is higher may support a higher diversity of plant species.

Figure 239. Coniferous forests of pine on Eagle Lake. Northern Bioscience.

Land use

Approximately 2% of the land base is devoted to settlement and associated infrastructure, including the communities of Dryden and Vermilion Bay (Figure 240). Protected areas encompass nearly 5.6% of the ecodistrict. Timber harvesting, mineral exploration, aggregate extractions, hydroelectric generation, fishing, hunting, tourism, agriculture, and services associated with resource-based activities occur throughout.

Ecodistrict boundary delineation

The Dryden Ecodistrict is quite distinguishable. The deep, fine-textured glaciolacustrine deposits that dominate the area transition to very shallow to shallow morainal material along the southern and western boundaries with 4S-5 and shallow to deep morainal material along the northern and eastern boundaries with 4S-3.

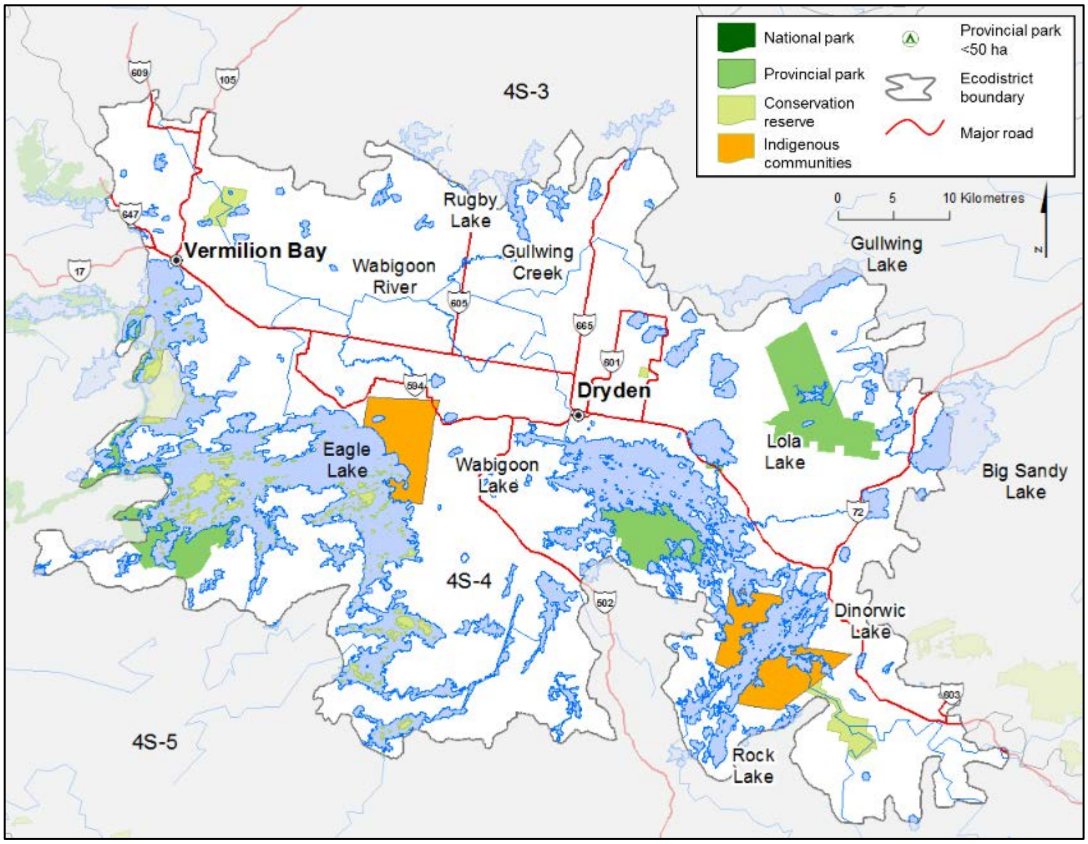


Figure 240. Select communities, major roads, natural heritage areas, river, creek, and lakes in Ecodistrict 4S-4.

Glacial Lake Agassiz

Formed behind the retreating ice sheet, glacial Lake Agassiz was the largest glacial lake in North America covering a total surface area of 1.5 million km^2 (Leverington and Teller 2003). As the ice retreated and readvanced, lake levels changed, altering the flow of water. Drainage occurred south through Minnesota, east into Lake Superior, or north to Hudson Bay. Changes in drainage patterns facilitated the movement and deposit of varved clays, alternating bands of red and grey fine-textured materials (Figure 241). The rapid drainage of water from glacial Lake Agassiz and glacial Lake Ojibway in northeastern Ontario and Quebec into the northern Atlantic Ocean may have caused a cooling event approximately 8,000 years ago (Barber et al. 1999). Today, one of the most northerly agricultural areas in northwestern Ontario can be found on the varved clays (Figure 242).

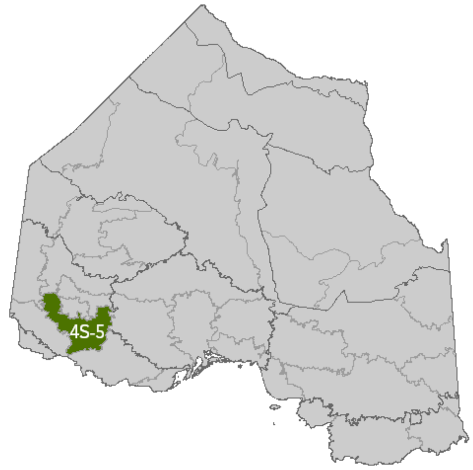
Figure 242. Agricultural field north of the community of Dryden. Shae Richter, MNRF.

Figure 241. Varved clay. Ontario Parks.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4S-5

Manitou Ecodistrict



This u-shaped ecodistrict extends from Canyon Lake in the northwest and Kukukus Lake in the northeast, south to the Little Turtle River. The western and eastern boundaries are roughly defined by Dryberry Lake and the community of Ignace, respectively. Ecodistrict 4S-5 encompasses 1,315,803 ha (22.1% of the ecoregion, 1.3% of the province). The hilly landscape ranges in elevation from 333 m above sea level near Rainy Lake to 535 m above sea level southwest of the community of Ignace.

Figure 243. Mixed and sparse forests of the Manitou Ecodistrict. Dryden District, MNRF.

Key features

- Mixed and sparse forests (Figure 243) grow over three-quarters of the ecodistrict.
- Bedrock dominates, covered by a very shallow to shallow layer of acidic mineral material.
- Is a transitional area between boreal and temperate vegetation zones.

Geology and substrates

The predominately bedrock landscape of the Manitou Ecodistrict was once under the influence of glacial Lake Agassiz, which inundated the area nearly 9,500 years ago (Dyke 2004). Fluctuating lake levels and wave action removed much of the overlying substrate. As the waters receded, a rolling landscape of Precambrian bedrock covered by a discontinuous, very shallow to shallow layer of mineral material remained (Figure 244). Typically acidic, base-rich bedrock occurs in the north-central portion of the ecodistrict as well as east of Dryberry Lake, and northwest of the community of Ignace. Faults including the Manitou Straits fault (Blackburn 1979) east of Upper and Lower Manitou lakes, the Wabigoon fault east of Dryberry Lake, and the Quetico fault through Rainy Lake (Blackburn et al. 1991) add relief to the area. Often filled with water, the faults contribute to the pattern of rivers and lakes in northwestern Ontario.

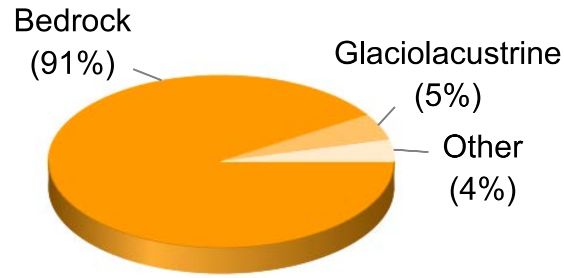


Figure 244. Modes of deposition in Ecodistrict 4S-5.

Limited, deeper pockets of glaciolacustrine material occur in valleys in the central part of the ecodistrict, primarily northeast of Upper Manitou Lake, south of Manion Lake, and in the northeast. This fine-textured material may be calcareous, a result of sediment flowing from Manitoba and being deposited in the deeper areas of glacial Lake Agassiz. Glaciofluvial deposits occur in the northeast and along the southern edge of the Eagle-Finlayson Moraine that bisects the ecodistrict from east of Upper Manitou Lake to west of White Otter Lake. Portions of the Hartmann and Lac Seul moraines occur in the northeast and level morainal deposits occur in the northeast and adjacent to Wapageisi Lake. Evidence of water modification by glacial Lake Agassiz (i.e., relict shorelines) can be seen along moraines. Organic substrates have developed in poorly drained depressions or valleys, particularly in south-central areas of the ecodistrict. Alluvial material has accumulated along larger river systems including the Turtle and Little Turtle rivers and small areas of aeolian deposits occur adjacent to fine-textured mineral material. Lakeshores may include lacustrine material.

The Manitou Ecodistrict is dominated by bedrock typically overlain by a very shallow to shallow layer of morainal material (Figure 245). Isolated pockets of Dystric Brunisols have developed in deeper, coarse-textured morainal and glaciofluvial deposits along the northern and northeastern boundaries. Gray Luvisols have developed in pockets of fine-textured, well drained, calcareous mineral material. Organic deposits are typically small and scattered throughout the ecodistrict with larger accumulations occurring southwest of Mameigwess Lake, south of Manion Lake, and along the Turtle River. Regosols occur in active mineral material including alluvial, aeolian, and lacustrine sediment.

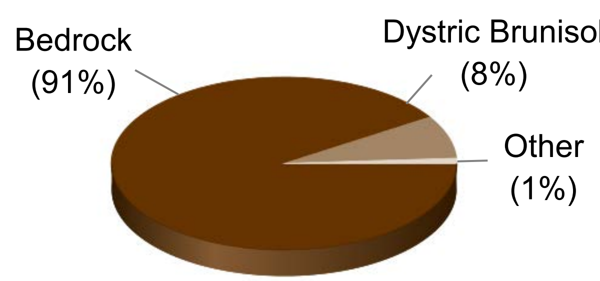


Figure 245. Substrate types in Ecodistrict 4S-5.

Land cover and vegetation

Ecodistrict 4S-5 is primarily associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Mixed forests of jack pine, trembling aspen, black spruce, balsam fir, paper birch, and white spruce predominate (Figure 246). Sparse forests generally occur on bedrock, and may include jack pine, eastern white pine, and red pine. Coniferous dominated forests grow throughout the ecodistrict. Larger forests are more prevalent west and south of Mameigwess Lake. Black spruce and American larch occur in low-lying areas, with eastern white cedar on richer sites. Eastern white pine and red pine are more common on lake shores and bedrock ridges. Several old growth eastern white and red pine forests can be found in the ecodistrict, for example, near White Otter and Lower Manitou lakes.

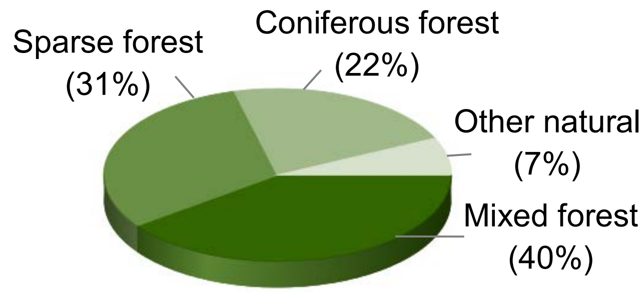


Figure 246. Land cover types in Ecodistrict 4S-5.

Deciduous forests are generally composed of trembling aspen and paper birch. In wetter, nutrient rich areas, associated tree species include black ash, balsam poplar, and American elm. In the south, several tree species more closely related to temperate forests occur at or very close to their northern limit. These include northern red oak, bur oak, red maple (Noble 1995b), large-toothed aspen, sugar maple, and yellow birch. On alluvial sites, temperate tree species such as green ash and silver maple can be found. Bog and fen complexes are small, occurring in wet areas where organic material has accumulated, and marshes may occur adjacent to rivers or lakes (Figure 247). Even though fires are limited across the landscape, the very shallow to shallow substrates and a warmer, drier climate in Ecodistrict 4S-5 results in a higher fire frequency relative to ecodistricts farther east. Small forest fires are common but large high intensity or stand-replacing fires can also occur (Van Sleeuwen 2006). Bare bedrock is restricted to higher ridges including areas around Atikwa Lake.

Ecosystems (i.e., meadows and woodlands) containing grassland affiliates may occur on warmer-than-normal slopes adjacent to a shore or on a bedrock ridge (Foster and Harris 2004). Grassland species may include Richardson's alumroot, prairie buttercup, big bluestem, and slender beardtongue. Several species occur at or very close to their northern limits in the southern part of the ecodistrict. In addition to the tree species listed above, other notable species with more southern ranges include nannyberry and herbaceous carrionflower (Noble 1995b). Plant species that are more common in the west include mountain cranberry, a species associated with the western boreal forest. Northern firmoss occurs at its southern limit in the Manitou Ecodistrict. Bog complexes are more representative of similar communities farther north (Thacker 1974). A higher diversity of plant species can be found in areas of base-rich bedrock or calcareous mineral material where the availability of substrate nutrients is higher.

Figure 247. Sandbar Lake Provincial Park, northeast of the community of Ignace. Ontario Parks.

Land use

Settlement and associated infrastructure, including the community of Ignace, account for less than 1% of the land base (Figure 248). Timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, fishing, hunting, tourism, and services associated with resource-based activities occur throughout the ecodistrict. Protected areas encompass 9.2% of the ecodistrict.

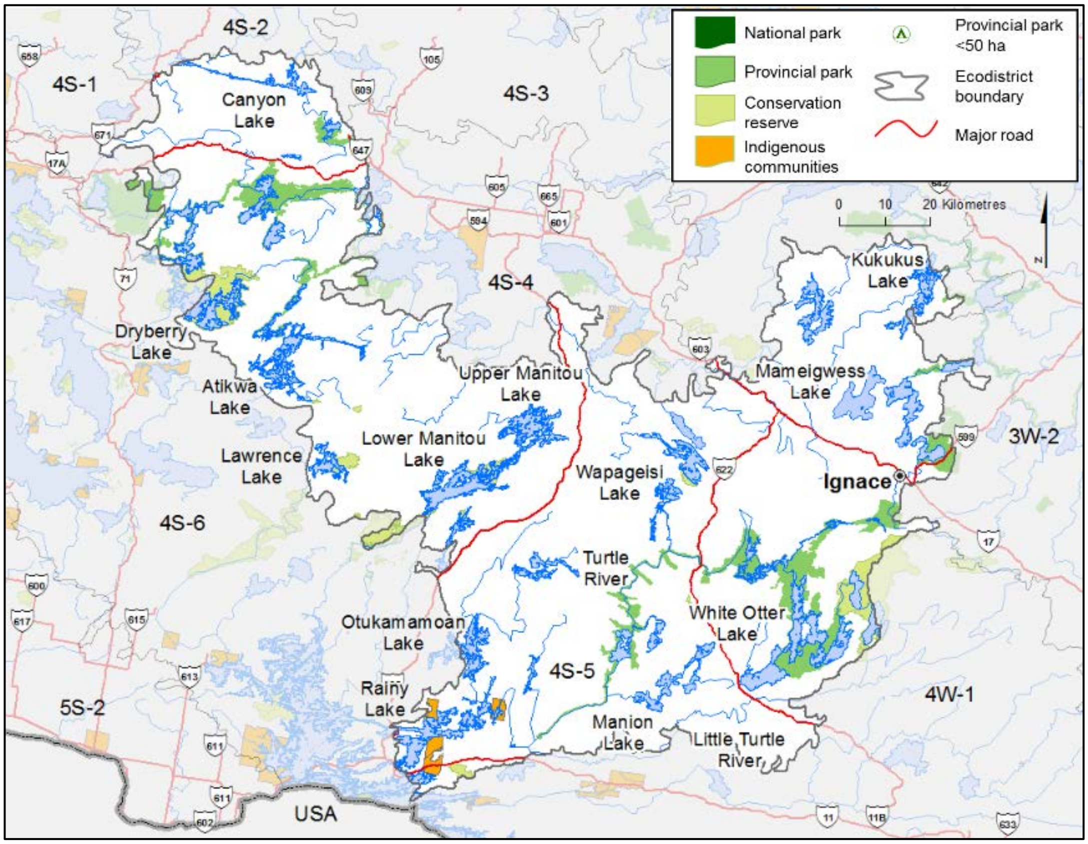


Figure 248. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4S-5.

Ecodistrict boundary delineation

The very shallow to shallow mineral material over bedrock that characterizes the Manitou Ecodistrict distinguishes it from many of the adjoining ecodistricts. The northwestern boundary with Ecodistrict 4S-1 reflects the change to bedrock, exposed at the surface or with a very shallow layer of mineral material in 4S-1. The northern and western boundaries with 4S-2, 4S-3, 4S-4, and 4S-6 are defined by the transition to deeper mineral material. In addition, substrates are typically morainal in 4S-5 compared with glaciolacustrine in 4S-4. In the east, the boundary with 3W-2 reflects a change to deeper mineral material and climate differences. Ecoregion 4S is warmer and drier than 3W. The southeastern and southern boundary with 4W-1 recognizes differences in climatic variables at the ecoregional level (i.e., 4S is drier).

Ecodistrict 4S-6

Sioux Narrows Ecodistrict

The Sioux Narrows Ecodistrict extends from the Ontario-Manitoba border in the west to approximately Hwy 502 in the east, and from the community of Kenora in the north to the border with the United States near Couchiching First Nation. It covers an area of 1,023,062 ha (17.2% of the ecoregion, 1.0% of the province). The elevation ranges from 320 m above sea level near the Manitoba border to 484 m above sea level west of Vickers Lake.

Figure 249. Mixed forests of the Aulneau Peninsula. Wasyl Bakowsky, MNRF.

Key features

- Mixed forests of boreal tree species (e.g., jack pine, white spruce, black spruce, trembling aspen, and paper birch) predominate (Figure 249).
- Rolling landscape is dominated by Precambrian bedrock, exposed at the surface or with a shallow to moderately deep layer of mineral material.
- Includes a portion of Lake of the Woods — a lake shared by Ontario, Manitoba, and Minnesota.

Geology and substrates

The Sioux Narrows Ecodistrict is characterized by a rolling landscape of Precambrian bedrock, covered by a discontinuous layer of shallow to moderately deep, acidic, typically morainal material (Figure 250). Deposited by glaciers, much of the morainal sediment has been reworked or removed from the bedrock due to fluctuating lake levels and wave action of glacial Lake Agassiz that inundated the area nearly 10,000 years ago (Dyke 2004). Deeper morainal materials occur near the southern boundary with Ecodistrict 5S-2, along the Lake of the Woods-Rainy Lake moraine, and northeast of Rainy Lake.

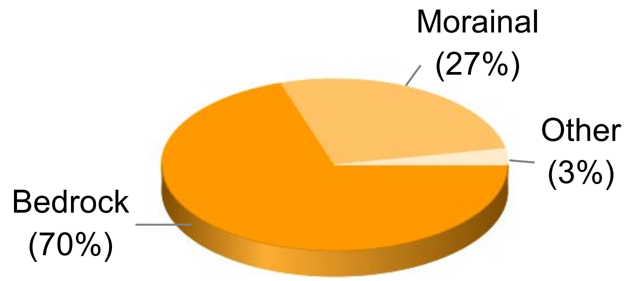


Figure 250. Modes of deposition in Ecodistrict 4S-6.

Organic substrates are limited, developing in poorly drained areas on former lake beds, in river systems, or in bedrock depressions (Sado et al. 1994). Glaciolacustrine deposits, often calcareous, are restricted to depressions and valleys (Zoltai 1965b), particularly east of the community of Kenora, on the islands of Lake of the Woods (Hallett and Roed 1980), and along the 5S-2 boundary south of the lake. The calcareous mineral material is a result of sediment carried from Manitoba to Ontario during various stages of glacial Lake Agassiz. Alluvial material can be found adjacent to larger waterways including Splitrock River and Log Creek. Glaciofluvial deposits are limited, with several larger areas occurring in the north. Lacustrine deposits occur adjacent to Lake of the Woods and Rainy Lake.

Nearly three-quarters of Ecodistrict 4S-6 is characterized by bedrock, typically acidic, exposed at the surface or with a shallow to moderately deep layer of mineral material (Figure 251). Deeper mineral material occurs in bedrock depressions or adjacent to bedrock ridges and cliffs. A network of faults can be found throughout the area adding relief and influencing drainage patterns. Major faults include the Wabigoon Fault, north of the community of Sioux Narrows, and the Quetico Fault through Rainy Lake (Blackburn et al. 1991). Prominent cliffs are associated with faults and may also occur adjacent to lakes. Areas of base-rich bedrock can be found in the north and to the east of Kakagi Lake.

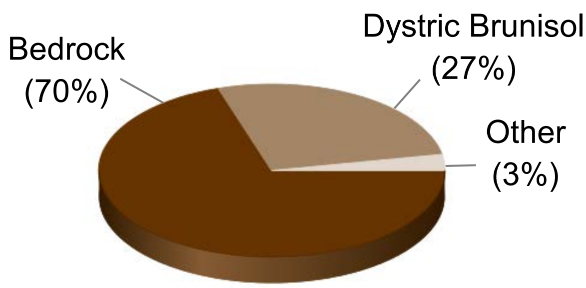


Figure 251. Substrate types in Ecodistrict 4S-6.

Dystric Brunisols have developed in deeper, coarse-textured morainal and glaciofluvial material. Organic deposits, typically Mesisols, occur as small scattered pockets across the landscape. Along the border with Manitoba and the 5S-2 boundary, south of Lake of the Woods, larger accumulations have developed. Gleysols have developed in low-lying areas, generally associated with fine-textured, glaciolacustrine deposits. Regosols are associated with lacustrine and alluvial material.

Land cover and vegetation

Ecodistrict 4S-6 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) classified the Sioux Narrows Ecodistrict as part of the Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region. Given the rolling topography and local climate influenced by Lake of the Woods and Rainy Lake, associated tree species are quite variable. Mixed forests of jack pine, black spruce, trembling aspen, balsam fir, paper birch, and white spruce dominate, occurring on normal or colder-than-normal sites (Figure 252). Sparse coniferous and deciduous forests occur throughout, generally on bare bedrock or in areas with very shallow substrates.

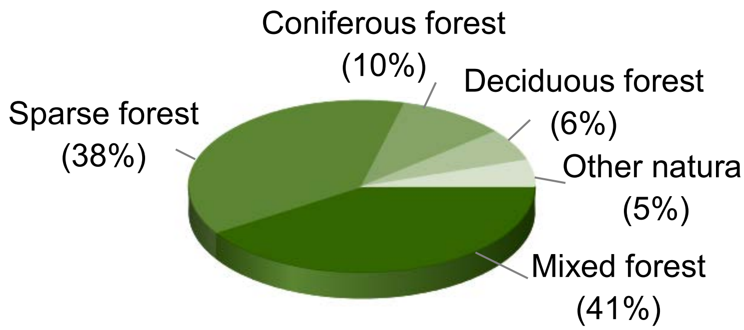


Figure 252. Land cover types in Ecodistrict 4S-6.

Coniferous forests, upland and lowland, may occur as single species stands or mixed stands of jack pine, balsam fir, and/or spruces. Eastern white pine and red pine occur throughout the ecodistrict commonly on shallow mineral material or exposed bedrock sites. Several of these forests have been classified as old growth (OMNR 2009b). In wet areas, American larch and eastern white cedar are common associates of black spruce. Deciduous forests are typically composed of trembling aspen and paper birch but on wetter, nutrient rich sites, balsam poplar, American elm, and black ash may occur. Tree species associated with temperate forests, such as northern red oak, red maple, silver maple, sugar maple, yellow birch, large-toothed aspen, and American basswood, can be found on warmer-than-normal sites (Noble 1998a). Scattered across the landscape, bog and fen complexes occupy wet areas where organic material has accumulated, including the Aulneau Peninsula and west of Rainy Lake. Marshes have developed in many of the sheltered bays in Lake of the Woods and Rainy Lake. Exposed bedrock occurs in areas with more rugged topography and along the shores of lakes. Fire has an important influence throughout the ecodistrict. Aided by the dry, warm climate and shallow mineral material, small fires are frequent. Large fires, when they do occur, include high intensity or stand-replacing fires (Van Sleeuwen 2006).

The Sioux Narrows Ecodistrict represents the meeting place of the boreal, temperate, and grassland vegetation zones. Aided by the warming influence of Lake of the Woods, forests with species typical of the boreal region (e.g., black spruce, jack pine) transition to include eastern hop-hornbeam and green ash, species that are more common farther south, Manitoba maple and bur oak (Figure 253) that occur farther west, and northern pin oak that is typically found southeast of the area. Ecosystems (i.e., meadows, woodlands) with grassland affinities may occur on warmer-than-normal south slopes, typically near a lake, and may include prairie onion, slender beardtongue, and brittle prickly-pear cactus (Harris and Foster 2003c). Species with primary ranges farther east that occur in Ecodistrict 4S-6 include Hayden's sedge, nodding ladies'-tresses, and Steller's rockbrake (Harris et al. 2002). Increased plant species richness may occur in areas of calcareous mineral material or base-rich bedrock where substrate nutrient availability is higher.

Figure 253. Bur oak woodland with an understory of grassland affiliates. Sam Brinker, MNRF.

Land use

Land uses include timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, fishing, hunting, tourism, and services associated with resource-based activities. Settlement and associated infrastructure, including the communities of Sioux Narrows and Kenora, account for less than 1% of the land base (Figure 254). Approximately 9% of the ecodistrict is designated as protected areas.

Ecodistrict boundary delineation

Previously classified as Site District 5S-1 (Hills 1959), Burger (1993) proposed the incorporation of Site Districts 5S-1 and 5S-2 into Site Region 4S. Crins and Uhlig (2000) proposed that Site District 5S-1 become Ecodistrict 4S-6 based on similarities in topography (i.e., 5S-1 and adjacent ecodistricts in Ecoregion 4S are bedrock dominated) and mean annual temperature.

The northern and eastern boundary reflects the transition from bedrock with a shallow to moderately deep layer of mineral material in 4S-6 to bedrock exposed at the surface or with a very shallow to shallow layer of mineral material in 4S-1 and 4S-5. The southern boundary is partially defined by the Lake of the Woods-Rainy Lake Moraine, but generally separates a rolling bedrock topography with a discontinuous layer of shallow to moderately deep morainal deposits in 4S-6 from a subdued to undulating landscape dominated by glaciolacustrine sediment in 5S-2. Ecoregional climatic variables — 4S is cooler and wetter than 5S — also define the southern boundary. The portion of Ecodistrict 4S-6 near Lake of the Woods and east of Couchiching First Nations is defined by the border with the United States. The western boundary of the Sioux Narrows Ecodistrict is defined by the border with Manitoba.

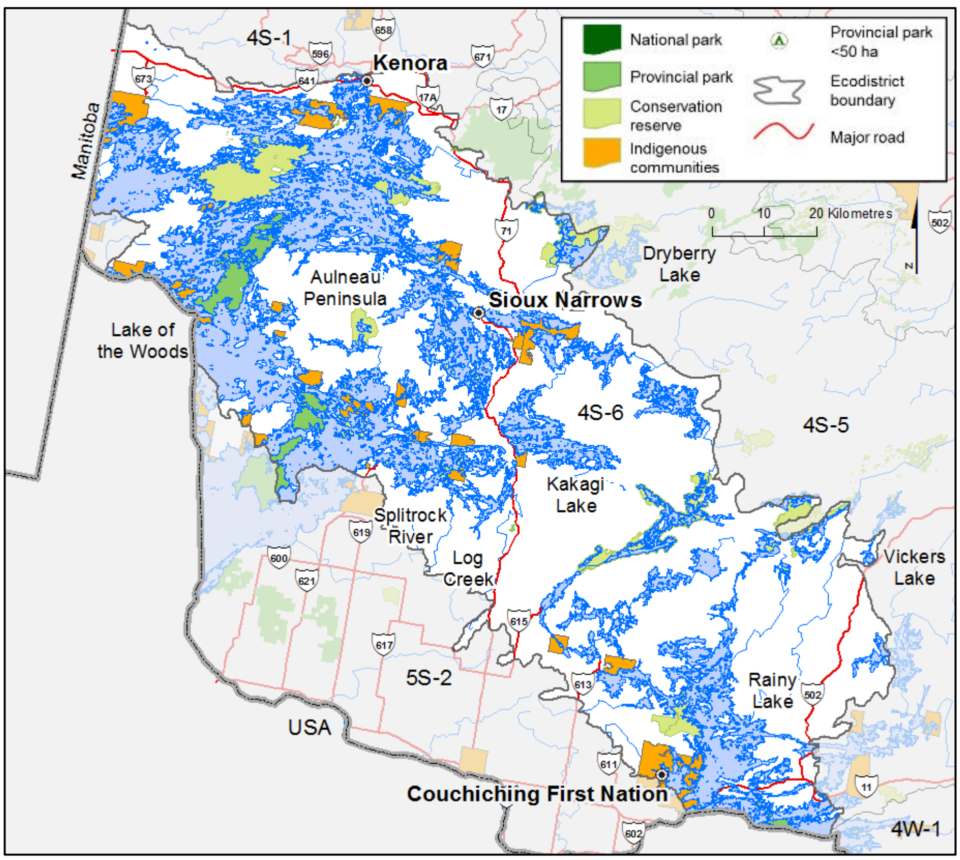
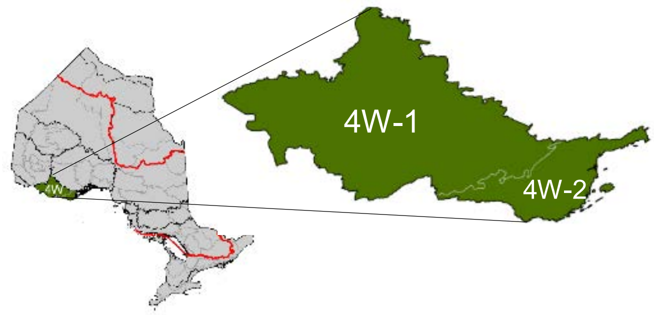


Figure 254. Select communities, major roads, natural heritage areas, river, creeks, and lakes in Ecodistrict 4S-6.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecoregion 4W

Pigeon River Ecoregion



Located in the Ontario Shield Ecozone, the Pigeon River Ecoregion extends from the United States border north to Gulliver Lake. The ecoregion spans from the southeastern shore of Rainy Lake to west of the Sibley Peninsula and includes two ecodistricts (Table 9).

Table 9. Ecodistricts in Ecoregion 4W.

Ecodistrict	Ecodistrict name
4W-1	Quetico
4W-2	Kakabeka

Located on the Precambrian shield, the bedrock is mostly granitic with some richer bands of base-rich ultramafic and greenstone material. In the east, the bedrock is overlain with fine-textured glaciolacustrine material. The remainder of the ecoregion is covered by a thin layer of acidic coarse-textured morainal material. Fine-textured, calcareous sediment, typically red in colour, occurs in the east. Glaciofluvial deposits are mixed with glaciolacustrine material in the west and central portions, and organic deposits have accumulated in low-lying areas. The irregular terrain is quite rugged in the central and northern portions. Rock rimmed lakes, mesas, and cuestas can be found in the ecoregion.

The ecoregion is characterized by bedrock with a variable layer of mineral material. Dystric Brunisols have developed in morainal and glaciofluvial materials. Gray Luvisols are limited, but can be found associated with glaciolacustrine deposits. One-third of Ecoregion 4W is characterized by bedrock. In very poorly drained areas, Mesisols have developed.

Ecoregion 4W is cool and relatively dry, supporting primarily temperate with some boreal expressions, particularly in the north. Mixed forests include eastern white pine, red pine, jack pine, trembling aspen, white spruce, large-toothed aspen, balsam fir, paper birch, and black spruce. Sugar maple, yellow birch, American basswood, northern pin oak, and bur oak grow on warmer-than-normal sites in the south. Black spruce, American larch, eastern white cedar, black ash, American elm, and red maple occur in lowland areas. Sparse coniferous and deciduous forests also grow here.

Most of the ecoregion is well drained. Water flows through a series of small rivers and streams to the Nelson Watershed. In the south, water drains through the Great Lakes Watershed to Lake Superior. The Pigeon River is one of the few major rivers.

Characteristic mammals and birds include moose, American black bear, hooded merganser, magnolia warbler, and pileated woodpecker. Central newt, gray treefrog, and red-bellied snake occur throughout the ecoregion, while lake chub, golden shiner, and bluntnose minnow inhabit lakes and rivers.

Thunder Bay is the largest community in the Pigeon River Ecoregion. Smaller communities include Atikokan and Kakabeka Falls. Timber harvesting, resource-based tourism, mineral exploration, and agriculture predominate.

Figure 255. Cirrus Lake, Quetico Provincial Park. Gerry Racey, MNRF.

Twelve types of natural heritage areas have been established in the area (Figure 255) (Gray et al. 2009), including LaVerendrye Provincial Park, whose canoe routes were used by early explorers and voyageurs (Ontario Parks 1993).

Ecoregion 4W has been delineated based on climatic (e.g., temperature, precipitation) and geological characteristics. It is wetter than Ecoregion 4S to the west, and warmer and drier than 3W to the north. Ecoregion 4W is also more rugged than 3W. The eastern boundary occurs along the shore of Lake Superior and the southern boundary of Ecoregion 4W occurs along the Ontario-United States border.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4W-1

Quetico Ecodistrict

Encompassing 1,666,679 ha (81.9% of the ecoregion, 1.7% of the province), Ecodistrict 4W-1 extends north from the Canada-United States border to Gulliver Lake. The western boundary includes the southeastern shore of Rainy Lake, and the eastern boundary occurs east of Lower Shebandowan Lake. Throughout the rolling landscape the elevation ranges from 336 m above sea level along the Rainy Lake shoreline to 678 m (NRCan 2002) above sea level in the southeast.

Figure 256. Mixed forests of the Quetico Ecodistrict. Gerry Racey, MNRF.

Key features

- Mixed forests (Figure 256) grow over nearly half of the ecodistrict.
- Three-quarters of the land base is classified as bedrock, exposed at the surface or covered with a very shallow layer of mineral material.
- Includes Quetico Provincial Park — northwestern Ontario's first official park (Gray et al. 2009).

Geology and substrates

The Quetico Ecodistrict is characterized as a rolling topography of Precambrian bedrock. Nearly 11,000 years ago (Dyke 2004) glacial Lake Agassiz inundated the area. Fluctuating lake levels and wave action modified and removed large amounts of previously deposited morainal material leaving behind a landscape dominated by bedrock, exposed at the surface or covered by a very shallow layer of acidic, coarse-textured mineral material (Figure 257).

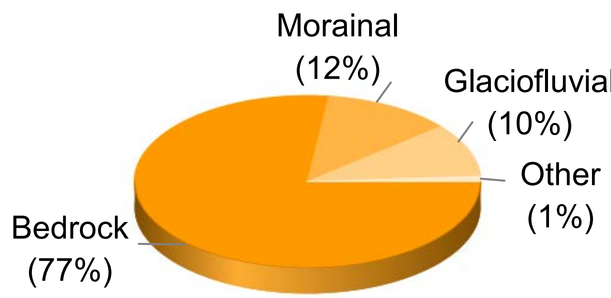


Figure 257. Modes of deposition in Ecodistrict 4W-1.

Morainal material associated with the Brule and Steep Rock moraines, possible extensions of the Eagle-Finlayson Moraine (Barnett 1992), occur along a northwest to southeast track. The two moraines diverge at Steep Rock Lake northwest of Atikokan. The Brule Moraine generally follows present day Highway 11, and the Steep Rock Moraine extends southeast towards the northern shore of Northern Light Lake. The Marks Lake Moraine occurs along the eastern boundary with Ecodistrict 4W-2. Level areas of deep morainal deposits occur south of the Seine River in the western portion of the ecodistrict, south of Beaverhouse and Guillver lakes, and in the east. Discontinuous areas of shallow to moderately deep morainal material separated by extensive bedrock outcrops occur across the region (Sado et al. 1995). In the north, a thin layer of windblown material (i.e., loess) covers much of the morainal material (Noble 1980). Abundant meltwater and ice contact deposits have resulted in glaciofluvial materials commonly associated with moraines (Burwasser 1977). Large, deep deposits of glaciolacustrine sediment are a result of the deposition of fine-textured mineral material in the deep parts of glacial lakes including Lake Agassiz, and in the northeast Lake Kaministikwia. Deposits associated with glacial Lake Agassiz are typically calcareous. Glaciolacustrine material may also occur as pockets between bedrock outcrops or as a thin layer on bedrock (Mollard and Mollard 1980a). Larger deposits occur adjacent to the Seine River, west of Greenwater Lake, and along the eastern and western boundaries. Organic accumulations are generally small occurring in low-lying areas over glaciolacustrine sediment or between bedrock outcrops (Mollard and Mollard 1980a). Larger accumulations can be found in the east, particularly along the Matawin River and west of Greenwater Lake. Alluvial deposits are restricted to larger river systems including the Seine and Matawin rivers and lacustrine material may occur adjacent to larger lakes.

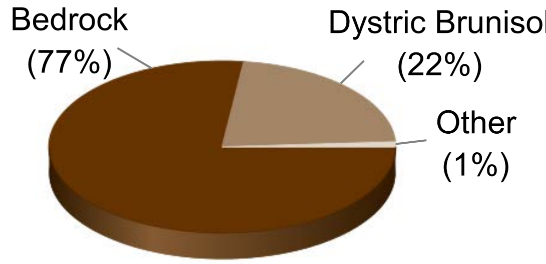


Figure 258. Substrate types in Ecodistrict 4W-1.

The dominant substrate type in Ecodistrict 4W-1 is acidic bedrock, exposed at the surface or with a discontinuous, very shallow layer of mineral material (Figure 258). Bands of base-rich bedrock occur in the north and east, often associated with faults. The Quetico fault is an east-west trending fault near the community of Atikokan (Williams 1991) and the Knife Lake fault system occurs in the south, following a southwest-northeast track to north of Saganaga Lake (Williams et al. 1991). Dystric Brunisols have formed in coarse-textured mineral material associated with moraines and glaciofluvial deposits. Gray Luvisols, which developed in well drained, often calcareous, fine-textured glaciolacustrine deposits, occur in the east and west. Organic deposits, typically Mesisols, occur in low-lying poorly drained areas. Regosols are associated with active mineral material including alluvial and lacustrine deposits.

Land cover and vegetation

The predominantly mixed forests (Figure 259) of the Quetico Ecodistrict contain a combination of temperate and boreal tree species (Figure 260). Associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972), tree species include jack pine, black spruce, paper birch, trembling aspen, large-toothed aspen, red maple, balsam poplar, red pine, white spruce, balsam fir, and eastern white pine (Noble 1980). Sparse forests are more prevalent in the south, in areas with discontinuous mineral material and exposed bedrock. Trees species typically associated with sparse forests include red pine, eastern white pine, jack pine, and trembling aspen. Old growth red and eastern white pine areas occur in the north and south (OMNR 2009b). Coniferous forests are scattered throughout the ecodistrict. Lowland coniferous forests generally comprise black spruce and American larch and may include eastern white cedar in nutrient rich areas. Upland coniferous forests may be dominated by a single species or contain a mix of tree species. Aspen-birch forests are the predominant deciduous forest type. Tree species that are more common to the south, such as red maple, yellow birch, northern red and bur oak, and sugar maple may also occur. American basswood, eastern hop-hornbeam, silver maple, Manitoba maple, northern pin oak, Canada plum, and green ash may grow on warmer-than-normal sites including south facing slopes and shorelines (Harris and Foster 2003b, Ontario Parks 2013). On wetter, nutrient rich sites typically associated with rivers and lakes, black ash and American elm may be found. Fen and bog complexes are scattered through the ecodistrict, constituting a small component of the overall land base. Fires in Ecodistrict 4W-1 are characterized as small, frequent events combined with high intensity and stand-replacing fires that affect larger areas (Van Sleeuwen 2006). Marshes are restricted to sheltered lake bays and river mouths.

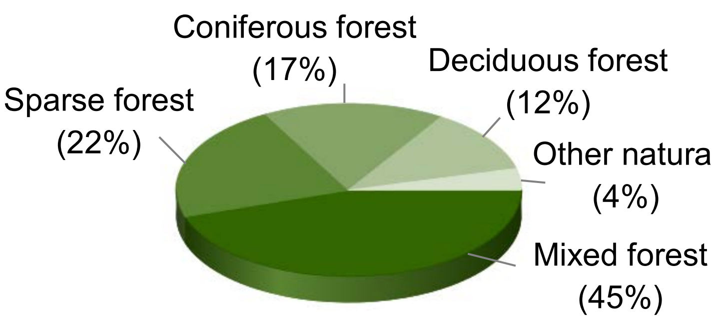


Figure 259. Land cover types in Ecodistrict 4W-1.

Vegetation in the Quetico Ecodistrict is influenced by the boreal forest to the north and the grassland vegetation zone to the west and south resulting in a diverse group of plant species. Jack-in-the-pulpit and hairy-nerved carrionflower, southern plants at their northern limits (Harris et al. 2002), and sweet fern and heart-leaved willow, eastern plants at their western limits (Bakowsky 2015, MNRF, pers. comm.) may be found. Ecosystems (e.g., meadows, woodlands) with grassland affiliates including big bluestem and brittle prickly-pear cactus (Harris et al. 2002) may occur on shallow substrates on warmer-than-normal sites or on south facing slopes adjacent to lakes and rivers. Colder-than-normal cliffs support Arctic-alpine species including snow cinquefoil and white mountain saxifrage (Ontario Parks 2013). Nutrient rich sites including base-rich bedrock and calcareous mineral material may support more varied plant species.

Figure 260. Mixed upland forest and lowland mosaic in Quetico Provincial Park. Gerry Racey, MNRF.

Land use

Less than 1% of the total area is settled. The largest community in the Quetico Ecodistrict is Atikokan (Figure 261). Other land uses include timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, trapping, hunting, fishing, and services associated with resource-based activities. Protected areas encompass approximately 30% of the ecodistrict.

Ecodistrict boundary delineation

The southern boundary of Ecodistrict 4W-1 is defined by the Ontario-United States border. The southeast boundary with Ecodistrict 4W-2 is defined by the transition from bedrock, typically exposed at the surface or with a very shallow layer of mineral material in 4W-1 to deeper mineral material in 4W-2. In addition, the bedrock types in 4W-1 are predominately Neo-to Mesoarchean era (2.5 to 3.4 billion years ago), composed of metasedimentary, muscovite, tonalite, or granitic rock while the bedrock in 4W-2 is younger from the Mesoproterozoic era (0.9 to 1.6 billion years ago) or Paleoproterozoic era (1.6 to 2.5 billion years ago) and composed of sedimentary or mafic and related intrusive rocks. The northwestern boundary with 4S-5 and the northeastern boundary with 3W-2 are defined based on ecoregional climatic attributes. Ecoregion 4W is wetter than 4S, and warmer and drier than 3W. Ecodistrict 4W-1 is also more rugged and the mineral material depth is shallower than 3W-2.

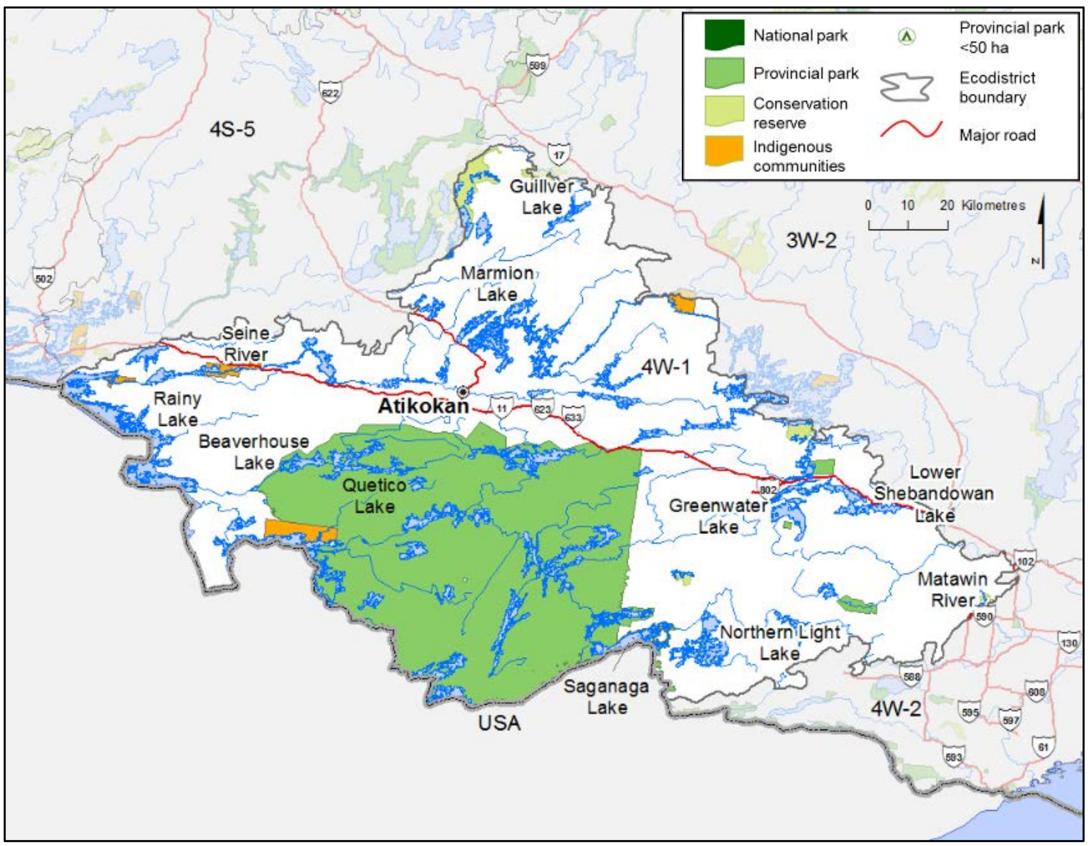


Figure 261. Select community, major roads, natural heritage areas, rivers, and, lakes in Ecodistrict 4W-1.

Figure 262. Canoeing at Quetico. Erin Banton, MNRF.

Figure 263. Silver Falls, Quetico Provincial Park, 1958. Archives of Ontario, RG 65-35-3.

Quetico Provincial Park

Established in 1913 (Gray et al. 2009), Quetico Provincial Park is located in the south-central portion of Ecodistrict 4W-1. The park shares its border with the Superior National Forest and Voyageurs National Park in the United States. The parks help to protect cultural, natural heritage, and recreational values over a contiguous area of approximately 1,002,000 ha (figures 262, 263) (Ontario Parks 2009c). It is also part of the Boundary Waters-Voyageur Waterway, a Canadian Heritage River. The extensive network of lakes and streams were once major transportation routes for Indigenous peoples and fur traders (Ontario Parks 2013).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 4W-2

Kakabeka Ecodistrict

The Kakabeka Ecodistrict extends from the shore of Lake Superior and the Canada-United States border in the south to north of the community of Kakabeka Falls. The western boundary occurs near Gunflint Lake, while in the east the boundary lies west of the Sibley Peninsula. It is 369,224 ha (18.1% of the ecoregion, 0.4% of the province) and contains the islands east and south of the community of Thunder Bay, including Pie Island. The lowest point, 179 m above sea level, is along the shore of Lake Superior near the community of Thunder Bay. The highest point in the ecodistrict, 670 m above sea level, is northeast of Head Lake.

Figure 264. Mixed forests of Ecodistrict 4W-2. Evan McCaul, Ontario Parks.

Key features

- Includes sparse and mixed forests (Figure 264) in which temperate and boreal tree species predominate.
- Morainal deposits occur over half of the land base.
- Includes the Nor'Westers a series of flat-topped ridges south of Thunder Bay.

Geology and substrates

Noble (1980) described Ecodistrict 4W-2 as consisting of upland sites with irregular surface topography, flat-topped ridges with broad valleys and escarpments, and level areas of deeper lacustrine and morainal materials. The landscape is generally undulating to rolling, overlain by a variable layer of coarse-textured, acidic, morainal material (Figure 265). Rugged areas consisting of bedrock ridges are located adjacent to the Lake Superior shoreline and on the string of Great Lake islands. The underlying Precambrian bedrock is typically base-rich with areas of acidic bedrock occurring in the north. The bedrock is generally younger than that in adjacent ecodistricts. Significant faults trend southwest to northeast near the community of Kakabeka Falls, in the northeast, and through Loch Lomond.

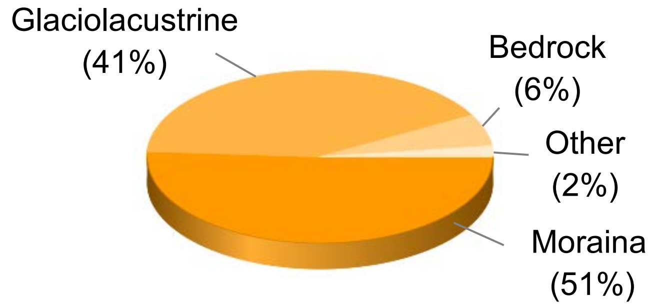


Figure 265. Modes of deposition in Ecodistrict 4W-2.

Deep, level morainal deposits occur in the north and as scattered pockets in the south-central portion of the ecodistrict. A discontinuous layer of very shallow to shallow morainal material separated by bedrock outcrops occurs in the west. Moraines in the ecodistrict include the Marks Moraine north and west of the community of Kakabeka Falls and the Mackenzie Moraine in the northeast. Nearly 9,600 years ago (Dyke 2004), glacial lakes including Minong and Duluth, inundated areas in the east and southeast, depositing calcareous, glaciolacustrine materials. As the glacial lakes receded, relict beaches were left behind. Bedrock, generally with a very shallow to shallow covering of mineral material, dominates the landscape in the west and northeast. Exposed bedrock is commonly associated with bedrock ridges along the Lake Superior shoreline and flat-topped ridges south of the community of Thunder Bay (Burwasser 1977). Flat-topped ridges or mesas (Figure 266) may also occur on some of the islands in Lake Superior. Colluvial debris (e.g., talus) is often found adjacent to cliffs associated with these ridges (Mollard and Mollard 1983b).

Figure 266. Flat-topped ridge on Pie Island. Phil Kor, MNRF.

Glaciofluvial deposits occur in the northeast and southwest, especially surrounding the Current River and along the Kaministiquia River east of the community of Stanley, which was formed as a meltwater channel and spillway draining glacial Lake Kaministikwia to the north. Organic deposits have developed in poorly drained areas typically overlying glaciolacustrine or glaciofluvial deposits or as scattered pockets in bedrock depressions. Along the major rivers such as the Kaministiquia, Whitefish, and Arrow rivers, alluvial deposits may occur. Aeolian deposits occur west of the community of Thunder Bay along the Kaministiquia River (Mollard and Mollard 1983b) and lacustrine deposits can be found along the shore of Lake Superior.

Substrates in Ecodistrict 4W-2 are generally Dystric Brunisols or Gray Luvisols (Figure 267). Dystric Brunisols have developed in acidic, coarse-textured, typically morainal material but may also include glaciofluvial deposits. Fine-textured, calcareous materials, often associated with well drained glaciolacustrine deposits, have developed Gray Luvisolic profiles. Bedrock, exposed at the surface or with a very shallow to shallow layer of mineral material, is found throughout the ecodistrict. Organic accumulations are typically Mesisols but may include Fibrisols and Humisols (Agriculture Canada 1981), and are typically found in low-lying, wet areas. Larger deposits occur along the shore of Lake Superior and throughout the central portion of the ecodistrict. Gleysols have developed in mineral material with poor drainage. Regosols are associated with alluvial and lacustrine deposits.

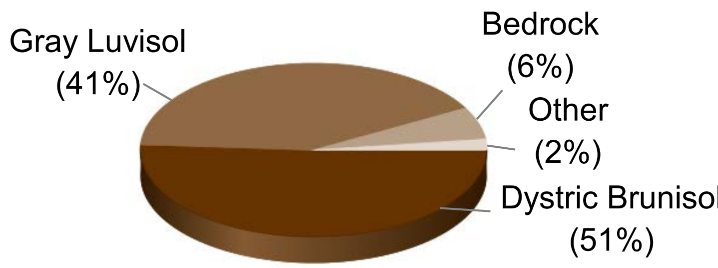


Figure 267. Substrate types in Ecodistrict 4W-2.

Land cover and vegetation

Associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Quetico Section (L.11) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972), more than one-third of Ecodistrict 4W-2 is characterized as sparse forests (Figure 268). A higher proportion of sparse forests occur on the flat-topped ridges and on morainal material near the northern boundary.

Mixed forests include trembling aspen, paper birch, black spruce, white spruce, and balsam fir, and jack pine grow throughout the ecodistrict but are more prominent south of Whitefish Lake. Deciduous forests dominated by aspen often occur on dry to moist fine-textured mineral material. Paper birch dominated communities typically occur

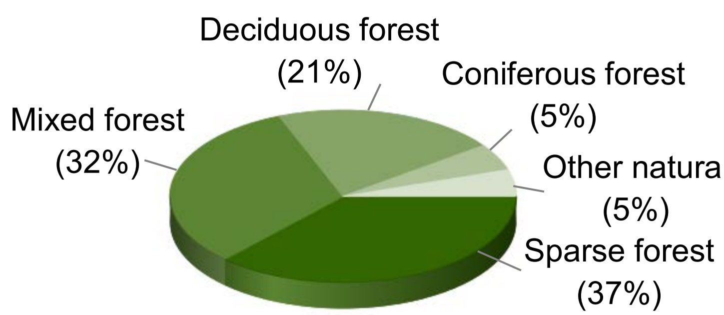


Figure 268. Land cover types in Ecodistrict 4W-2.

on the slopes adjacent to the flat-topped ridges, especially around the shores of Lake Superior (Noble 1980). Waterways along river valleys support black ash and tree species more commonly found farther south, including red maple, bur oak, green ash, and isolated pockets of American elm, eastern hop-hornbeam, and American basswood (Noble 1980). Black ash forests may also be associated with glaciolacustrine deposits. Sugar maple forests that may contain yellow birch can be found at the base of several flat-topped ridges from the community of Thunder Bay south to the border with the United States. On warmer-than-normal upland sites, northern red oak may also be found. Coniferous forests of black spruce, eastern white cedar, and American larch are limited, occurring in low-lying areas with poor drainage. On upland sites, including the edges of the flat-topped ridges, coniferous forests of red pine and/or eastern white pine may occur. A small portion of the land base has been cleared for pasture and cropland, generally in the north-central part of the ecodistrict. Bog and fen complexes are restricted to low-lying, poorly drained areas. Exposed bedrock is limited and marshes occur in sheltered bays adjacent to rivers and lakes. Fires are limited, due to the close proximity to Lake Superior. When fires do occur they are generally small. Occasionally, high intensity and stand-replacing fires affecting larger areas occur (Van Sleeuwen 2006).

Figure 269. Drummond’s thistle. Wasyl Bakowsky, MNRF.

Variable topography in the Kakabeka Ecodistrict results in a range of climatic conditions. Arctic-alpine species, including northeastern paintbrush, alpine hedysarum, and alpine bistort (Henson and Brodribb 2005) may be found on the rocky Lake Superior shoreline or associated with cold cliffs and canyons. On warmer-than-normal cliff tops, ecosystems (i.e., meadows, woodlands) with grassland species such as western fescue and Drummond’s thistle (Figure 269) occur (Harris and Foster 2004a). Near the community of Stanley, plants typically associated with grasslands include prairie sagebrush, plains rough fescue, and hoary puccoon (Bakowsky 2007). Northern species near their southern limits include low blueberry willow and alpine woodsia, while sticky goldenrod is more commonly found in the west (Bakowsky 2015, MNRF, pers. comm.; Henson and Brodribb 2005). Higher nutrient availability and an increase in plant species diversity may occur on base-rich bedrock. Base-rich cliff systems support species including long-leaved arnica and dryland sedge (Bakowsky 2002). Nutrient rich sites also occur northeast of the community of Kakabeka Falls where marl lakes can be found (Speed et al. 1985) or associated with calcareous, glaciolacustrine material.

Land use

Settlement and associated infrastructure accounts for approximately 2% of the total area. Communities found in the ecodistrict include Thunder Bay, Kakabeka Falls, and Stanley (Figure 270). Protected areas occur over 4.3% of the ecodistrict. In addition, the Lake Superior National Marine Conservation Area protects approximately 893 ha of water. Timber harvesting, resource-based tourism, mineral exploration, hydroelectric generation, agriculture, aggregate extraction, and business and industry (manufacturing, transportation services, and government) occur in the ecodistrict.

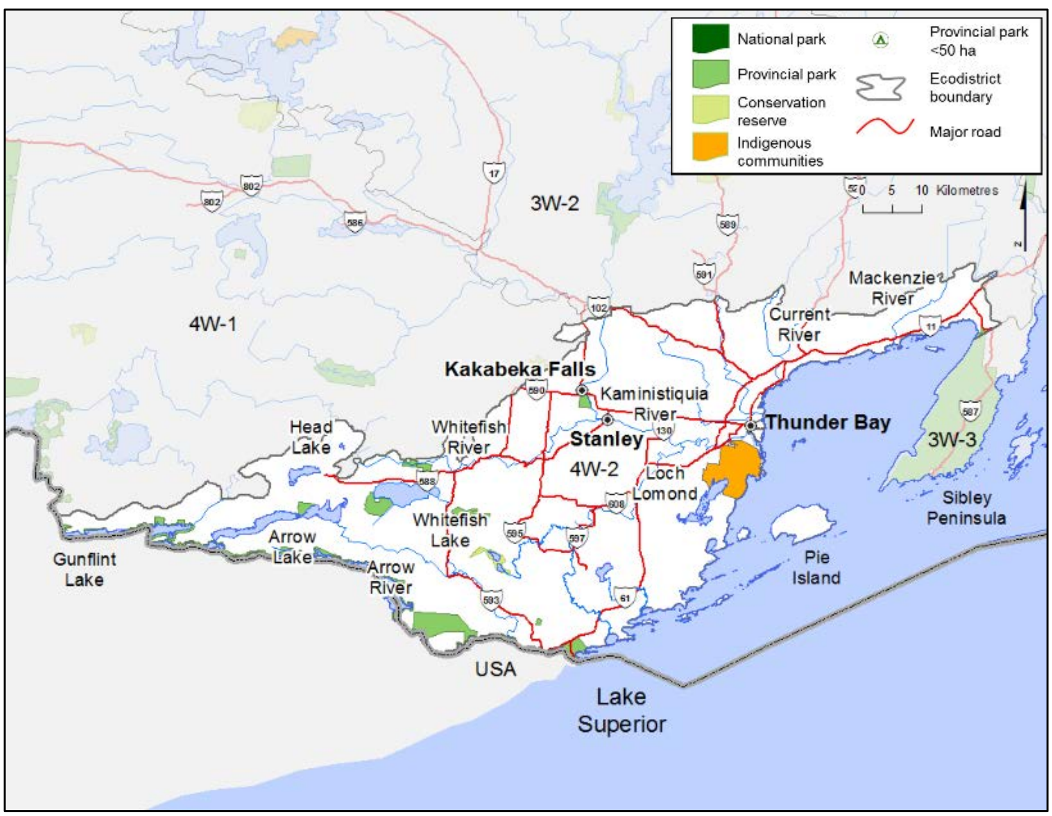


Figure 270. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 4W-2.

Ecodistrict boundary delineation

The Kakabeka Ecodistrict is bounded in the south by the border with the United States and in the east by Lake Superior. The age and composition of the bedrock in Ecodistrict 4W-2 helps distinguish it from adjacent ecodistricts 4W-1 and 3W-2. The bedrock types in 4W-2 are from the Mesoproterozoic era (0.9 to 1.6 billion years ago) or Paleoproterozoic era (1.6 to 2.5 billion years ago) and are composed of sedimentary or mafic and related intrusive rocks rather than the older Neo-to Mesoarchean era (2.5 to 3.4 billion years ago) bedrock, composed of metasedimentary, muscovite, tonalite, or granitic rock in 4W-1 and 3W-2. The northwest boundary with 4W-1 is also marked by the transition from deeper mineral material in 4W-2 to bedrock, typically exposed at the surface or with a very shallow layer of mineral material in 4W-1. The northeastern boundary with 3W-2 and eastern boundary with 3W-3 are defined by ecoregional climatic variables where Ecoregion 4W is warmer and drier.

Mesas and cuestas

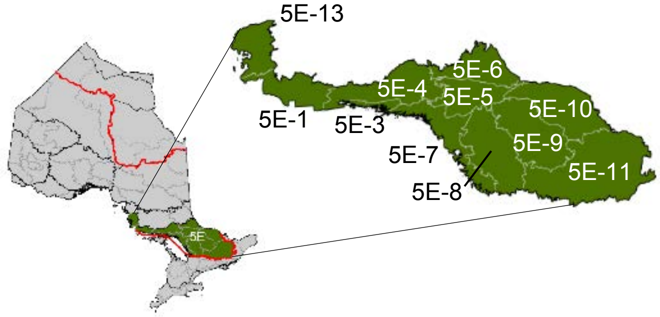
South and west of the community of Thunder Bay, the relatively undulating landscape rises dramatically culminating in flat-topped ridges with a sloping wall on one side and a steep wall on the other. Locally referred to as the Nor'Wester Mountains (Figure 271), these geological formations resulted from the weathering of stratified layers of rock. Mesa, which refers to the flat-topped ridges with steep slopes, and cuesta, a reference to the characteristic gentle backslope (Gutiérrez and Gutiérrez 2016), were formed as a result of the differential erosion of the rock layers. The flat-top consists of a harder, generally igneous rock layer underlain by a softer sedimentary layer that is exposed on the sides to weathering.

Figure 271. Mount McKay, part of the Nor'Wester Mountains, Thunder Bay. Phil Kor, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecoregion 5E

Georgian Bay Ecoregion



The Georgian Bay Ecoregion encompasses 7,447,869 ha or 7.5% of the province. Located in the Ontario Shield Ecozone, it extends from the southeastern shore of Lake Superior east to the Ontario-Québec border. The approximate northern boundary occurs at the Montreal River in the west and Mackenzie Lake in the east. The southern boundary follows the southern extent of the Precambrian shield. Eleven ecodistricts occur in Ecoregion 5E (Table 10).

Table 10. Ecodistricts in Ecoregion 5E**.**

Ecodistrict	Ecodistrict name
5E-1	Thessalon
5E-3	La Cloche
5E-4	Sudbury
5E-5	North Bay
5E-6	Tomiko
5E-7	Parry Sound
5E-8	Huntsville
5E-9	Algonquin Park
5E-10	Brent
5E-11	Bancroft
5E-13	Batchawana

Situated on the southern edge of the Precambrian Shield, the topography in Ecoregion 5E is quite variable, alternating from an undulating landscape to rugged terrain. The underlying bedrock is primarily migmatitic gneissic and felsic igneous rocks. The area is bedrock controlled with variable depths of morainal material. Glaciofluvial deposits are common, associated with large river valleys and outwash deposits. Lakes, such as Nipissing, Muskoka, Joseph, Lake of Bays, and Opeongo, are prominent features. Situated within the Great Lakes Watershed, numerous river systems (e.g., Mattawa, Mississagi, Spanish, Petawawa, Severn, and Magnetawan) rapidly drain the area.

Humo-Ferric Podzols have developed in well drained coarse-textured morainal and glaciofluvial deposits. Bedrock, bare or with a thin layer of mineral material, occurs throughout the ecoregion, especially in the west. Mesisols and Melanic Brunisols also occur, but are limited in extent.

A mix of temperate and boreal vegetation and wildlife species characterize the Georgian Bay Ecoregion. Primarily forested, typical tree species include eastern white pine, red pine, eastern hemlock, eastern white cedar, sugar maple, yellow birch, and large-toothed aspen. In the north or on cooler-than-normal sites, black spruce, trembling aspen, paper birch, white spruce, jack pine, American larch, and balsam fir are more common. American beech, American basswood, black cherry, white ash, and bur oak are more common in the south. Red spruce, once a component of many forests across the landscape, occurs less frequently due to silvicultural practices (Gordon 1992).

Figure 272. Islands of Georgian Bay. Sam Brinker, MNRF.

Characteristic fauna include American black bear, moose, beaver, broad-winged hawk, pileated woodpecker, veery, rose-breasted grosbeak, gray treefrog, snapping turtle, and ring-necked snake. The numerous rivers and lakes are inhabited by lake trout, yellow perch, rock bass, bluntnose minnow, and northern redbelly dace.

Timber harvesting, mining, mineral exploration, resource-based tourism, and agriculture occur throughout the ecoregion. Sault Ste. Marie, Sudbury, North Bay, Parry Sound, Huntsville, Minden, and Bancroft are several of the larger communities.

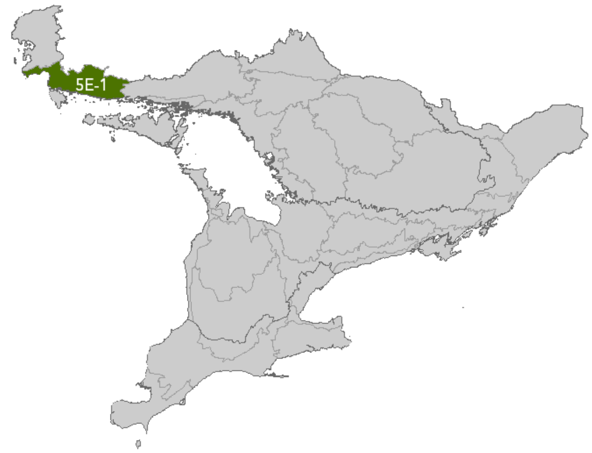
Twenty-six types of natural heritage areas are located in Ecoregion 5E (Gray et al. 2009). Jocko Rivers Provincial Park located in the northeast features a patterned peatland with aeolian ridges (Ontario Parks 2006).

The northern boundary with Ecoregion 4E is strongly correlated with climatic variables, elevation, and geological differences (Baldwin et al. 1998). Compared with Ecoregion 4E, 5E is warmer, has a lower elevation, and the underlying bedrock is typically from the Proterozoic Eon (less than 2.5 billion years old) whereas in 4E the bedrock is from the Archean Eon (more than 2.5 billion years old). The boundary with Ecoregion 6E reflects the transition from Precambrian bedrock in 5E to Paleozoic bedrock in 6E, as well as a cooler and wetter climate in 5E.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 5E-1

Thessalon Ecodistrict



The Thessalon Ecodistrict extends from the Ontario-United States border in the west to the community of Elliot Lake in the east. The northern boundary is north of Wakomata Lake and the southern boundary includes the islands along the northern shoreline of the St. Mary's River and the North Channel of Lake Huron. Ecodistrict 5E-1 encompasses 398,820 ha (5.4% of the ecoregion, 0.4% of the province). The elevation ranges from 171 m above sea level along the shorelines of the St. Mary's River and North Channel of Lake Huron to 553 m above sea level east of Wakomata Lake.

Figure 273. Deciduous and mixed forests of the Batchawana Ecodistrict. Aspen Zeppa, MNRF.

Key features

- Maple dominated deciduous forests (Figure 273) occur on more than one-third of the land base.
- Precambrian bedrock with a shallow to moderate mineral material layer dominates.
- Sandstone and shale Cambrian bedrock are found along the St. Mary's River.

Geology and substrates

The Thessalon Ecodistrict consists of two landscape patterns. Most of the ecodistrict is characterized as a bedrock controlled, rolling landscape with a shallow to moderate layer of acidic, morainal material (Figure 274). Fault and joint patterns including the McCarrol Lake and McMahon Lake faults (Jackson 2001) control drainage patterns. Adjacent to the St. Mary's River, Lake Superior, and the North Channel of Lake Huron, glaciolacustrine material has created an undulating topography with deep mineral material. In this area, relief occurs as small ridges and wave-washed bedrock. The bedrock is primarily Precambrian and acidic however, Cambrian sandstone, shale, and conglomerates can be found along the St. Mary's River and base-rich bedrock occurs in bands particularly in the central portion of the ecodistrict.

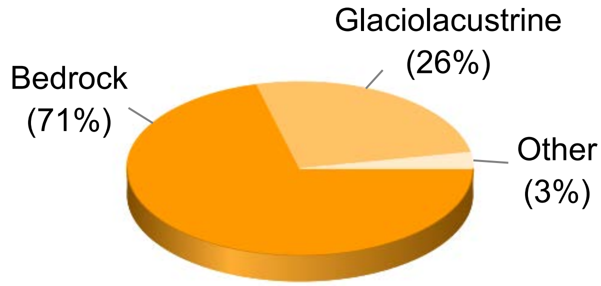


Figure 274. Modes of deposition in Ecodistrict 5E-1.

Glaciolacustrine materials are lake bed remnants from a series of glacial lakes including glacial lakes Algonquin and Mattawa and the Nipissing Great Lakes (Lewis et al. 1994) that inundated the area nearly 5,000 to 11,000 years ago (Dyke 2004). Several of these deposits are calcareous (Agriculture Canada 1983a). Additional glacial lake features include relict shorelines. Glaciofluvial deposits occur in larger river valleys (e.g., Garden and Mississagi rivers) which served as spillways for glacial meltwater. Beneath the glaciofluvial material, fine-textured glaciolacustrine deposits may occur (McQuay 1980c). Deep morainal deposits are limited, occurring between bedrock ridges in the north in areas unaffected by the glacial lakes. Alluvial deposits are found along rivers and streams and organic materials have accumulated in limited low-lying areas such as bedrock depression or on poorly drained glaciolacustrine deposits. Exposed rock is more common in the north occurring as bedrock ridges and colluvial material associated with talus slopes. Shorelines on the main land and islands may be composed of exposed bedrock, lacustrine, or aeolian materials.

The most common substrate type in Ecodistrict 5E-1 is bedrock covered with a discontinuous shallow to moderate layer of mineral material (Figure 275). Humo-Ferric Podzols have developed in better drained, deeper glaciolacustrine, glaciofluvial, and morainal deposits. In areas of poor drainage, Gleysols are more common. Organic deposits, typically Mesisols and Humisols (Agriculture Canada 1983a), have developed in low-lying areas where water can accumulate including along the shore of Lake Huron east of Thessalon (Van Dine 1980a). In more rugged areas and adjacent to larger water bodies exposed bedrock may occur. Regosols are associated with areas of active mineral material (i.e., lacustrine, aeolian).

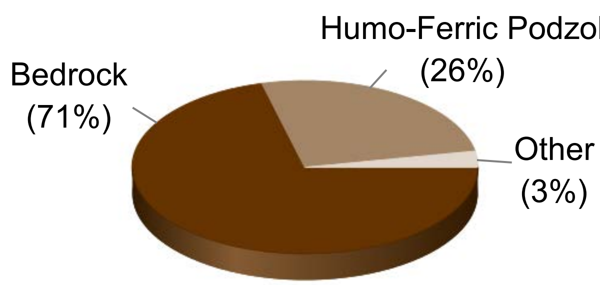


Figure 275. Substrate types in Ecodistrict 5E-1.

Land cover and vegetation

Associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Algoma Section (L.10) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972), the vegetation in this ecodistrict is a mix of species from the temperate and boreal vegetation zones. Deciduous forests are more frequent in the north and occur over one-third of the land base (Figure 276). Sugar maple dominated forests are common especially on upper slopes and bedrock ridges, often containing yellow birch, northern red oak, red maple, eastern hop-hornbeam, and occasionally American beech and white ash (OMNRF 2016d). In areas of recent disturbance, trembling aspen, large-toothed aspen, and paper birch are more prevalent. On fresh to moist sites, bur oak, American basswood, green ash, black ash, American elm, and silver maple may also occur (Bergsma 1998, OMNRF 2016d). Mixed forests are spread across the central and eastern portions of the landscape growing a variety of species including white spruce, eastern hemlock, and balsam fir. In low-lying areas, mixed forests comprising black ash can be found. Sparse forests, often interspersed with bare bedrock, occur on bedrock knobs and ridges with little mineral material. Areas in the south have been cleared for pasture and cropland. Exposed bedrock can be found northwest of Basswood Lake, in the southeast (OMNRF 2016d), and along the Lake Superior shoreline (Figure 277). Coniferous forests are generally associated with low-lying areas or very shallow substrates (Bergsma 1998). Low-lying areas support black spruce, American larch, and eastern white cedar while eastern white pine, red pine, and jack pine are more commonly associated with very shallow substrates. Bog and fen complexes and marshes often occur along shorelines including those of lakes Huron and Superior. Marshes are found inland associated with quiet areas of lakes and rivers. Several abandoned agricultural fields have renaturalized into meadows and shrub communities.

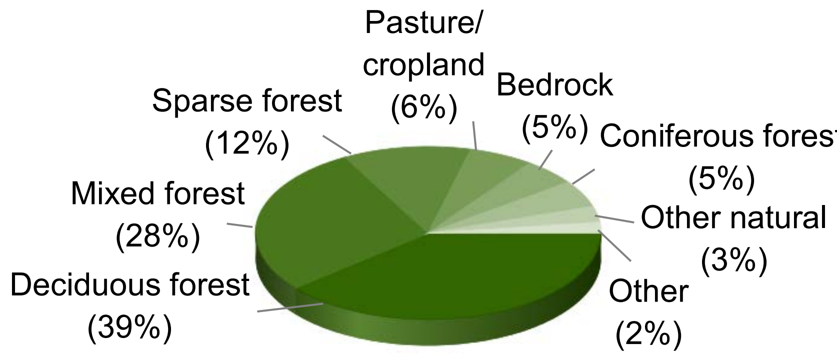


Figure 276. Land cover types in Ecodistrict 5E-1.

The climate of the Thessalon Ecodistrict is moderated by the Great Lakes. This effect enables the northward extension of the ranges of several species including skunk cabbage, lance-leaved tickseed, and small-flowered blue-eyed Mary (Noble 1991). Ecodistrict 5E-1 is also home to several species endemic to Lake Superior (e.g., pointed moonwort and false northwestern moonwort; Henson and Brodribb 2005) as well as species whose primary range is to the east on the Atlantic coastal plain (e.g., brownish beakrush and Canadian St. John's-wort; Bergsma 1998). Shorelines may contain plant species that are adapted to high energy (i.e., wave-action, wind) including beach pea and American beachgrass (Bergsma 1998).

Increased plant species richness may occur in areas of calcareous mineral material or where base-rich bedrock is near the surface. These areas have a higher availability of nutrients in the substrate and may support vegetation such as fen grass-of-Parnassus (Bergsma 1998) that typically grows in calcareous environments.

Figure 277. Lake Superior shoreline in Ecodistrict 5E-1. Mike McMurtry, MNRF.

Land use

Business and industry, timber harvesting, mineral exploration, aggregate extraction, hydroelectric generation, agriculture, fishing, hunting, and services associated with resource-based activities occur in the ecodistrict. Approximately 2% of the land base is devoted to settlement and associated infrastructure. Communities include Sault Ste. Marie, Elliot Lake, Thessalon, Blind River, and Gros Cap (Figure 278). Protected areas encompass nearly 10.5% of the ecodistrict.

Ecodistrict boundary delineation

The northeastern boundary with Ecodistricts 4E-3 is defined by ecoregional variables. In general, Ecoregion 5E is warmer, has a lower elevation, and the primary bedrock is from the Proterozoic Eon (less than 2.5 billion years old) whereas 4E is underlain with bedrock from the Archean Eon (more than 2.5 billion years old). Ecodistrict 5E-1 and 5E-13 are recognized as distinct areas based on topography — 5E-1 has a less variable topography; depth of substrates — the mineral material is typically deeper in 5E-1; and climate — at the ecodistrict scale, 5E-1 is drier and warmer. The transition from Precambrian bedrock in 5E-1 to Paleozoic bedrock in 6E-17, as well as a cooler climate in Ecoregion 5E help to differentiate the two areas. The eastern boundary with 5E-4 is generally defined by climatic differences at the ecodistrict scale. The effect of the Great Lakes diminishes eastward from 5E-1 to 5E-4. Ecodistrict 5E-1 is warmer and wetter than 5E-4. Along the southern and western boundaries, Ecodistrict 5E-1 includes the shorelines of the St. Mary's River, Lake Superior, the North Channel of Lake Huron and associated islands to the Ontario-United States border.

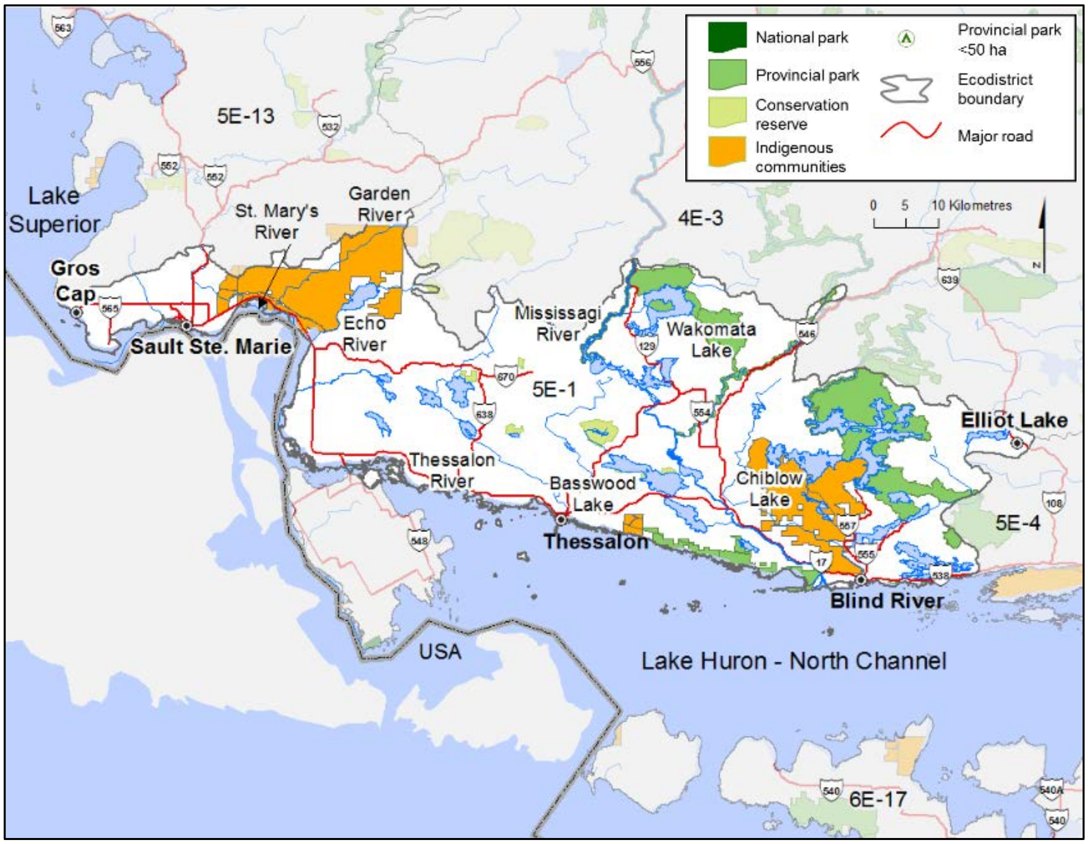
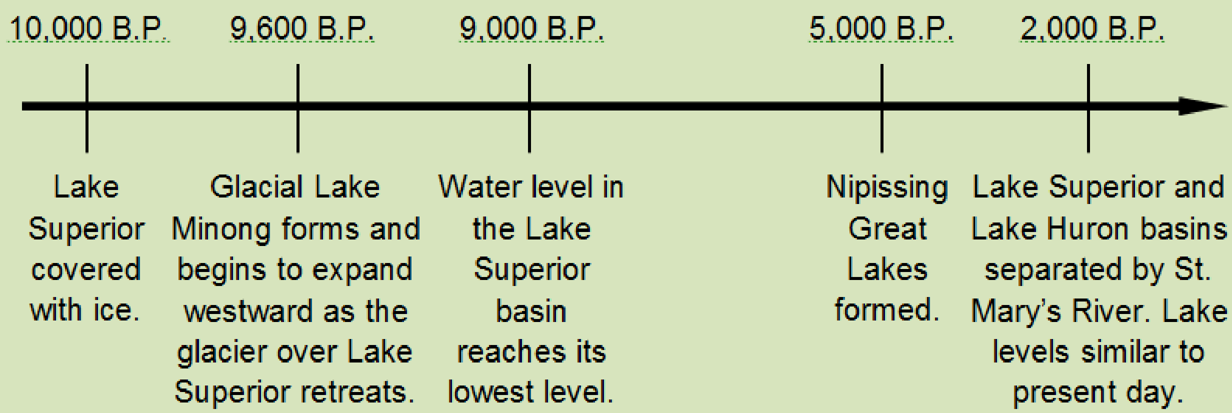


Figure 278. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-1.

Glacial history of Lake Superior

Approximately 10,000 years ago, 3 km of ice pressed down over Lake Superior and the surrounding area. As the ice retreated, glacial meltwater began to fill the Lake Superior basin. Several lakes occupied the basin. Affected by changing drainage patterns and isostatic rebound, the lakes left behind shoreline features (e.g., relict beaches) that today are well above the modern shoreline. Sources used to construct the timeline provided below include Farrand and Drexler (1985), Barnett (1992), and Dyke (2004).



Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 5E-3

La Cloche Ecodistrict

The La Cloche Ecodistrict is a narrow landscape along the northern shore of Lake Huron that encompasses 89,270 ha (1.2% of the ecoregion, 0.1% of the province). The smallest ecodistrict in Ecoregion 5E, it includes numerous islands in the North Channel of Lake Huron as well as a small area inland. Ecodistrict 5E-3 extends from the outlet of the Spanish River eastward to David Lake in Killarney Provincial Park, and southward to include Heywood Island. The elevation ranges from 171 m above sea level on the islands at the mouth of the Spanish River to 532 m above sea level south of David Lake.

Figure 279. Mixed forests of Ecodistrict 5E-3. Monique Wester, MNRF.

Key features

- Over one-third of the landscape is covered by mixed forests (Figure 279).
- Undulating to rugged topography is dominated by Precambrian bedrock.
- The La Cloche Mountains, an area of extensive white quartzite hills, occur here.

Geology and substrates

After deglaciation, nearly 10,000 years ago (Dyke 2004), the Lake Huron basin was inundated by a series of glacial lakes (Lewis et al. 1994, Barnett 2016). The glacial lakes reworked the thin layer of morainal material, often washing the bedrock clean and depositing the modified sediment in lower lying areas. The resulting landscape is composed of undulating bedrock hills intermixed with rugged bedrock ridges, typically exposed or covered with a very shallow layer of acidic mineral material (Figure 280). The ridges are part of an ancient mountain range primarily composed of white quartzite, called the La Cloche Mountains. Pink granitic bedrock hills can be found in the southeast. Deep bedrock controlled valleys, often containing lakes and streams, commonly separate the bedrock hills and ridges. Exposed rock is more common in rugged areas, along shorelines, and as small areas of colluvial material (i.e., talus). The topography is further influenced by numerous folds and faults including the Spanish and Charleton Lake faults (Card 1976, Robertson 1976). The Precambrian bedrock is generally acidic however, Paleozoic outcrops occur south of the community of Birch Island and on several islands including Heywood Island.

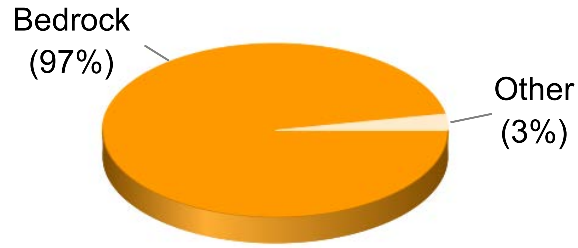


Figure 280. Modes of deposition in Ecodistrict 5E-3.

Limited pockets of deep morainal material occur south of the Spanish River and David Lake. Organic deposits are restricted to poorly drained bedrock and mineral material depressions or along the shore of Lake Huron, especially southwest of La Cloche Lake. Glaciolacustrine lake bed sediment is generally associated with glacial Lake Algonquin; however, the Nipissing Great Lakes also inundated the shoreline (Lewis et al. 1994). These deposits are found in low-lying areas in the western half of the ecodistrict and west of the community of Whitefish Falls. Relict shorelines that were formed by higher lake levels are also present. Glaciofluvial and alluvial deposits are found along rivers and streams, especially in the west along the Spanish River. Lacustrine deposits may occur along the shorelines of Lake Huron and larger inland lakes.

Most of Ecodistrict 5E-3 is characterized as bedrock, exposed at the surface or covered by a discontinuous layer of very shallow mineral material (Figure 281). Bedrock hills and ridges, shoreline areas, and talus slopes may have areas of exposed rock. Gray Luvisols have developed in better drained fine-textured, occasionally calcareous (Agriculture Canada 1983a, b), morainal, glaciolacustrine, and glaciofluvial material. Gleysols have developed in mineral material in poorly drained, low-lying areas. In depressions and along the Lake Huron shoreline, organic substrates, generally Mesisols, have accumulated. Regosols are associated with areas of active mineral material (e.g., lacustrine and alluvial deposits).

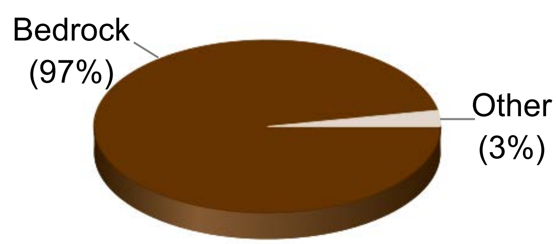


Figure 281. Substrate types in Ecodistrict 5E-3.

Land cover and vegetation

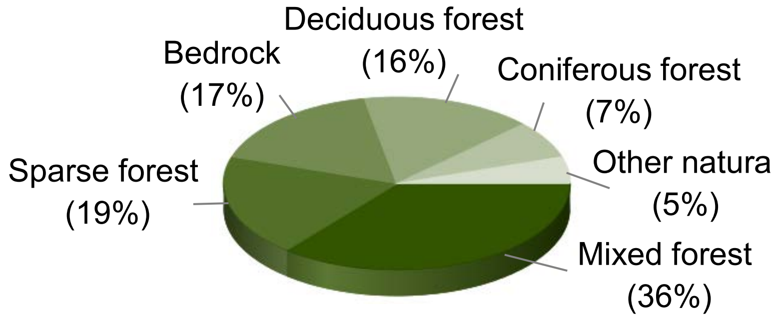


Figure 282. Land cover types in Ecodistrict 5E-3.

Ecodistrict 5E-3 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Sudbury-North Bay Section (L.4e) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Mixed forests that include eastern white pine, northern red oak, sugar maple, yellow birch, eastern hemlock, red pine, jack pine, red maple, paper birch, balsam fir, trembling aspen, large-toothed aspen, and white spruce grow on over one-third of the land base (Figure 282). These forests occur throughout the area, but are more common in areas of lower elevation and on deeper substrates. Sparse forests typically grow on bedrock ridges associated with very shallow to mostly exposed bedrock sites. In these areas, the natural cover often occurs in a linear pattern reflecting the accumulation of mineral or organic material in cracks in the bedrock. Bare bedrock with lichen and moss cover are interspersed with forested areas (Figure 283), often supporting common juniper and blueberries.

Figure 283. Killarney Provincial Park. Ed Morris, Ontario Parks.

Northern red oak, sugar maple, yellow birch, red maple, paper birch, trembling aspen, large-toothed aspen, and eastern hop-hornbeam are common components of the deciduous forests. American basswood, American beech, white oak, bur oak, and white ash may also occur and are typically associated with warmer-than-normal sites with deeper mineral material. Fresh to moist sites support black ash, American elm, balsam poplar, green ash, and silver maple. Trembling aspen and paper birch are more prevalent in areas affected by timber harvesting and fire. On dry sites, shallow substrates support coniferous forests of red pine and eastern white pine. Eastern hemlock and mixed coniferous forests occur on fresh sites. American larch, black spruce, and eastern white cedar are found in poorly drained areas. Other land cover types include fen and bog complexes that are typically found in low-lying areas such as bedrock depressions. Marsh ecosystems, occur along the Lake Huron shoreline. A small portion of the landscape has been converted to pasture and cropland. Shrubs and meadows are limited, generally representing abandoned agricultural fields. Paleozoic outcrops in the south may support specialized environmental conditions (i.e., alvar) with a unique assemblage of plant and animal species. Vegetation growing in these alvar ecosystems may include wild chives, Hill's thistle, fragrant sumac (Henson and Brodribb 2005), and upland white goldenrod (Macdonald 1973).

The moderating influence of Lake Huron and the rugged nature of the ecodistrict results in local climatic differences. Warmer-than-normal sites adjacent to the lake and on southern slopes host temperate species. Indicators of more southern affinities include Indian cucumber-root, hairy Solomon's seal, and Virginia chain fern, which is at its northern and western limits (Macdonald 1973). Squarrose goldenrod also reaches its western limit in Ecodistrict 5E-3 (Semple et al. 1999). Northern slopes on high bedrock ridges and wetland areas exhibit colder-than-normal temperatures and host species more typical of the boreal vegetation zone. Along the shore of Lake Huron, typically on Paleozoic bedrock, species endemic to the Great Lakes including Ontario goldenrod (Semple et al. 1999), Houghton's goldenrod, and stiff yellow flax (Henson and Brodribb 2005) may occur. Increased plant species biodiversity is found in areas where the availability of substrate nutrients is higher including where base-rich bedrock or calcareous mineral materials occur. The proximity of Ecodistrict 5E-3 to Lake Huron and higher precipitation rates would normally decrease the incidence of fire however, the abundance of exposed bedrock and very shallow substrates results in drier conditions and a higher fire frequency than adjacent ecodistricts.

Land use

Services associated with resource-based activities, aggregate extraction, fishing, and timber harvesting occur in the ecodistrict. Less than 1% of the land base is devoted to settlement and associated infrastructure. Communities include Whitefish Falls and Birch Island (Figure 284). Nearly 50.5% of the ecodistrict is designated as protected areas.

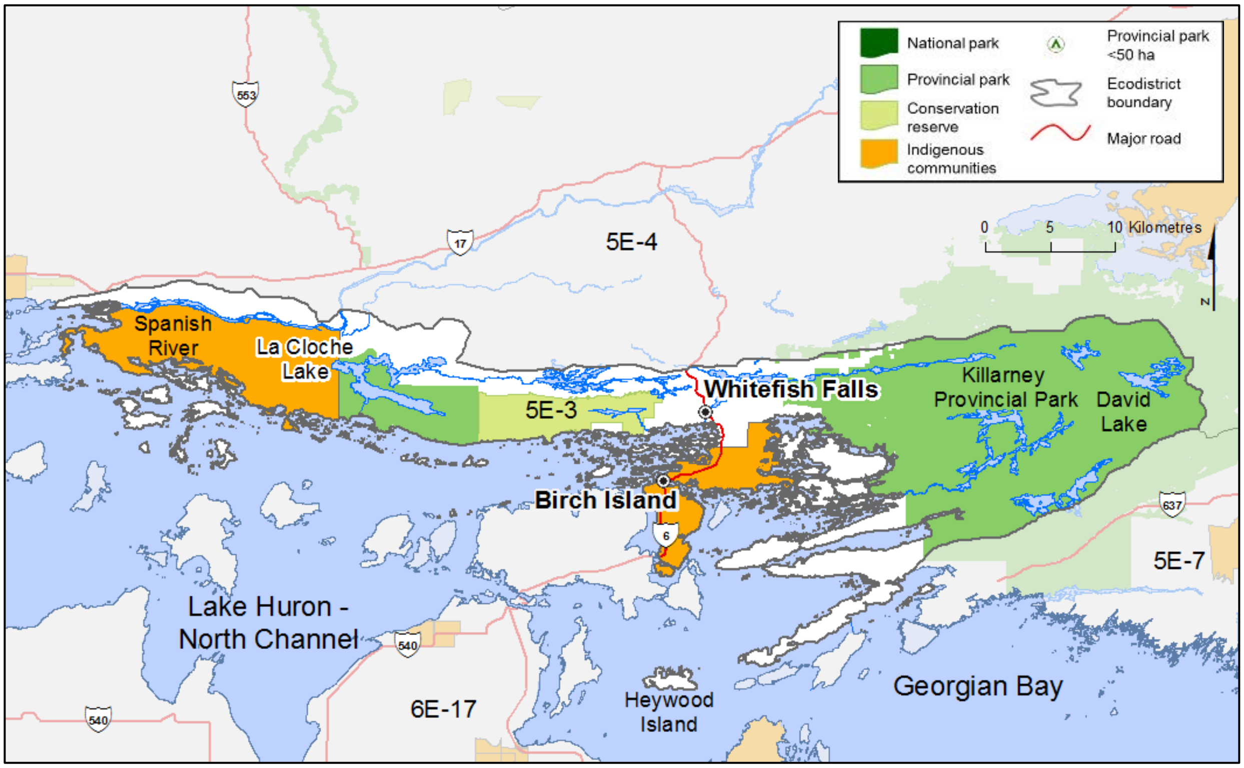


Figure 284. Select communities, natural heritage areas, major roads, and waterways in Ecodistrict 5E-3.

Ecodistrict boundary delineation

In general, the La Cloche Ecodistrict is distinguished from neighbouring ecodistricts based on bedrock and terrain differences. Bedrock types of the Cobalt group dominate 5E-3 while Quirke Lake, Lough Lake, and Elliot Lake groups are common in 5E-4 and felsic intrusives, migmatitic rocks, and gneisses can be found in 5E-7. The northern and western boundary with 5E-4 and the eastern boundary with 5E-7 can also be characterized based on topography. The landscape in Ecodistrict 5E-3 is highly variable. It is typically undulating with significant rugged areas. Ecodistrict 5E-4 and 5E-7 are more subdued with an undulating to rolling landscape in 5E-4 and an undulating terrain in 5E-7. The southern boundary is defined by the transition from the Precambrian bedrock in 5E-3 to Paleozoic bedrock in 6E-17 and a generally cooler, wetter climate in Ecoregion 5E.

The La Cloche Mountains

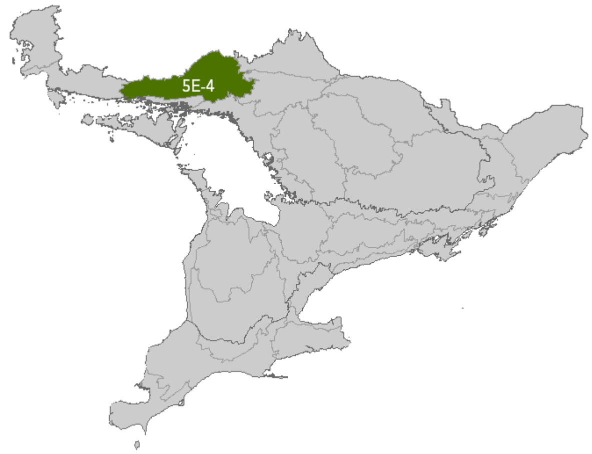
Figure 285. White quartzite ridges in Ecodistrict 5E-3. Ontario Parks.

The La Cloche Mountains consist of a range of bedrock ridges in Ecodistrict 5E-3 (Figure 285). The ancient ridges extend 24 km, parallel to Lake Huron, from Killarney Provincial Park to the Spanish River, and southwest as peninsulas towards Manitoulin Island (North-South Environmental Inc. 2003). They are composed of white quartz sand that was deposited in a shallow sea nearly 2.5 billion years ago. Approximately 6 million years later, the sand grains were compressed and heated into rock. The ridges formed during the mountain-building event called the Penokean Orogeny when the rock was folded and uplifted. It has been suggested that the La Cloche Mountains were once the height of the rocky mountains (Storck 2004).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 5E-4

Sudbury Ecodistrict



Ecodistrict 5E-4 extends from the community of Spragge in the west to the western shore of Lake Nipissing. In general, the southern boundary is south of Lake Panache; however, in the west the southern boundary is along the Lake Huron shoreline and includes several islands (e.g., John and Aird). The northern boundary occurs near the community of Capreol. The Sudbury Ecodistrict encompasses 731,332 ha (9.8% of the ecoregion, 0.7% of the province). The undulating to rolling landscape ranges in elevation from 172 m above sea level on Aird Island to 474 m above sea level east of Pecors Lake.

Figure 286. Mixed and deciduous forest along Highway 17 in the Sudbury Ecodistrict. Monique Wester, MNRF.

Key features

- Mixed and deciduous forests occur over half of the ecodistrict (Figure 286).
- Acidic Precambrian bedrock, exposed at the surface or covered by a shallow layer of mineral material, dominates.
- Includes the Sudbury Basin, a large impact crater.

Geology and substrates

Noble (1991) described the Sudbury Ecodistrict as a rolling topography of bedrock controlled uplands often alternating with an undulating landscape of linear valleys of deeper mineral material. The area is dominated by Precambrian bedrock, exposed at the surface or covered by a discontinuous shallow layer of acidic morainal material (Figure 287). Approximately

11,000 years ago (Dyke 2004), the first of several glacial lakes extended over much of the area (Lewis et al. 1994). Fluctuating water levels and wave action removed much of the mineral material. A portion of this material was deposited in depressions between bedrock outcrops. Glaciolacustrine lake bed deposits from glacial lakes Algonquin and Mattawa as well as the Nipissing Great Lakes (Lewis et al. 1994) are scattered throughout the ecodistrict. Larger accumulations occur north and south of the Spanish and Vermillion rivers and in a linear band from the community of Garson to south of the community of Lively. Glaciolacustrine deposits in the Sudbury basin, between the communities of Capreol and Chelmsford, may exceed 110 m in depth (Gartner 1980a). Several glaciolacustrine deposits are calcareous (Agriculture Canada 1983b). Relict shorelines of the glacial lakes are also evident. Glaciofluvial deposits are found in large river valleys including the Spanish and Vermillion rivers as well as along the River aux Sables. Two large glaciofluvial deposits unrelated to river valleys occur south of the community of Capreol and northeast of the community of Garson (Barnett and Bajc 1999). Organic deposits occur throughout the ecodistrict, most commonly in poorly drained areas (i.e., depression) associated with bedrock or mineral material. Deep morainal deposits can be found to the south of the community of Capreol, part of the Cartier Moraine (Boissonneau 1968), along the northern part of the Wanapitei River, and in the southwest. Larger rivers, including the Spanish, Vermillion, and Wanapitei rivers and River aux Sables, have developed alluvial deposits.

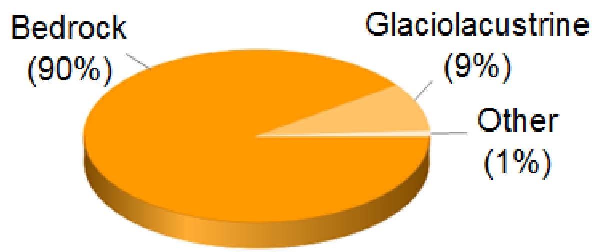


Figure 287. Modes of deposition in Ecodistrict 5E-4.

Exposed bedrock is more common on bedrock ridges and areas around the community of Sudbury that have been affected by timber harvesting, fire, and smelter fumes. The bedrock is Precambrian and typically acidic, with outcrops of base-rich material occurring in narrow linear bands throughout the area as well as in a series of dikes (i.e., the Sudbury dike swarm). Several faults forming narrow valleys or cliffs are found throughout the Sudbury Ecodistrict. Trending from the southwest to northeast, the Murray System includes the Murray, Espanola, and Lake Panache faults (Card 1978). The Grenville Front Tectonic Zone, which runs from the shore of Lake Huron to Québec, is a significant northeast trending fault zone east of the community of Sudbury that is the boundary between bedrock with major structural and age differences (Card 1978).

Most of the ecodistrict is bedrock covered by a very shallow layer of mineral material or exposed at the surface (Figure 288). Gleysols have developed under wet conditions in mineral material, typically in low-lying areas. Gray Luvisols are characteristic in fine-textured better drained mineral materials. Organic material, typically Mesisols and Humisols

(Agriculture Canada 1983b) have accumulated in wet, bedrock or mineral material depressions. Regosols are associated with active mineral material including alluvial deposits.

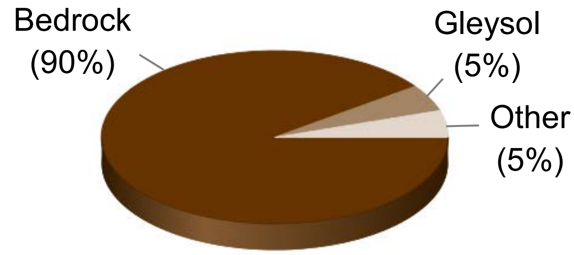


Figure 288. Substrate types in Ecodistrict 5E-4.

Land cover and vegetation

Ecodistrict 5E-4 falls within the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) associated Ecodistrict 5E-4 with the Sudbury-North Bay Section (L.4e) of the Great Lakes-St. Lawrence Forest Region. Mixed forests predominate throughout the area (Figure 289). Tree species typically include trembling aspen, paper birch, large-toothed aspen, jack pine, eastern white pine, and red pine. Sparse forests are common, growing where mineral and organic materials have accumulated in bedrock cracks and crevices. Deciduous forests of trembling aspen and paper birch occur on deeper morainal material. Sugar maple, red maple, northern red oak, American beech, American basswood, and yellow birch are limited. Bur oak may be found on dry upland sites or with silver maple, green ash, black ash, American elm, and balsam poplar adjacent to river banks (Kershaw and Hawes 1999). Bare bedrock is found intermittently in Ecodistrict 5E-4, occurring in a mosaic with sparse and open treed systems. Coniferous forests of red pine and eastern white pine, eastern hemlock, and spruce/pine complexes occur on upland sites especially in the east. Lowland areas provide habitat for black spruce, American larch, and eastern white cedar. A small part of the landscape, typically on glaciolacustrine material, has been cleared for agriculture. Bog and fen complexes occur in low-lying areas associated with organic material. Marsh ecosystems may be found adjacent to lakes, rivers, and streams. The presence of meadow and shrub communities is typically related to the renaturalizing of abandoned agricultural fields.

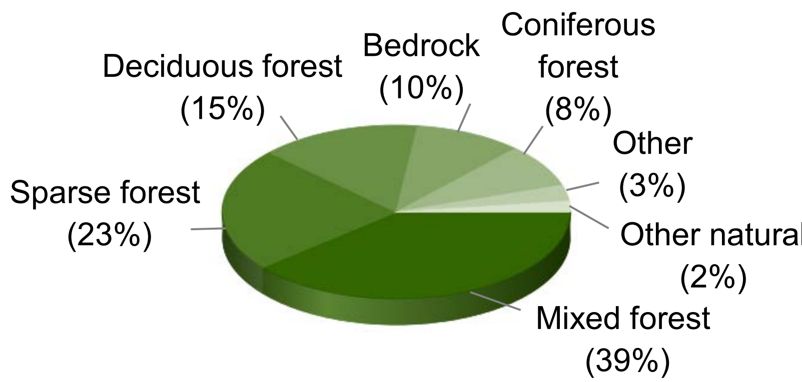


Figure 289. Land cover types in Ecodistrict 5E-4.

Prior to 1970, extensive areas of native vegetation in the Sudbury Ecodistrict were destroyed or significantly reduced by timber harvesting, fire, and smelter fumes. Subsequent erosion (e.g., rain, wind) has decreased the substrate depth, exposing more bedrock. This disturbance resulted in hardy pioneer species such as paper birch and trembling aspen dominating the landscape (Figure 290), with stunted northern red oak and red maple occurring on upland sites. Several pollution abatement and rehabilitation activities including liming, native species seeding, and tree planting have been completed (Winterhalder 1996).

Figure 290. Stunted paper birch and trembling aspen in a fume kill area near the City of Sudbury. Monique Wester, MNRF.

Increased plant species diversity may occur in areas of base-rich bedrock or calcareous mineral material where the availability of nutrients in the substrate is greater. Plant species near their northern ranges in the Sudbury Ecodistrict include northern dewberry (Soper and Heimburger 1982) and New York fern (Flora of North America Editorial Committee 1993+).

Land use

Mining, mineral exploration, timber harvesting, fishing, hunting, agriculture, aggregate extraction, hydroelectric generation, and services associated with resource-based activities occur in the ecodistrict. Approximately 1% of the land base is devoted to settlement and associated infrastructure, including the communities of Sudbury, Chelmsford, Lively, Espanola, Spragge, Capreol, and Hagar (Figure 291). Protected areas encompass approximately 4.2% of the ecodistrict.

Ecodistrict boundary delineation

Ecodistrict 5E-4 shares a boundary with seven other ecodistricts. To the north, the ecoregional boundary with 4E is strongly correlated with ecoregional climatic variables — 5E is warmer; elevation — 5E on average has a lower elevation; and geological differences — the primary bedrock in 5E is from the Proterozoic Eon (less than 2.5 billion years old) compared with 4E where the bedrock is from the Archean Eon (more than 2.5 billion years old). The western boundary with 5E-1 is generally defined on climatic differences at the ecodistrict scale. The effect of the Great Lakes diminishes eastward from 5E-1 to 5E-4. Ecodistrict 5E-4 is cooler and drier than 5E-1. The southwestern boundary includes several islands (e.g., John and Aird) in the North Channel of Lake Huron. In the southeast, the landscape transitions from an undulating to rolling topography in 5E-4 to an undulating terrain with significant rugged areas in 5E-3 and an undulating environment in 5E-7. The boundary with 5E-5 reflects the change from shallow morainal material and cooler temperatures in 5E-4 to deeper glaciolacustrine material in the western part of 5E-5 and warmer temperatures. Shallow mineral material in 5E-4 helps to distinguish it from the deep mineral material in 5E-6.

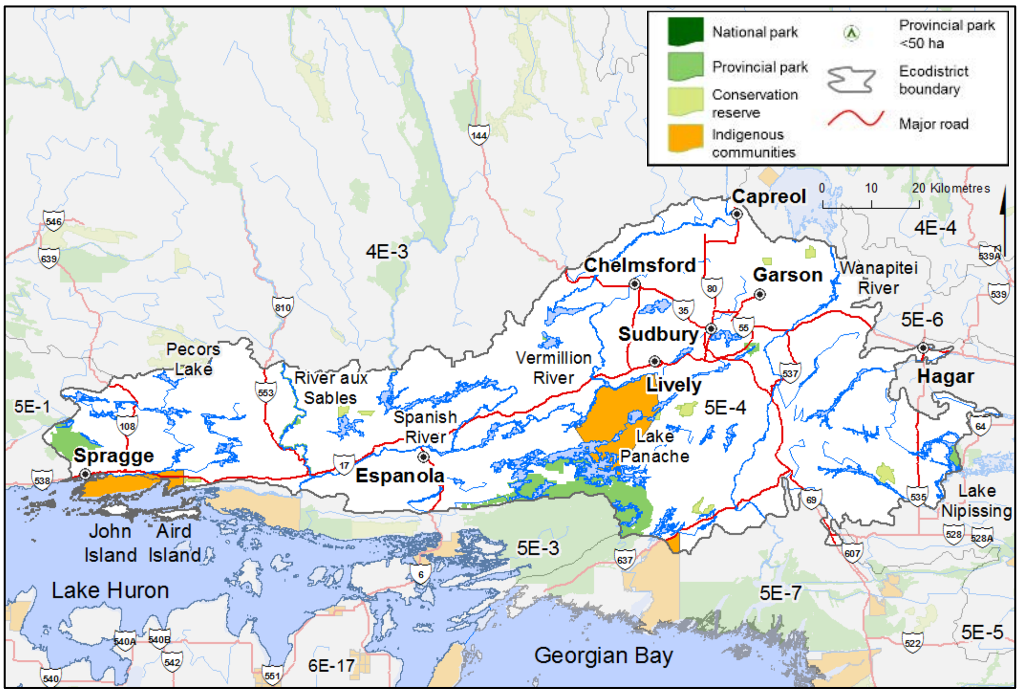


Figure 291. Select communities, natural heritage areas, major roads, lakes, and rivers in the Ecodistrict 5E-4.

The Sudbury Basin

Approximately 1,850 million years ago, the Sudbury Basin was formed. The elliptical structure, 150 to 260 km in diameter, is the second largest known impact crater on the planet (Figure 292). Based on its size and the distribution of debris, it is theorized that an asteroid or more likely a comet hit the site (Petrus et al. 2015). Following the impact, melted rock and explosion-related debris partially filled the crater. Molten material, rich in metals, including nickel and copper, sank to the crater floor. Geological processes further shaped and eroded the area (NRCan and OGS 2015). A large concentration of mines occurs along the edge of the basin, and some agricultural areas have been developed on deeper sediment in the basin.

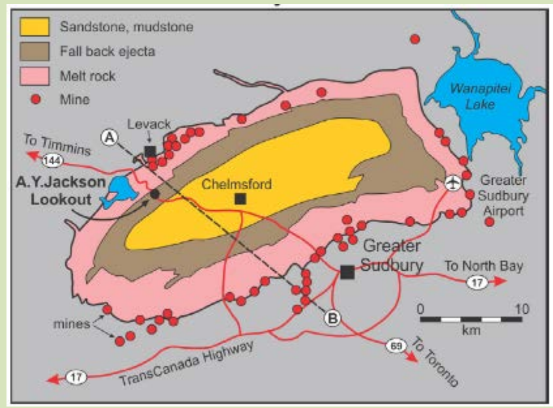
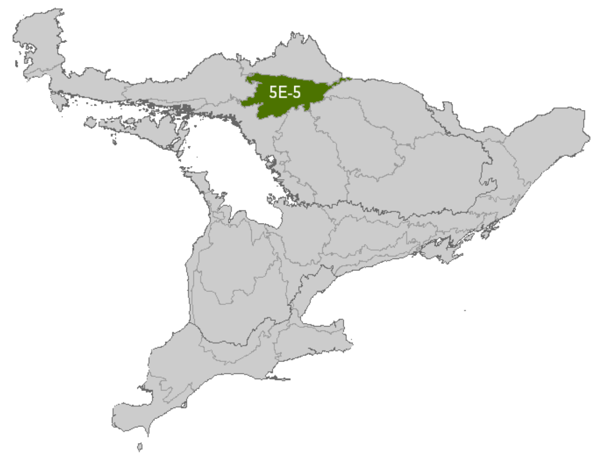


Figure 292. Sudbury Basin (NRCan and OGS 2015).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 5E-5

North Bay Ecodistrict



Encompassing 511,764 ha (6.9% of the ecoregion, 0.5% of the province), the North Bay Ecodistrict extends from the community of Ouellette in the west to the Ontario-Québec border near the community of Mattawa in the east. The Veuve River and Lake Nipissing are at the northern boundary. Kawigamog Lake and the community of Port Loring are in the south. Ecodistrict 5E-5 ranges in elevation from 154 m above sea level along the Ottawa River near the Ontario-Québec border to 430 m above sea level southeast of Lake Nosbonsing.

Figure 293. Mixed forests near the community of Powassan. Monique Wester, MNRF.

Key features

- Nearly half of the land base is covered by mixed forests (Figure 293).
- Bedrock with a discontinuous layer of shallow mineral material dominates.
- Location of the Fossmill and North Bay outlets — major drainage pathways for glacial Lake Algonquin and the Nipissing Great Lakes.

Geology and substrates

The North Bay Ecodistrict is characterized by large areas of wave-washed bedrock, with a discontinuous layer of shallow, acidic mineral material, and deeper deposits of morainal and glaciolacustrine materials (Figure 294). Approximately 11,000 years ago (Dyke 2004), the land base was first inundated by glacial Lake Algonquin (Heath and Karrow 2007) followed by the Nipissing Great Lakes (Noble 1991). Fluctuating lake levels and wave action washed mineral material from the Precambrian bedrock, depositing it in lower lying areas. Higher elevations unaffected by the glacial lakes retained a deeper layer of morainal material. Deeper deposits of coarse-textured morainal material also occur in the east, associated with the Rutherglen Moraine south of the community of Rutherglen, the Genesse Moraine, 15 km east of the community of Powassan, and a third moraine west of the community of Powassan (Gartner 1980b). The undulating topography of Ecodistrict 5E-5 is accentuated by these moraines as well as several faults. Several steep-sided valleys containing rivers and lakes are associated with the faults. Two larger faults include the Mattawa River Fault, which extends from Lake Nipissing along the Mattawa Valley to the community of Mattawa, and the Nipissing Fault that passes through the community of Powasson (Lumbers 1971). These faults are part of the western extension of the Ottawa-Bonnechere Graben (Lumbers 1971). The Mattawa River Fault includes Paleozoic (i.e., limestone) outliers that are found in Lake Nipissing. Additional outcrops of base-rich bedrock are limited to some of the islands in Lake Nipissing, the east shore of Lake Nipissing near the community of Callander, and small areas north of Kawigamog Lake and near Pautois Creek.

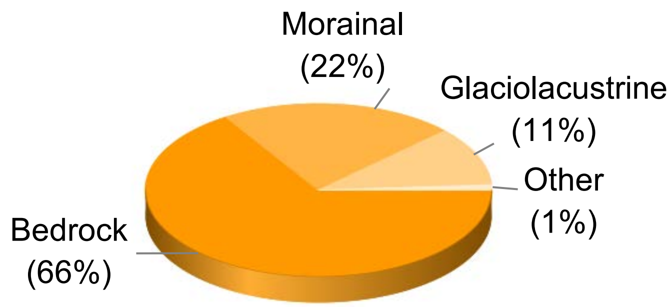


Figure 294. Modes of deposition in Ecodistrict 5E-5.

Glaciolacustrine deposits consist of fine-textured lake bed sediment and relict beaches from glacial Lake Algonquin and the Nipissing Great Lakes. Lake bed deposits occur to the east and southwest of Lake Nipissing and stretch from the north-central shore of Lake Nipissing to the community of Warren. Several of the glaciolacustrine deposits are calcareous (Agriculture Canada 1986). In the east, the glaciolacustrine sediments are intermixed with morainal and glaciofluvial deposits. During the time of the Nipissing Great Lakes, the Mattawa Valley carried the entire surface water flow discharge from the upper Great Lakes to the Ottawa River. Evidence of a much larger river is seen in scoured, bare rock walls and glaciofluvial boulder pavements (Chapman 1975). Glaciofluvial deposits (e.g., eskers and outwash plains) are correlated with the Rutherglen and Genesse moraines. The northern portion of a 160 km long esker starts west of the community of Rutherglen and extends into Ecodistrict 5E-8 (Chapman 1975). Organic deposits are found throughout the area, but are particularly evident along the western shore of Lake Nipissing. Larger river valleys including the Veuve and South rivers contain alluvial deposits. Lacustrine deposits occur adjacent to parts of Lake Nipissing.

Due to the influence of glacial lakes, areas of bedrock with a discontinuous layer of shallow mineral material dominate (Figure 295). Exposed bedrock is common along the French River and west of Lake Nipissing. Mineral material was eroded from these areas as large quantities of water passed from the glacial lakes to the east. Humo-Ferric Podzols have developed in coarse-textured mineral material, typically morainal and glaciofluvial deposits, on better drained sites. Gleysols have developed in fine-textured, glaciolacustrine material with poor drainage. Organic deposits are typically Mesisols and are limited to bedrock and mineral material depressions across the landscape. Regosols occur in areas of active mineral material including the shore of Lake Nipissing and river valleys.

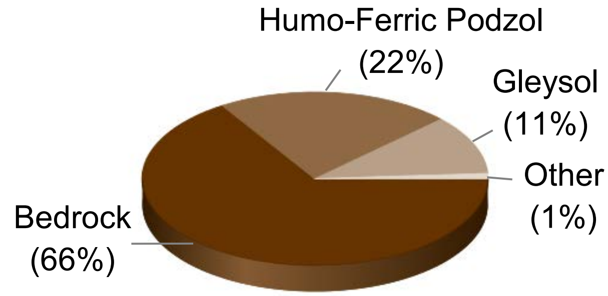


Figure 295. Substrate types in Ecodistrict 5E-5.

Land cover and vegetation

The North Bay Ecodistrict is found within the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) associated most of the ecodistrict with the Sudbury-North Bay Section (L.4e) of the Great Lakes-St. Lawrence Forest Region. Southern portions, including Restoule Lake and the communities of Ouelette and Port Loring, are located in the Georgian Bay Section (L.4d). Lake Nipissing occupies nearly a quarter of the land base. Mixed forests growing sugar maple, American beech, American basswood, red maple, yellow birch, eastern hemlock, and eastern white pine dominate (Figure 296). Associated species include eastern hop-hornbeam, balsam fir, paper birch, trembling aspen, large-toothed aspen, white spruce, and black spruce. Eastern white pine, red pine, jack pine, and northern red oak occur on dry bedrock ridges and shallow coarse-textured mineral material. Red spruce is an infrequent species of the mixed forests around North Bay reaching its northern and western limits in the area. In poorly drained areas common mixed forest tree species include black ash, black spruce, eastern white cedar, and American larch. Deciduous forests dominated by sugar maple are common in the south, and trembling aspen and paper birch are frequently found in areas previously harvested or burned. On wetter, nutrient rich sites American elm, black ash, and balsam poplar may occur. Green ash, silver maple, bur oak (Kershaw 2005), black cherry, and white ash are limited.

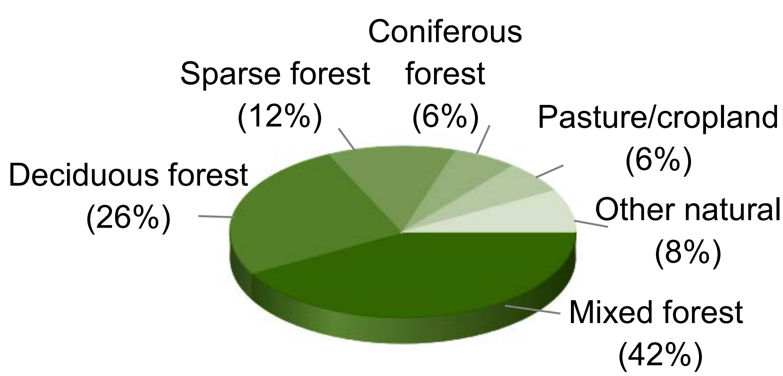


Figure 296. Land cover types in Ecodistrict 5E-5.

Sparse forests of eastern white pine, red pine, and jack pine are commonly associated with very shallow mineral material particularly along the French River. Upland coniferous forests with eastern hemlock occur on fresh sites, and jack pine forests occur on flat areas between bedrock outcrops. Cooler, wetter areas support plant species more commonly associated with the boreal vegetation zone (e.g., black spruce, American larch, and balsam fir; Brunton 1979). Pasture and cropland are common on fine-textured mineral material, particularly in the east and west. Bog and fen complexes have developed in low-lying areas where organic material has accumulated. These communities are particularly evident south of Lake Nipissing where a mosaic of upland bedrock and lowland wetlands can be found. Bare bedrock is limited to areas southwest and east of Lake Nipissing. Abandoned agricultural fields have renaturalized forming shrub and meadow ecosystems. Marshes may occur in embayments and quiet areas associated with lakes and rivers (Figure 297). Several lakes south of Lake Nipissing (Bakowsky 2015, MNRF, pers. comm.) may contain marsh communities with Atlantic coastal plain species including Virginia meadow-beauty and bog yellow-eyed-grass (Reznicek 1994).

Figure 297. Loudon Peatland, Mashkinonje Provincial Park. Ed Morris, Ontario Parks.

In Ecodistrict 5E-5, several plant species with western and eastern affinities occur in areas near the shorelines of former glacial Lake Algonquin. As the glaciers melted, spillways carried water east to the Champlain Sea in the Ottawa Valley, providing a corridor for the dispersal of plants between these separate geographic areas (Noble 1991). Brunton (1979) noted the western species prairie cordgrass and woodland pinedrops as well as the eastern species clustered sedge and slender water-milfoil. Several plant species occur near their northern limits due to the modifying influence of Georgian Bay, including downy rattlesnake-plantain and northern maidenhair fern (Brunton 1979). In areas with base-rich bedrock or calcareous mineral material where the availability of substrate nutrients is higher plant species diversity may increase.

Land use

Land uses in Ecodistrict 5E-5 include timber harvesting, aggregate extraction, hydroelectric generation, agriculture, mineral exploration, fishing, hunting, and services associated with resource-based activities. Approximately 1% of the land base is devoted to settlement and associated infrastructure, including the communities of North Bay, Sturgeon Falls, Powassan, Mattawa, Rutherglen, Ouellette, and Port Loring (Figure 298). Nearly 6.6% of the ecodistrict has been designated as protected areas.

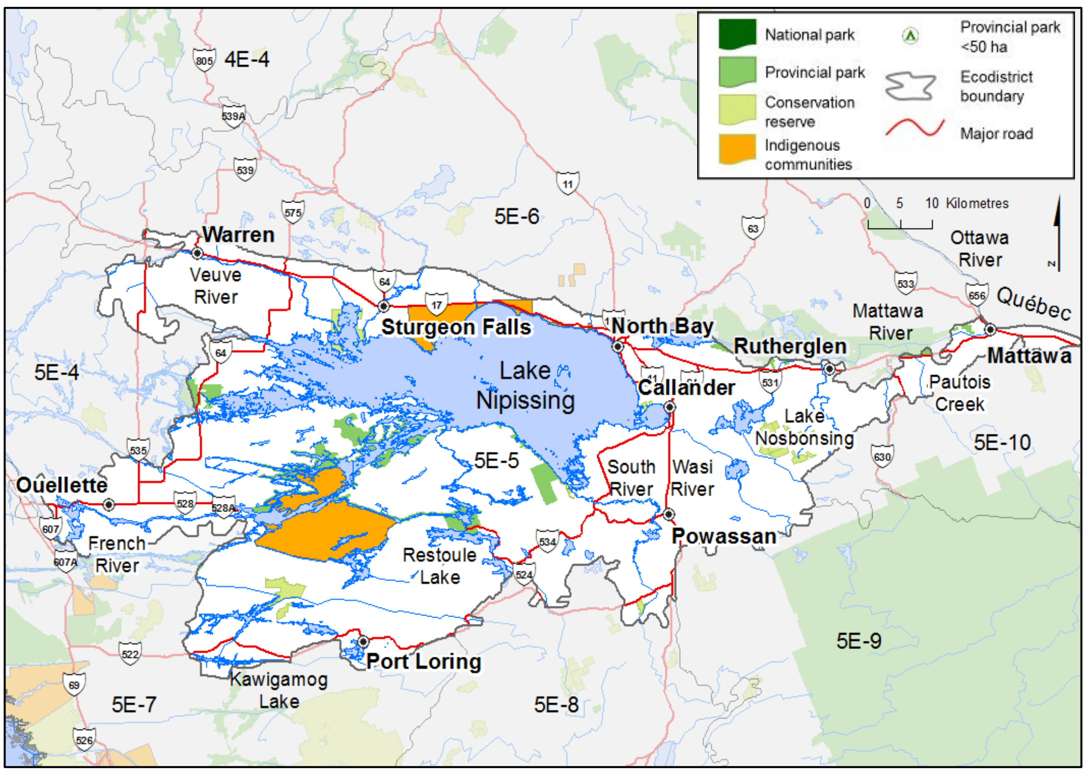


Figure 298. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-5.

Ecodistrict boundary delineation

The western boundary with 5E-4 is defined by warmer temperatures and the transition of deeper glaciolacustrine material in the western part of 5E-5 to cooler temperatures and shallow morainal material in 5E-4. In the north, the Nipissing Escarpment forms a physical boundary between 5E-5 and 5E-6 and the topography in 5E-5 is flatter than that in 5E-6.

Ecodistrict 5E-5 also has large areas of exposed bedrock and deep glaciolacustrine material, unlike 5E-6 where the bedrock is typically covered by a moderate layer of mineral material with areas of deeper glaciofluvial deposits. Ecodistrict 5E-5 is bound in the east by the border with Québec. The boundaries with 5E-8, 5E-9, and 5E-10 were established in part to reflect the change from an undulating topography in 5E-5 to a rolling landscape with more changes in elevation including areas of rugged terrain. The Ontario Climate Model (OMNR 2000) also indicated that 5E-5 was cooler than 5E-7 and 5E-8, warmer than 5E-9, and wetter with a shorter growing season than 5E-10.

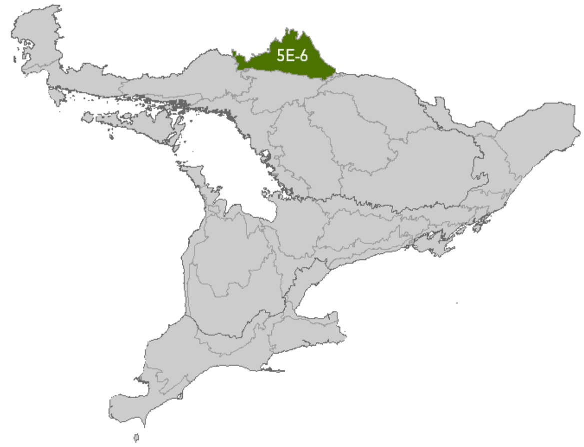
The drainage of glacial lakes

As the ice sheet melted in central Ontario, a large glacial lake — glacial Lake Algonquin — was formed. In addition to covering present day Lake Michigan, Lake Huron, and Georgian Bay, the glacial lake covered the land in between the lakes and extended east of Georgian Bay (Figure 299; Heath and Karrow 2007). As the glacier retreated, an outlet was uncovered at Fossmill, along the Wasi River, east of Powassan. This new drainage channel carried a large volume of water east through the Petawawa and Barron river valleys to the Champlain Sea. With continued melting of the ice sheet, the drainage path shifted to the North Bay outlet creating the Nipissing Great Lakes. Water flowed through the outlet to the Mattawa and Ottawa river valleys leaving behind bare rock walls and boulder pavements well above the present river (Chapman and Putnam 1984).

Figure 299. Glacial Lake Algonquin nearly 10,500 years ago (Adapted from Heath and Karrow 2007).

Ecodistrict 5E-6

Tomiko Ecodistrict



Ecodistrict 5E-6 extends from the community of Markstay, east to the Ottawa River and the Ontario-Québec border. The approximate northern and southern limits coincide with Mackenzie Lake and the Mattawa River, respectively. The Tomiko Ecodistrict encompasses 518,194 ha (7.0% of the ecoregion, 0.5% of the province). It ranges in elevation from 177 m above sea level near the Mattawa River to 474 m above sea level, northwest of the community of Redbridge.

Figure 300. Mixed forests of Mattawa River Provincial Park. Ontario Parks.

Key features

- Mixed forests occur over half of the ecodistrict (Figure 300).
- Undulating to rolling Precambrian bedrock with a discontinuous layer of moderate mineral material dominates.
- Large organic accumulations on glaciofluvial deposits are common.
- Red spruce can be found.

Geology and substrates

Glaciation and the processes associated with the subsequent deglaciation of Ecodistrict 5E-6 have shaped the current landscape. As the ice advanced, a discontinuous, moderate layer of morainal material was deposited, dominating the ecodistrict (Figure 301). The underlying Precambrian bedrock is typically acidic; however, a small area of base-rich bedrock occurs in the northwest. The terrain is generally undulating to rolling. More rugged topography is associated with numerous faults that control most of the existing drainage patterns (Gartner 1980c). In the south, the Mattawa River follows the Mattawa River Fault, part of the western extension of the Ottawa-Bonnechere Graben (Lumbers 1971).

During deglaciation, the ice front briefly halted in several locations creating moraines and associated glaciofluvial features across the land base. In the northeast, a large glaciofluvial outwash plain is associated with the McConnell Lake Moraine. Similar deposits also occur southeast of Red Cedar Lake and north of Trout Lake, where two smaller morainal systems can be found. Glaciofluvial deposits are also found in river valleys associated with remnant glacial spillways, while kames and eskers occur throughout the ecodistrict. Coarse-textured morainal deposits associated with the McConnell Lake Moraine and two smaller moraines occur in the north and southeast.

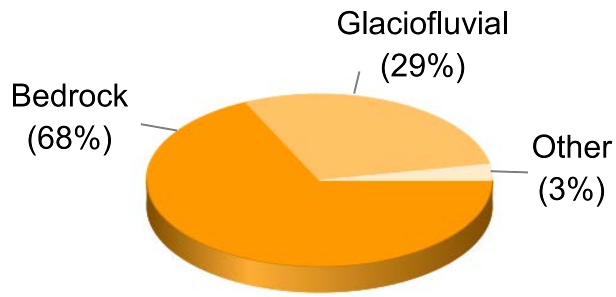


Figure 301. Modes of deposition in Ecodistrict 5E-6.

Nearly 11,000 years ago (Dyke 2004), glacial Lake Algonquin inundated the southwestern corner of the ecodistrict. Glaciolacustrine material including fine-textured lake bed sediment and relict shorelines that define successive former lake levels (Noble 1991) can be found southwest of the Sturgeon River. Calcareous mineral material may be associated with glaciolacustrine materials (Agriculture Canada 1983b). Organic deposits typically occur in low-lying areas between bedrock ridges however, larger organic accumulations can overlie glaciofluvial and aeolian deposits (Bergsma 1995). Ridges of aeolian deposits may also be found along the western part of the Jocko River (Ontario Parks 2006). Bedrock exposures are more common in rugged areas. Alluvial deposits occur along creek and river systems including Antonie Creek as well as the Sturgeon and Jocko rivers.

The dominant substrate type in the Tomiko Ecodistrict is bedrock (Figure 302). The Precambrian bedrock is typically covered by a moderate, discontinuous layer of mineral material. Humo-Ferric Podzols have developed in glaciofluvial and morainal deposits in well drained areas. Organics, typically Mesisols and Humisols (Agriculture

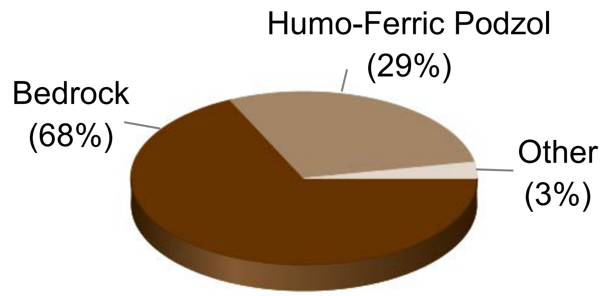


Figure 302. Substrate types in Ecodistrict 5E-6.

Canada 1983b), have accumulated in wetter areas. The Osborne Township Patterned Peatland along the western part of the Jocko River and the Little Jocko River wetland are examples of large organic accumulations on glaciofluvial and aeolian material (Bergsma 1995). Gleysols are limited across the land base and have generally developed in poorly drained fine-textured glaciolacustrine material. Exposed bedrock with a discontinuous layer of very shallow mineral material is more common along the Mattawa and Ottawa rivers. Regosols can be found in active mineral material adjacent to creek and river systems.

Land cover and vegetation

Ecodistrict 5E-6 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018). The eastern portion is also found in the Algonquin-Pontiac Section (L4.b) and in the west, the Sudbury-North Bay Section (L4.e) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). In the east, boreal species are more prevalent, often mixed with characteristic species of the temperate vegetation zone (Rowe 1972). Mixed forests grow on over half of the ecodistrict (Figure 303). Common tree species include trembling aspen, large-toothed aspen, paper birch, jack pine, balsam fir, sugar maple, yellow birch, eastern hemlock, northern red oak, black spruce, white spruce, eastern hop-hornbeam, and red maple. American beech, American elm, black cherry, green ash, and American basswood occur, but are less common (Brinker et al. 2005). Black ash is a common associate with black spruce in low-lying areas. Red spruce, which has a limited distribution in Ontario, is found in the mixed forests in the east.

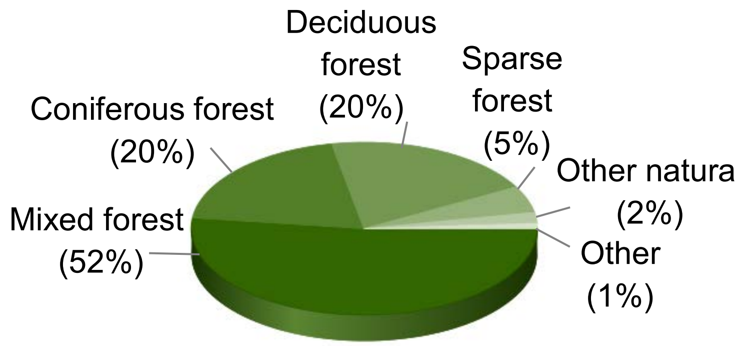


Figure 303. Land cover types in Ecodistrict 5E-6.

Coniferous and deciduous forests are common in the eastern portion of the ecodistrict. Coniferous forests of eastern white cedar, American larch, and black spruce grow in wetter areas. On shallow substrates jack pine is more common. Eastern white pine and red pine typically occur as scattered forests, remnants of fire and past forestry practices (Rowe 1972) These species can be found along the river channel in the Mattawa River valley (Brinker et al. 2005). Old growth eastern white pine and red pine forests may occur in the north (OMNR 2009b). Deciduous forests typically occur on deeper mineral material as a mix of tree species. Forests dominated by sugar maple occur in the southeast. On wet sites, tree species may include silver maple, bur oak, balsam poplar, and green ash (Bergsma 1995).

Sparse forest grow throughout the ecodistrict, primarily on rock outcrops with shallow mineral material interspersed with exposed bedrock. Common tree species include eastern white pine, red pine, black spruce, jack pine, and northern red oak. Bog and fen complexes are restricted to low-lying wet areas with organic accumulations. Marsh communities may be associated with lakes and rivers including Rice Bay at the west end of Talon Lake and the Jocko River (Bergsma 1995). Agricultural areas are commonly associated with glaciolacustrine deposits in the west especially near the Sturgeon River.

Ecosystems in the Tomiko Ecodistrict may contain a diverse array of plant species. The Mattawa River, a major spillway during deglaciation, served as a pathway for the dispersal of plants between the east and west (Figure 304). Species with eastern affinities found in the area include lakecress and cardinalflower (Bergsma 1995). Hobblebush and common elderberry occur near their northern distribution (Soper and Heimburger 1982). Increased plant species diversity may occur in areas of base-rich bedrock or calcareous mineral material where nutrient availability is high.

Figure 304. Talon Chutes, Mattawa River. Sandy Dobbyn, Ontario Parks.

Land use

Timber harvesting, aggregate extraction, hydroelectric generation, mineral exploration, fishing, hunting, and services associated with resource-based activities predominate in Ecodistrict 5E-6. Settlement and associated infrastructure for the communities of Markstay, Marten River, Field, River Valley, Thorne, and Redbridge occupy less than 1% of the land base (Figure 305). Protected areas encompass nearly 8% of the ecodistrict.

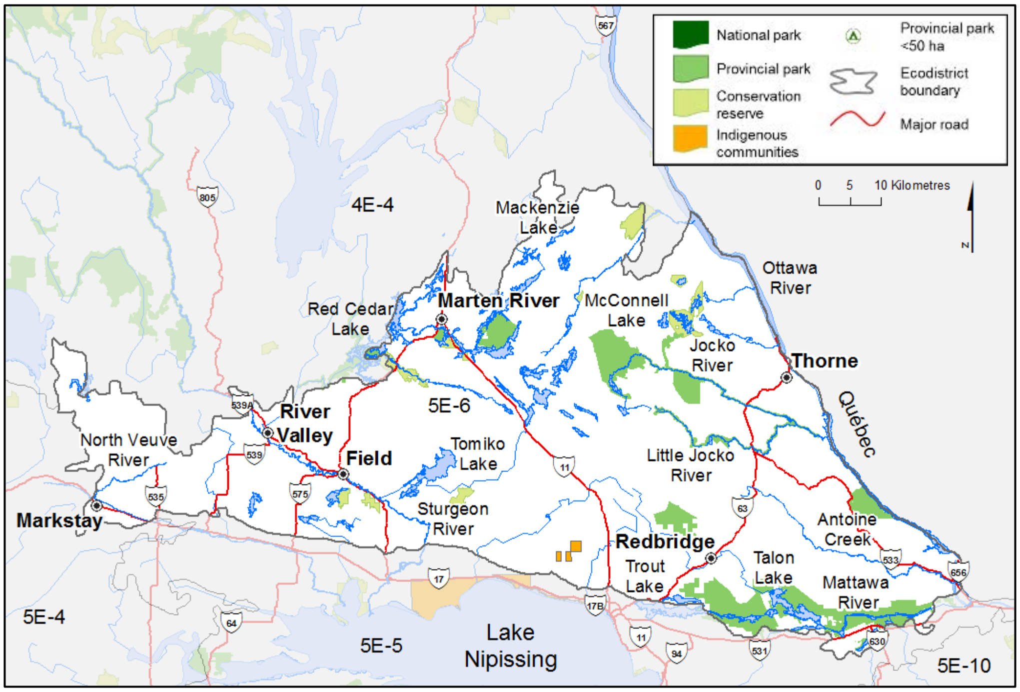


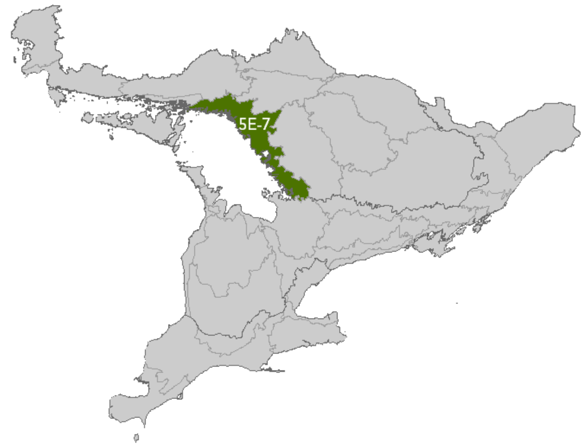
Figure 305. Select communities, natural heritage areas, major roads, lakes, and rivers in the Ecodistrict 5E-6.

Ecodistrict boundary delineation

The ecoregional boundary with Ecoregion 4E to the north reflects differences in ecoregional climatic variables, elevation, and geology. Ecoregion 5E is warmer, typically at a lower elevation, and the primary bedrock is less than 2.5 billion years old (from the Proterozoic Eon) compared with 4E where the bedrock is older than 2.5 billion years (from the Archean Eon). Ecodistrict 5E-6 is bound in the east by the Ottawa River and the border with Québec. The Nipissing Escarpment forms a physical boundary in the south between 5E-6 and 5E-5. In addition, 5E-6 generally has a moderate layer of mineral material with areas of deeper glaciofluvial deposits, while the mineral material over bedrock in 5E-5 is thinner and large areas of exposed bedrock and deeper glaciolacustrine material are common. The topography in 5E-6 is more uneven than that in 5E-5. The transition from 5E-6 to 5E-4 highlights differences in mineral material depth, where 5E-6 is typically moderate and 5E-4 is shallow.

Ecodistrict 5E-7

Parry Sound Ecodistrict



The Parry Sound Ecodistrict is located along the shore of Georgian Bay and extends approximately 20 km inland except in the north where it extends about 60 km to Chartier Lake. The communities of Alban and Port Stanton occur near the northern and southern boundaries, respectively. Ecodistrict 5E-7 encompasses 625,998 ha (8.4% of the ecoregion, 0.6% of the province) and includes several islands such as Limestone and Western. It ranges in elevation from 172 m above sea level along the shoreline of Georgian Bay to 436 m above sea level northeast of the community of Killarney.

Figure 306. Mixed forests in the southern portion of the Parry Sound Ecodistrict. Sandy Dobbyn, Ontario Parks.

Key features

- One-third of the land base is covered by mixed forests (Figure 306).
- Discontinuous layer of very shallow to moderate morainal material over Precambrian bedrock dominates.
- Includes Paleozoic outliers.
- Atlantic coastal plain flora, such as branched bartonia, occur here.

Geology and substrates

The Parry Sound Ecodistrict is characterized as a complex mosaic of morainal deposits overlying and intermixed with exposed bedrock and accumulations of organic material. The distinctive pattern of bedrock terrain is associated with the narrow strip along the Great Lakes shoreline and includes a network of islands, islets, inlets, and peninsulas (Noble 1991). Acidic morainal deposits of variable depth dominate the landscape (Figure 307; Brunton 1993a). Deeper deposits occur in the east, near the community of Parry Sound, and in the south (Brunton 1993a). These sites typically occur on higher ground, unaffected by glacial Lake Algonquin that inundated the area nearly 11,000 years ago (Dyke 2004) followed by the Nipissing Great Lakes. Wave action and fluctuating glacial lake levels washed off most surface material exposing bedrock or leaving a very shallow layer of mineral material. Bedrock is more common along the Georgian Bay shoreline, on bedrock ridges, as well as in the north especially around the French River. The bedrock is typically Precambrian and acidic. Small areas of Paleozoic outliers are located on the Limestone Islands and in the south. Bands of base-rich Precambrian bedrock are found near the eastern boundary and south and east of the community of Parry Sound (Brunton 1993a). A series of faults influence the drainage pattern and add relief to the typically gently rolling landscape. The Grenville Front Tectonic Zone is a significant northeast trending fault zone that runs from the Lake Huron shoreline through Carlyle Lake to Québec (Card 1978). Several east-west trending faults occur as straight narrow valleys associated with rivers and streams (Chapman 1975) including the French, Magnetawan, and Shawanaga rivers or as narrow bays or inlets extending many kilometres inland of Georgian Bay (Dobbyn 2017, Ontario Parks, pers. comm.).

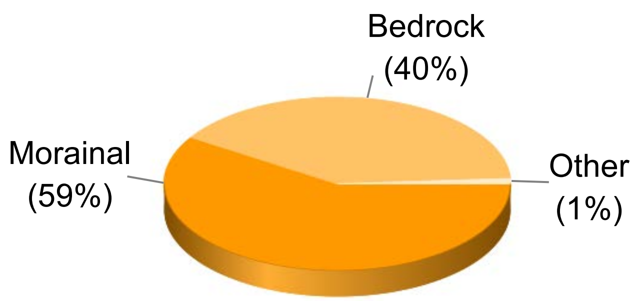


Figure 307. Modes of deposition in Ecodistrict 5E-7.

Glaciolacustrine deposits are limited across the ecodistrict. These lake bed remnants of glacial Lake Algonquin and the Nipissing Great Lakes often occur in bedrock depressions or valleys. Occurrences of calcareous mineral material may occur in the south (Hoffman et al. 1962). Glaciofluvial deposits are restricted to some of the larger river valleys. Organic deposits occur in low-lying areas where water has accumulated. These deposits are often between bedrock outcrops overlying glaciolacustrine and glaciofluvial deposits.

Substrate types are dominated by Humo-Ferric Podzols and bedrock (Figure 308). Humo-Ferric Podzols have developed in coarse-textured, well drained morainal deposits. Bedrock, exposed at the surface or covered by a discontinuous layer of very shallow mineral material, is more common in areas adjacent to Georgian Bay as well as in the northern portion of the ecodistrict. Gleysols occur in poorly drained mineral material. Organic material, typically Mesisols, have accumulated in bedrock depressions forming a mosaic of bare bedrock and wetlands.

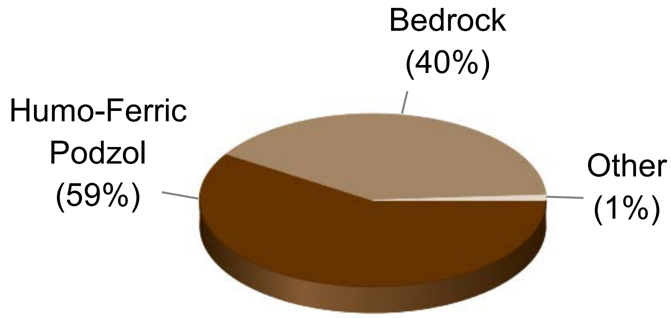


Figure 308. Substrate types in Ecodistrict 5E-7.

Land cover and vegetation

Ecodistrict 5E-7 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Georgian Bay Section (L.4d) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Mixed forests of sugar maple, American beech, American basswood, yellow birch, eastern hemlock, eastern white pine, red maple, and white ash dominate upland sites (Figure 309). Jack pine, trembling aspen, northern red oak, paper birch, and black spruce mixed forests occur on bedrock with a discontinuous layer of very shallow mineral material. In wet areas, red maple, black ash, balsam poplar, American elm, silver maple, and eastern white cedar are common associates. Sparse forests occur on bedrock where vegetation is limited to cracks where mineral or organic materials have accumulated. The eastern white pine, red pine, jack pine, and northern red oak that occur on these sites are typically stunted and often are the result of fire. Deciduous forests are more common on deeper mineral material in the south and east. Green ash, white oak, bur oak, butternut (Henson and Brodribb 2005), and black cherry occur in limited amounts.

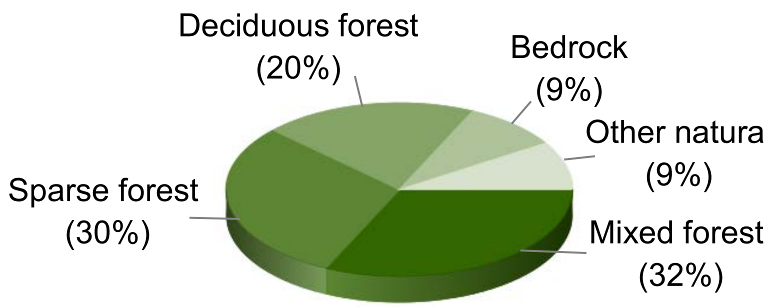


Figure 309. Land cover types in Ecodistrict 5E-7.

Bedrock is more frequent in the west and north. This area is characterized by ridge and trough topography with exposed bedrock on the ridges and wetlands in the troughs (Figure 310; Noble 1991). Coniferous forests are scattered throughout the area. White spruce grows on deeper glaciolacustrine and morainal deposits, and the abundance of eastern hemlock increases near Georgian Bay. Eastern white pine, jack pine, and red pine dominate shallow morainal material. Old growth forests of eastern white pine and red pine are typically restricted to islands. Rocky ridges adjacent to Georgian Bay may support eastern red cedar

(Hanna 1979). In poorly drained areas, black spruce and American larch are common. Wetland communities include marshes as well as bog and fen complexes. Marshes occur throughout the ecodistrict and have developed along the Georgian Bay shoreline. Agriculture is limited to fine-textured mineral material typically found in valleys. Forest fires are generally low intensity occurring over short intervals (Van Sleeuwen 2006). However, relative to adjacent ecodistricts, large areas of shallow mineral material and bedrock terrain increase the incidence of periodic, extensive fires.

Figure 310. Bedrock controlled topography of Northern Georgian Bay Shoreline and Island Conservation Reserve. Sam Brinker, MNRF

The vegetation in Ecodistrict 5E-7 is influenced by the moderating conditions of Georgian Bay. Increased air humidity, precipitation, cooler springs, and an extended summer growing season have enabled some species (e.g., woodland sunflower, eastern buttonbush; Hanna 1979) to extend their ranges farther north. Atlantic coastal plain species including Virginia meadow-beauty, branched bartonia, and bog yellow-eyed-grass (Henson and Brodribb 2005) and species with western affinities (e.g., western fescue) occur along the shoreline (Noble 1991). Hanna (1979) noted several species approaching their southern limits in 5E-7, including alternate-flowered water-milfoil and water lobelia. Along Georgian Bay, stunted and wind-swept pine trees grow along with species that are specifically adapted to the harsh conditions of immediate shoreline areas (e.g., eastern ninebark and Kalm's St. John's-wort, Noble 1991). The shoreline also supports species endemic to the Great Lakes such as stiff yellow flax (Henson and Brodribb 2005). An increase in substrate nutrients associated with Paleozoic outliers and base-rich Precambrian bedrock may increase plant species diversity. Calciphiles found in the ecodistrict include Crawe's sedge, spring forget-me-not, and small skullcap (Korol 2003b).

Land use

Settlement and associated infrastructure occupy less than 1% of the ecodistrict and include the communities of Parry Sound, Bayfield Inlet, Port Stanton, Nobel, Alban, and Killarney (Figure 311). Land use in the Parry Sound Ecodistrict is primarily recreational. In addition, the provision of services for resource-based tourism, timber harvesting, hydroelectric and wind power generation, and aggregate extraction occur. Agriculture is limited by the lack of available mineral material. Approximately 27.4% of the ecodistrict comprises protected areas.

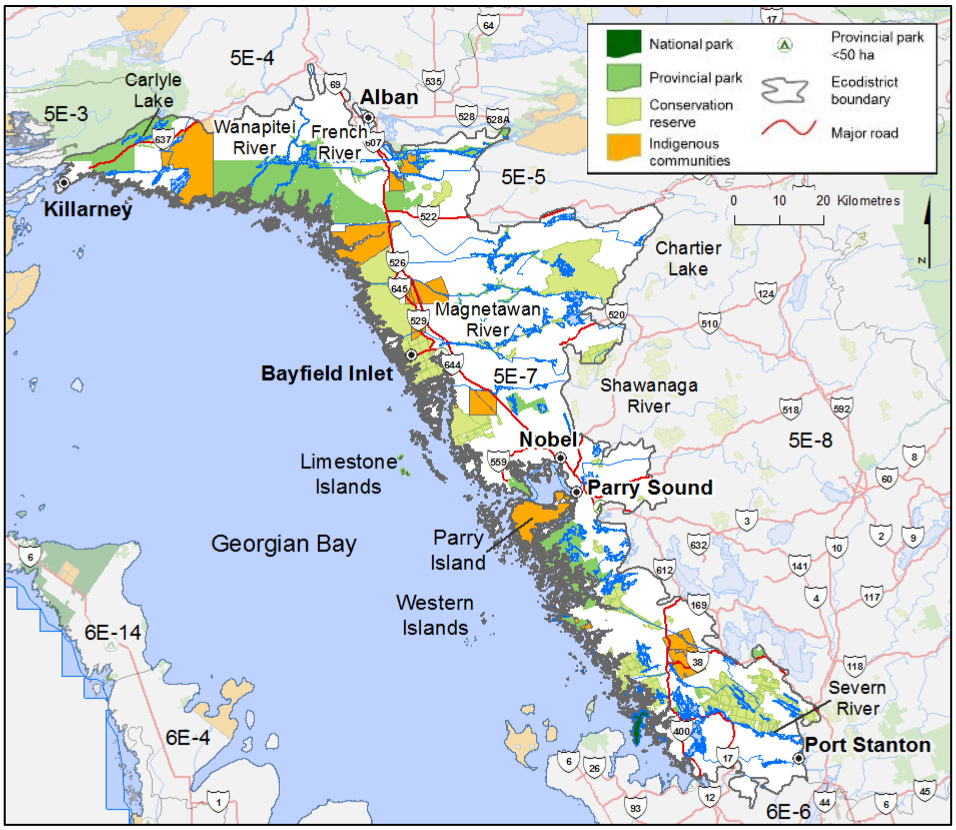


Figure 311. Select communities, natural heritage areas, major roads, and rivers in Ecodistrict 5E-7.

Ecodistrict boundary delineation

The northwestern boundary with Ecodistrict 5E-3 is defined by the transition from an undulating topography in 5E-7 to a highly variable landscape, generally characterized as undulating with significant rugged areas, in 5E-3. Bedrock differences are also seen. In 5E-7 felsic intrusives, migmatitic rocks, and gneisses dominate while in 5E-3 bedrock types of the Cobalt group are common. Topographic changes also help differentiate 5E-7 and 5E-4. Ecodistrict 5E-7 is classified as undulating while 5E-4 is undulating to rolling with more changes in elevation. In the west, the Ontario Climate Model (OMNR 2000) identified that 5E-7 was warmer than 5E-5 and 5E-8. The southern boundary with 6E-6 reflects ecoregional temperature, precipitation, and bedrock differences. Ecoregion 5E is cooler and wetter than Ecoregion 6E, and the underlying bedrock is Precambrian compared with Paleozoic bedrock in the south. The western boundary includes the adjacent islands in Georgian Bay.

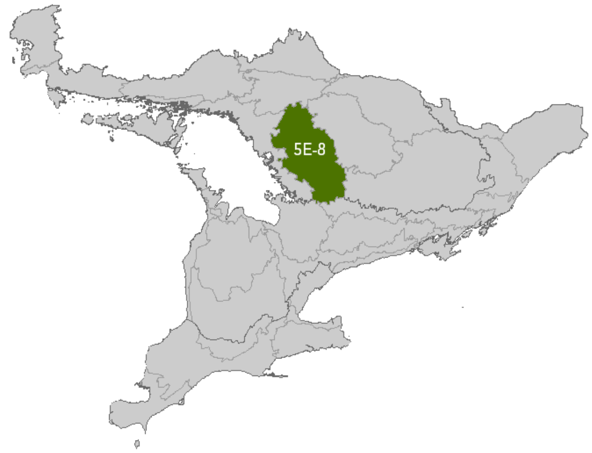
Georgian Bay Biosphere Reserve

Found along the eastern shore of Georgian Bay in Ecodistrict 5E-7, the Georgian Bay Biosphere Reserve is home to a diverse array of ecosystems (GBBR 2017). The ecosystems are a result of glacial history and current ecological conditions including topography, substrates, vegetation, and proximity to Lake Huron. The area is home to wetlands, bedrock, and upland forests. The contiguous nature and variety of ecosystems provide distinct habitats that support the highest concentration of reptiles and amphibians in Canada (Jalava et al. 2005) including the Massasauga rattlesnake (Figure 312).

Figure 312. Massasauga rattlesnake. Sandy Dobbyn, Ontario Parks.

Ecodistrict 5E-8

Huntsville Ecodistrict



The Huntsville Ecodistrict extends from the community of Otter Lake in the west to the eastern shore of Lake of Bays. Encompassing 847,130 ha (11.4% of the ecoregion, 0.9% of the province), the northern limit occurs near the community of Commanda and extends south to the community of Washago. The elevation rises from 194 m above sea level near the community of Otter Lake to 523 m above sea level west of Sand Lake.

Figure 313. Sugar maple dominated forest north of the community of Huntsville. Peter Uhlig, MNRF.

Key features

- Sugar maple deciduous forests dominate the landscape (Figure 313).
- Variable depths of acidic morainal materials are common.
- Paleozoic outliers occur.
- Atlantic coastal plain flora found along the shore of many lakes.
- Includes relict shorelines of glacial Lake Algonquin.

Geology and substrates

The Huntsville Ecodistrict is an undulating to rolling landscape underlain by Precambrian bedrock. Additional landscape relief occurs through a series of east-west and northeast-southwest trending faults (Brunton 1993b). The terrain, particularly in the west, has been heavily influenced by glacial Lake Algonquin that inundated the area about 11,000 years ago (Dyke 2004). As the land emerged from underneath the ice, morainal material was deposited. The area was then submerged under the glacial lake, which removed or reworked much of the material through wave action and fluctuating lake levels. The western portion of the ecodistrict is characterized by a mosaic of bedrock ridges with a discontinuous, shallow layer of morainal material, bare bedrock, and pockets of deeper glaciolacustrine sediment. In the east, mineral material deposits are moderately deep and the bedrock dominated landscape is less extensive (Noble 1991). Areas of acidic, morainal material of variable depth, generally shallow to moderately deep, dominate the ecodistrict (Figure 314). Several glaciolacustrine features occur in the east along the Highway 11 corridor from the community of Commanda to Washago. This area approximately coincides with a series of relict shorelines from glacial Lake Algonquin that mark the eastern extent of the glacial lake (Noble 1991). Deeper glaciolacustrine materials are associated with glacial lake bed sediment. Fine-textured glaciolacustrine deposits are typically calcareous (Brunton 1993b).

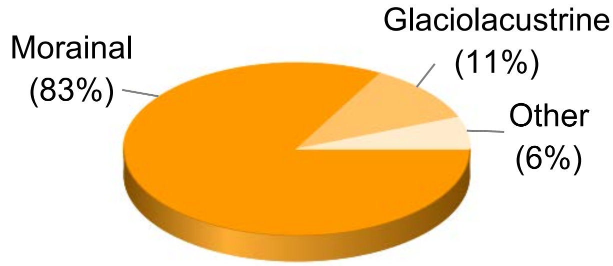


Figure 314. Modes of deposition in Ecodistrict 5E-8.

Most of the ecodistrict was covered by the shallow waters of glacial Lake Algonquin. In the south and low-lying areas in the west, deeper water removed more of the morainal material leaving behind bare bedrock ridges (Brunton 1993b). The bedrock is generally Precambrian; however, Paleozoic outliers are present near the southern boundary and Skeleton Lake. The outliers at Skeleton Lake may be the result of a meteorite impact crater created during the Early Paleozoic (Bajc 1994). The Precambrian bedrock is generally acidic however, a band of base-rich bedrock occurs between the communities of Otter Lake and Commanda and small pockets are scattered throughout the ecodistrict.

Glaciofluvial features are generally restricted to the eastern portion of the ecodistrict, where streams entered glacial Lake Algonquin from higher ground farther east depositing sediment. In this area, morainal covered bedrock ridges occur between glaciofluvial and glaciolacustrine deposits, representing historic islands in glacial Lake Algonquin. Chapman (1975) noted that the southern portion of a 160 km long esker that starts in Ecodistrict 5E-5 terminates near the community of Washago. Organic deposits are restricted to depressions in bedrock or mineral material where water accumulates. Several larger organic deposits occur in the central and eastern portion of the ecodistrict, north of Skeleton Lake, along the Magnetawan River, and east of the community of Bracebridge. Deposits of alluvial sediment occur along major waterways including the Black and Big East rivers (Bajc 1994).

The dominant substrate type in the Huntsville Ecodistrict is Humo-Ferric Podzol (Figure 315). This substrate type has developed in well drained coarse-textured morainal, glaciolacustrine, and glaciofluvial material. Exposed bedrock is prevalent in the south. In well drained fine-textured sites Gray Brown Luvisols have developed, while in poorly drained fine-textured sites Gleysols are common. Melanic Brunisols have developed in base-rich glaciofluvial deposits. Organic accumulations are typically Mesisols, located in low-lying wet areas. Regosols are associated with alluvial mineral material.

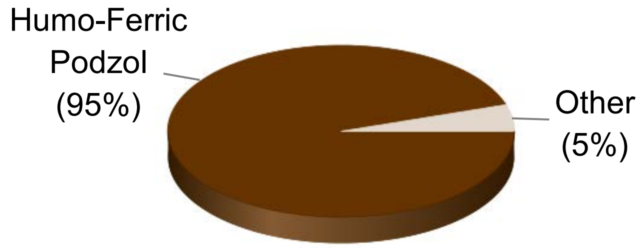


Figure 315. Substrate types in Ecodistrict 5E-8.

Land cover and vegetation

Associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Georgian Bay Section (L.4d) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972), most of Ecodistrict 5E-8 is covered by deciduous and mixed forests (Figure 316). Sugar maple forests dominate in the east on deeper mineral material, and aspen-paper birch forests prevail in the north. Common associates in deciduous forests include northern red oak, red maple, yellow birch, American beech, American basswood, and eastern hop-hornbeam. Black cherry, white oak, white ash, bur oak, and butternut (Henson and Brodribb 2005) can also occur. In wet areas, black ash, red maple, balsam poplar, and occasionally silver maple, green ash, and American elm grow. In mixed forests, common conifer tree species include eastern hemlock, eastern white pine, red pine, white spruce, and balsam fir. American larch, black spruce, and eastern white cedar are more common in low-lying habitats. Eastern hemlock and eastern white cedar are frequent components of mixed forests on cooler-than-normal, moist sites and adjacent to lakes. Sparse forests are more common in the western and southern portions of the ecodistrict in areas with bare bedrock. These dry environments typically support eastern white pine, red pine, jack pine, and northern red oak. Coniferous forest are scattered throughout the landscape. In the east, white spruce forests occur on deeper mineral material. North of Lake Rosseau, old growth eastern white pine forests can be found.

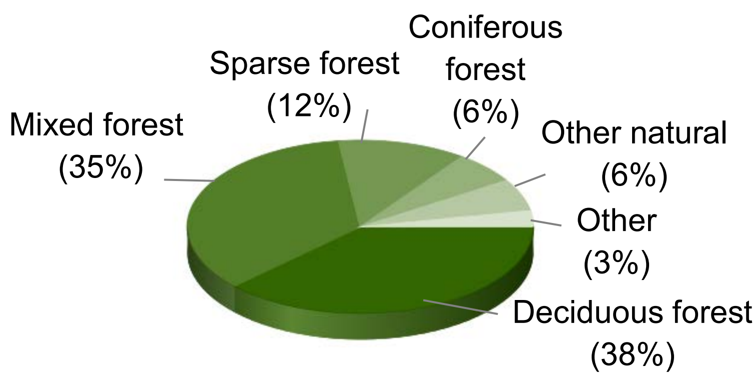


Figure 316. Land cover types in Ecodistrict 5E-8.

Agricultural activities occur on deeper mineral material across the ecodistrict, but are more prominent along the Highway 11 corridor (Brunton 1993b) associated with glaciolacustrine deposits. Wetlands, including bog and fen complexes (Figure 317), and marshes occur in bedrock depressions. Marshes also occur adjacent to lakes in quiet embayments. Extensive wetlands predominantly occur on low-lying glaciolacustrine deposits in the central portion of the area. Bedrock outcrops occur in the south and west.

Figure 317. Sedge fen, Kahshe Lake Barrens Conservation Reserve. Sam Brinker, MNRF.

Climatically, the Huntsville Ecodistrict is influenced by Georgian Bay in the west and the Algonquin Dome — a rugged upland area of Precambrian bedrock that reaches an elevation of 587 m above sea level (NRCan 2002) — east of Ecodistrict 5E-8. Short warm summers, long cold winters, and increased humidity affect the vegetation of the region. Species near their northern range include prickly gooseberry (Soper and Heimburger 1982) and hair-like bulbostylis (Argus et al. 1982–1987). Korol (2003a) noted the presence of Billings' sedge and New England sedge, species more commonly found in the east. Plant species with Atlantic coastal plain affinities (e.g., late-flowering muhly, bayonet rush, and little floatingheart; Keddy 1981) grow along the shoreline of several lakes. Increased plant species diversity may occur in areas of Paleozoic, Precambrian base-rich bedrock, or calcareous mineral material where soil nutrient availability is higher.

Land use

Approximately 1% of the land base is devoted to settlement and associated infrastructure. Communities located in the ecodistrict include Huntsville, Bracebridge, Gravenhurst, Sundridge, Otter Lake, Bala, Washago, and Commanda (Figure 318). Recreation and the provision of services for resource-based tourism, agriculture, timber harvesting, hydroelectric generation, aggregate extraction, and mineral exploration occur across the landscape. Approximately 8% of the ecodistrict has been designated as protected areas.

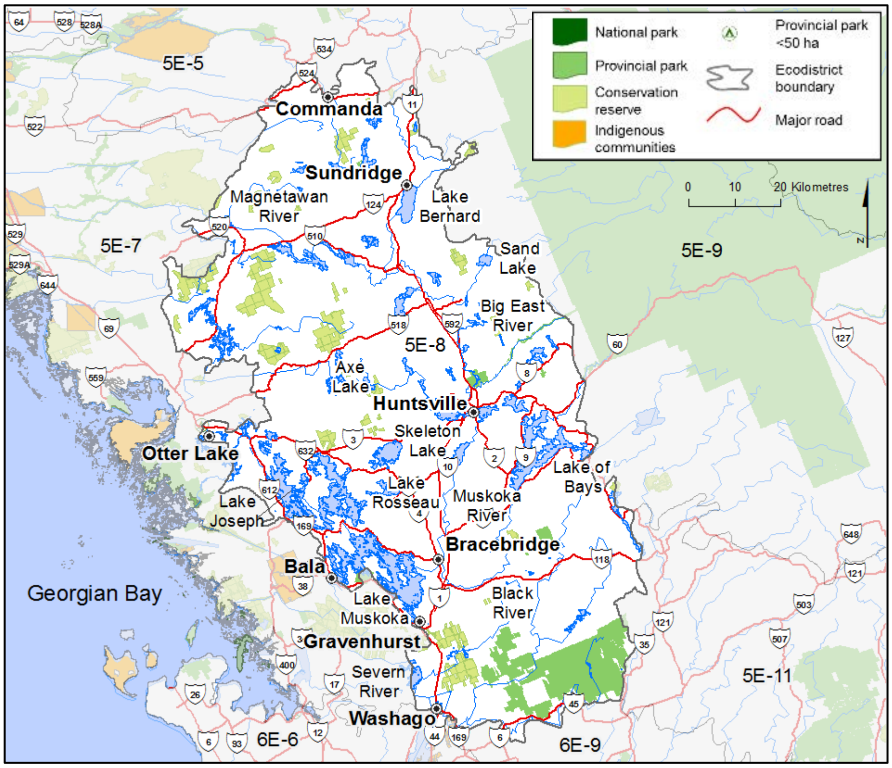


Figure 318. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-8.

Ecodistrict boundary delineation

The Ontario Climate Model (OMNR 2000) was used in part to define the western, northern, and eastern boundaries of 5E-8. In general, 5E-8 is cooler than 5E-7 and to the north, a warmer temperature regime occurs in 5E-8 compared with 5E-5 (OMNR 2000). In addition, rolling topography is more common in 5E-8 while 5E-5 is characterized by an undulating landscape. The eastern boundary with 5E-9 reflects a warmer climate and a lower elevation in 5E-8. The southwestern boundary with 5E-11 is defined by a cooler climate in 5E-8 and major changes in bedrock types. Ecodistrict 5E-8 is dominated by acidic bedrock typically from the Mesoproterozoic era (0.9 to 1.6 billion years ago). Ecodistrict 5E-11 is characterized by younger base-rich carbonate and mafic bedrock from the Neo- to Mesoproterozoic era (0.57 to 1.6 billion years ago). The southern boundary with 6E-6 and 6E-9 is based on ecoregional bedrock, temperature, and precipitation differences. The underlying bedrock in 5E is Precambrian compared with Paleozoic bedrock to the south. Ecoregion 5E is also cooler and wetter than Ecoregion 6E.

Atlantic Coastal Plain flora

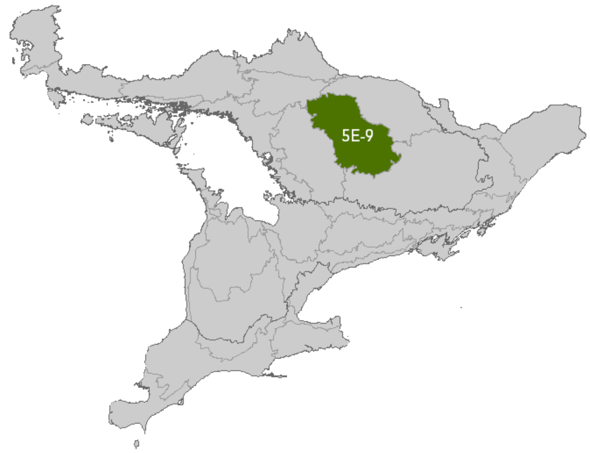
Approximately 11,000 years ago (Dyke 2004), glacial lake Algonquin extended from the current shore of Georgian Bay inland to the community of Bracebridge. The ice sheet to the north prevented the flow of water through the Petawawa and Mattawa rivers. At this time the glacial lake drained southeast into glacial Lake Iroquois (present day Lake Ontario) through the Hudson River to the Atlantic, facilitating the movement of flora from the Atlantic coast to central Ontario. As water levels in glacial Lake Algonquin decreased, lakes with Atlantic coastal plain flora were left behind. Plants with affinities to the Atlantic coastal plain that occur in Ontario today include Virginia meadow-beauty (Figure 319), bog yellow-eyed-grass (Figure 320), and bayonet rush (Keddy 1981).

Figure 319. Virginia meadow-beauty. Sam Brinker, MNRF.

Figure 320. Bog yellow-eyed-grass. Sam Brinker, MNRF.

Ecodistrict 5E-9

Algonquin Park Ecodistrict



Ecodistrict 5E-9 encompasses 876,360 ha (11.8% of the ecoregion, 0.9% of the province). It extends from the community of Kiosk in the north, to the community of Wilberforce in the south. The eastern boundary includes the west side of Bark Lake and extends to the community of Dorset in the west. The highest point (587 m above sea level, NRCan 2002) in the ecodistrict is located south of Opeongo Lake. The lowest point (258 m above sea level) occurs in the northwest along McGillvary Creek.

Figure 321. Forested landscape of Algonquin Provincial Park. Ontario Parks.

Key features

- Deciduous and mixed forests dominate the landscape (Figure 321).
- Variable depths of acidic morainal deposits are common.
- Contains the “Algonquin Dome”, an elevated area of Precambrian bedrock.
- Includes the western half of Algonquin Provincial Park — the first provincial park in Ontario.

Geology and substrates

The bedrock controlled landscape of the Algonquin Park Ecodistrict is underlain by Precambrian bedrock covered by a variable layer of morainal material (Figure 322).

Deposited by glaciers as they moved across the area, the morainal deposits are acidic and typically shallow to moderately deep. Areas of bare bedrock are common at higher elevations where the glacier was thinner and less morainal sediment was deposited. Faulting (e.g., Nipissing and Smoke Lake faults) occurs throughout the ecodistrict, adding more relief to the generally rolling terrain. Faults strongly affect the drainage pattern and size and shape of lakes and rivers. Deeper morainal deposits occur west of Opeongo and Burntroot lakes as well as in the southeastern corner of the ecodistrict where drumlins can be found. The occurrence of glaciofluvial features (e.g., eskers, outwash) are linked to bedrock topography (Ford and Geddes 1986). Glaciofluvial deposits commonly occur in linear topographic formations such as river valleys associated with faults. Larger rivers including the Madawaska and Petawawa are remnant glacial spillways (Guillet 1969). Two larger north-south trending eskers occur west of the community of Madawaska and west of North Tea Lake.

Figure 322. Modes of deposition in Ecodistrict 5E-9.

Areas of typically acidic bare bedrock and very shallow mineral material are more common in the south. Bands of base-rich bedrock also occur in the south. A prominent feature in Ecodistrict 5E-9 is the Algonquin Dome. This height of land, which reaches its peak near the eastern boundary, was part of an ancient mountain system that has been subsequently eroded by water, ice, and wind over billions of years. The headwaters of five major river systems are found on the dome (Guillet 1969). Organic deposits are restricted to small low-lying pockets throughout the ecodistrict, typically located in valleys associated with rivers, streams, and bedrock faults. Limited areas of glaciolacustrine deposits, commonly associated with glacial lakes, occur in the north near the community of Kiosk and in the south around Kawagama Lake (Ford and Geddes 1986). Alluvial sediment can be found along larger river systems including the Nipissing, Tim, and Madawaska rivers while lacustrine deposits are associated with larger lakes (e.g., Opeongo Lake; Ford and Geddes 1986).

Humo-Ferric Podzols are the dominant substrate type in the Algonquin Ecodistrict (Figure 323). They have developed in well drained coarse-textured material, typically associated with morainal and glaciofluvial deposits. Bedrock outcrops occur throughout the area but are more frequent in the south. Limited areas of Gray Brown Luvisols have developed in fine-textured well drained mineral material. Accumulations of organic material, typically Mesisols, are restricted to poorly drained, bedrock controlled

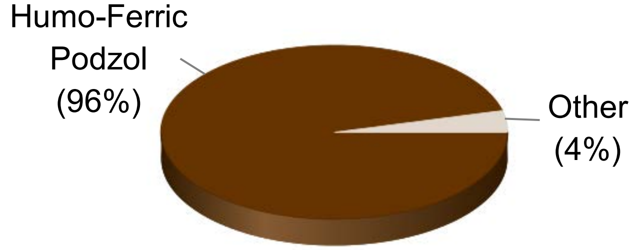


Figure 323. Substrate types in Ecodistrict 5E-9.

topography. Regosols are associated with active mineral material such as lacustrine deposits near larger lakes and alluvial deposits adjacent to rivers.

Land cover and vegetation

Ecodistrict 5E-9 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Algonquin-Pontiac Section (L.4b) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Deciduous forests of sugar maple, American beech, and yellow birch dominate on deeper substrates (Figure 324), often with large-toothed aspen, red maple, northern red oak, eastern hop-hornbeam, and black cherry. Paper birch and trembling aspen are more common on cooler-than-normal sites and in areas of disturbance. Balsam poplar, black ash, American elm, silver maple, and green ash grow along major river valleys on fresh to moist sites, and species found farther south such as American basswood, bur oak, and white ash inhabit south-facing slopes or can be found along the southern edge of the ecodistrict (Strickland 2006).

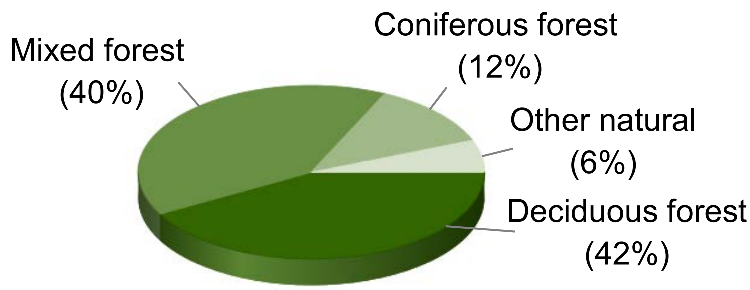


Figure 324. Land cover types in Ecodistrict 5E-9.

Upland mixed forests commonly include eastern hemlock, white spruce, and balsam fir. Eastern white pine, once characteristic of this area, occurs in limited amounts in mixed forests. Old growth forest communities have been identified southeast of the community of Dorset (OMNR 2009b, OMNR 2013b). Adjacent to lakes, mixed forests with eastern hemlock and eastern white cedar are common. Red spruce, which is more commonly found in the east, may occur along lakeshores and in moist pockets (Strickland 2006). The distribution of red spruce in Ecodistrict 5E-9 is also limited due to historical forestry practices. In lowland mixed forests, black spruce and eastern white cedar are common. Coniferous forests of eastern white pine occur on exposed cliff tops and along rocky lakeshores and islands. Lakeshores may also consist of a mix of coniferous tree species including eastern hemlock, balsam fir, and white spruce. Jack pine and red pine are scarce, favouring deeper mineral material that is limited in the area (Strickland 1996). Forests of black spruce, eastern white cedar, and American larch occur in low-lying wet areas. Sparse forests grow on very shallow mineral material, particularly in the south. Scattered across the landscape, bog and fen complexes occur in poorly drained areas (Figure 325). Marshes can be found adjacent to lakes and larger rivers.

The Algonquin Dome significantly affects Ecodistrict 5E-9 by controlling the hydrology and influencing climate, substrate development, and the distribution of vegetation communities

(Remmel 2009). The higher elevation creates a cooler and wetter environment compared to adjacent areas. On the lower slopes, species with southern (e.g., rock elm and blue cohosh) and eastern (e.g., red spruce and whorled wood aster) affinities occur (Brunton 1991a). Atlantic coastal plain flora, including Carey's smartweed and bayonet rush (Henson and Brodribb 2005) occur southeast of the community of Dorset (Bakowsky 2015, MNRF, pers. comm.). Increased plant species richness may occur in areas of base-rich bedrock where the availability of substrate nutrients is greater.

Figure 325. Forested and wetland communities in Algonquin Provincial Park. Ontario Parks.

Land use

Timber harvesting, recreation, and the provision of services for resource-based tourism are the dominant activities in Ecodistrict 5E-9. Aggregate extractions and mineral exploration may also occur. The area was first logged in the 1830s (AFA 2010) and in 1893, Algonquin Provincial Park was established and became a popular recreational area (Figure 326). Less than 1% of the land base is devoted to settlement and associated infrastructure including the communities of Whitney, Madawaska, Lake St. Peter, Dorset, Wilberforce, and Kiosk (Figure 327). Protected areas comprise approximately 51.3% of the ecodistrict.

Figure 326. Converted from a lumber company boarding house, the Mowat Lodge in Algonquin Park opened for business in 1913. Algonquin Park Museum & Archives #186, Donor O. Addison.

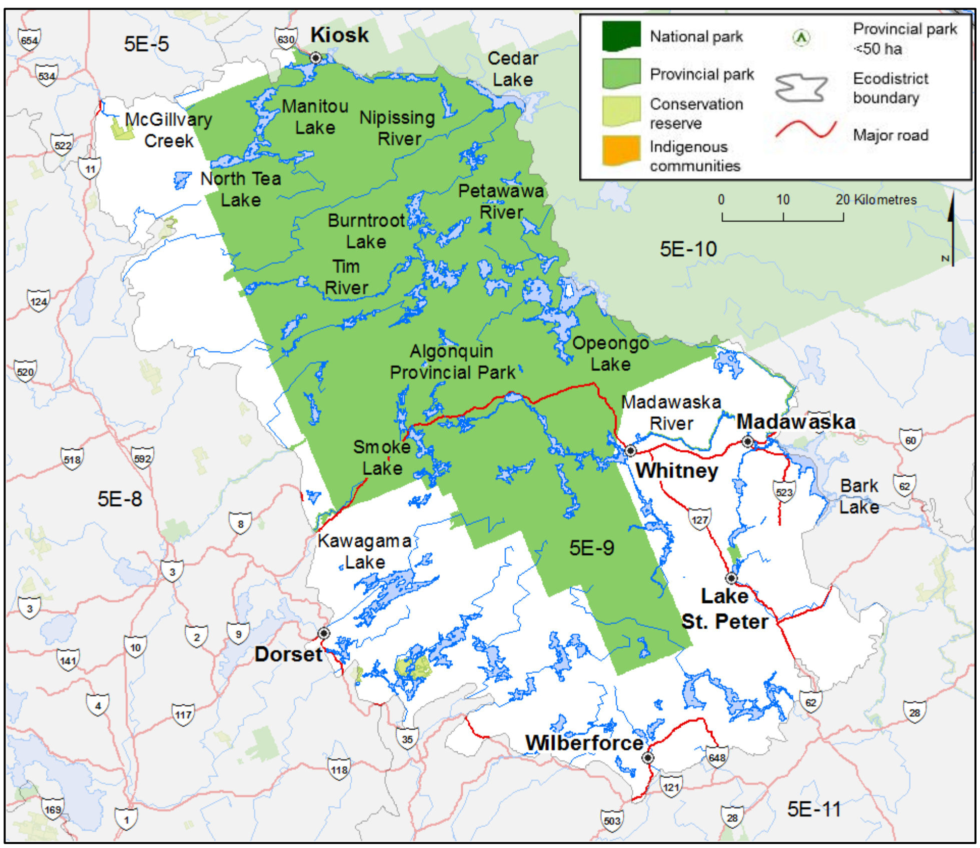


Figure 327. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-9.

Ecodistrict boundary delineation

The western boundary is defined by an increase in elevation and a cooler climate in Ecodistrict 5E-9 than 5E-8. The northern boundary with 5E-5 reflects the change from an undulating landscape in 5E-5 to a rolling terrain in 5E-9. The Ontario Climate Model (OMNR 2000) indicates that 5E-9 is cooler than 5E-5. In the east, the boundary with 5E-10 is defined by the transition from the Algonquin Dome to a lower elevation and warmer climate in 5E-10. The southeast boundary as defined by Hills (1959) has been modified. Hills (1976) and Brunton (1990b) adjusted the boundary to incorporate portions of 5E-11 where the bedrock is consistent with 5E-9. Ecodistrict 5E-9 is generally characterized by acidic bedrock from the Mesoproterozoic era (0.9 to 1.6 billion years ago) compared with the base-rich carbonate and mafic bedrock from the Neo-to Mesoproterozoic era (0.57 to 1.6 billion years ago) found in 5E-11. A warmer climate in 5E-11 also helps to define differences between 5E-9 and 5E-11.

Logging

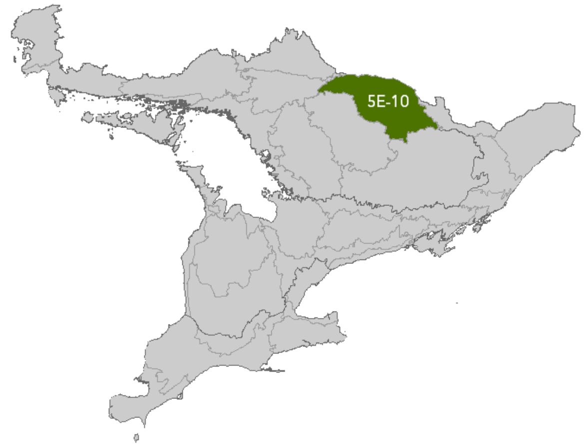
Logging in Algonquin Park began in the 1830s with the harvesting of eastern white pine and red pine to produce square timbers for export and lumber for Canadian and American markets (figures 328, 329). Trees were initially floated down many of the rivers that ran through the park including the Madawaska and Petawawa. Beginning in the 1880s, railroads were built to transport tree species that did not ‘float’ well. The railroads also opened the area for tourism and recreation. Harvesting continues in the park at a reduced volume and under the control of the Algonquin Forest Authority (AFA 2010).

Figures 328. Giant eastern white pines. MNRF.

Figure 329. Eastern white pine haul. Library and Archives Canada.

Ecodistrict 5E-10

Brent Ecodistrict



The Brent Ecodistrict extends from the Ottawa River and the border with Québec south to include the eastern portion of Bark Lake. The eastern boundary occurs near the community of Petawawa and extends to west of Highway 630. Ecodistrict 5E-10 encompasses 796,300 ha (10.7% of the ecoregion, 0.8% of the province). Its undulating to rolling topography ranges in elevation from 112 m above sea level along the shore of Allumette Lake to 546 m above sea level east of Opeongo Lake.

Figure 330. Mixed forest of Algonquin Provincial Park. Ontario Parks.

Key features

- Mixed forests occur over nearly half of the ecodistrict (Figure 330).
- Depth of morainal material overlying a Precambrian bedrock landscape varies.
- Includes the eastern half of Algonquin Provincial Park — Ontario's first provincial park.
- Brent meteorite impact crater is located here.

Geology and substrates

The Brent Ecodistrict has two distinct areas. Dominating the ecodistrict is a bedrock controlled topography overlain with an acidic, shallow to moderate layer of morainal material (Figure 331). Deeper morainal deposits including drumlins occur north of Golden Lake and east of

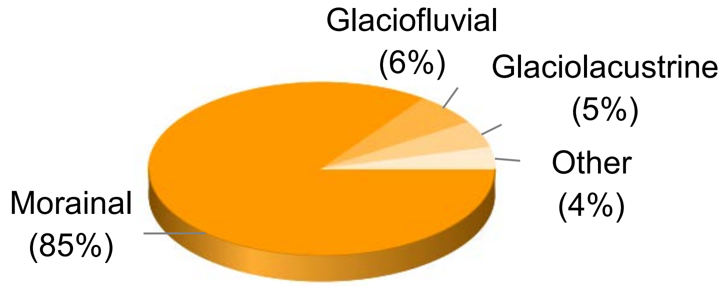


Figure 331. Modes of deposition in Ecodistrict 5E-10.

Deux Rivières Creek. The second landscape along the Ottawa River is a thin strip of glaciofluvial and glaciolacustrine sediment. The undulating to rolling terrain is broken by northwest-southeast trending faults that create a series of ridges and broad valleys. Major river systems in the ecodistrict (e.g., Petawawa, Barron, and Bonnechere) occupy these valleys. The Ottawa-Bonnechere Graben is a large rift valley that runs through this area. Historically, the drainage of glacial Lake Algonquin in Ecodistrict 5E-10 occurred mainly through Cedar Lake to the Petawawa River and the Barron River (Chapman 1975). Evidence of large amounts of water that flowed through the system is found on the scoured, bare rock walls and the presence of fields of large boulders. Glaciofluvial sediment occurs along river valleys and in the west along the edge of the Algonquin Dome. Large deposits can be found near the communities of Deep River and Petawawa. Additional glaciofluvial features include northeast-southwest trending eskers near Deux Rivières Creek and Boom Creek. Approximately 11,000 years ago (Barnett 1992), during deglaciation the Petawawa and Barron rivers emptied into the Champlain Sea, west of the community of Petawawa (Chapman 1975). As the rivers made contact with the sea, glaciofluvial and glaciolacustrine materials were deposited. Fine-textured mineral material associated with glaciolacustrine deposits also occur along the Indian River. The mineral material is generally acidic however, pockets of calcareous, typically fine-textured, material may occur including areas near Golden Lake (Gillespie et al. 1964).

Ecodistrict 5E-10 includes a small part of the Algonquin Dome that decreases in elevation from west to east. Areas of bare bedrock occur throughout the ecodistrict, especially in more rugged terrain. The bedrock is typically acidic; however, base-rich bedrock occurs along the southeastern boundary (Brunton 1991b). Paleozoic outliers occur along the shore of Cedar Lake, north of the community of Brent at the Brent meteorite crater, Greenleaf Creek south of the Barron River, and along the Barron River Canyon (Figure 332). In the southeastern portion of the ecodistrict, Paleozoic bedrock more common in Ecoregion 6E extends into the ecodistrict. In some areas, such as the Bonnechere Caves near the community of Eganville, groundwater action and precipitation have dissolved portions of the Paleozoic bedrock creating karst topography including solution caves. Organic materials have developed in low-lying areas particularly along rivers and streams. Larger organic accumulations occur in the southern portion of the ecodistrict, south and west of Golden Lake. Alluvial sediments can be found adjacent to rivers and streams including the Bonnechere River. Many lakes, including Cedar, Round, Golden, and Lavieille, contain lacustrine deposits.

Figure 332. Barron River Canyon. Hannah LaCroix.

Humo-Ferric Podzols dominate the ecodistrict, developing in coarse-textured, well drained mineral material (Figure 333). Gray Brown Luvisols have developed in base-rich fine-textured substrates in the southeast and areas of bare bedrock are more common in the west. Melanic Brunisols occur near Round Lake in base-rich coarse-textured substrates, while Gray Luvisols have developed in acidic well drained substrates in the east. Mineral materials in areas of poor drainage have developed Gleysolic profiles. Organic deposits, typically Mesisols, occur throughout the ecodistrict, developing in depressions and low-lying areas where water accumulates.

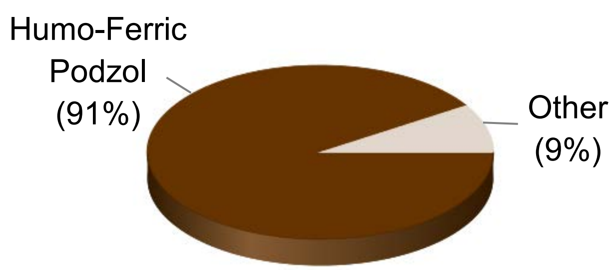


Figure 333. Substrate types in Ecodistrict 5E-10.

Land cover and vegetation

Ecodistrict 5E-10 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and two sections in the Great Lakes-St. Lawrence Forest Region. The west is represented by the Algonquin-Pontiac Section (L4.b), and the east by the Middle Ottawa Section (L4.c) (Rowe 1972). Nearly half of the ecodistrict is covered by mixed forests (Figure 334). Sugar maple, American beech, yellow birch, red maple, large-toothed aspen, eastern hemlock, eastern white pine, eastern hop-hornbeam, black cherry, northern red oak, and red pine are typical upland forest tree species. Mixed forests of trembling aspen,

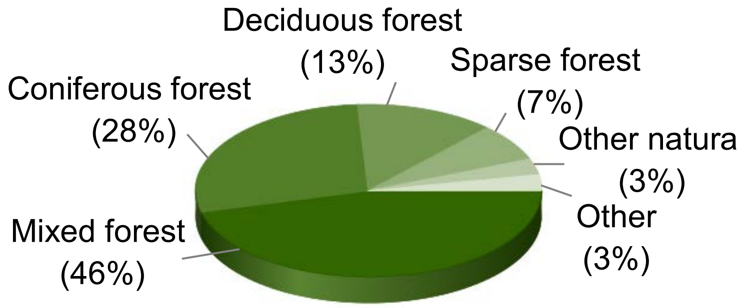


Figure 334. Land cover types in Ecodistrict 5E-10.

paper birch, eastern white pine, and red pine are more common in the north. Lowland mixed forests are generally composed of eastern white cedar, American larch, black spruce, black ash, balsam poplar, and red maple. Associates such as American elm, silver maple, and green ash are limited across the land base occurring along major rivers (Strickland 2006). Coniferous forests of eastern white pine and red pine occur on dry rocky ridges as well as associated with jack pine on deeper mineral material near the community of Petawawa. Old growth eastern white and red pine forests are typically found in the north (OMNR 2009b). White spruce and balsam fir occur on upland sites with deeper mineral material. Deciduous forests are scattered throughout. White oak (Noble 1984), bur oak, blue-beech, white ash, and American basswood (Strickland 2006) may be found on warmer-than-normal sites or in the southern portion of the ecodistrict. Sparse forests are more common in the south and eastern portions of the area. Wetland sites, including bog and fen complexes, are scattered throughout the ecodistrict, typically along rivers and streams. Marsh systems may also occur. A small portion of land has been cleared for pasture and cropland, especially in the southeast.

The climate in the Brent Ecodistrict is drier and warmer than Ecodistrict 5E-9 to the west. The higher elevation of the Algonquin Dome decreases the amount of precipitation that falls on the area. In the past, these drier conditions increased the likelihood of fire, which was a major disturbance agent in the ecodistrict, promoting the regeneration of pines and intolerant hardwoods. In response to warmer site conditions, several species that are typically found farther south grow here, including fragrant sumac and black huckleberry (Noble 1984). Several Atlantic coastal plain species are also present including Carey’s smartweed and little floatingheart (Henson and Brodribb 2005). Where substrate nutrients are more available, base-rich bedrock and calcareous mineral material may support higher plant species richness. Arctic-alpine affiliates, such as smooth woodsia and Hornemann’s willowherb, may be found on colder-than-normal base-rich cliffs, including the Barron River Canyon (Bakowsky 2017, MNRF, pers. comm.).

Land use

Less than 1% of the ecodistrict is devoted to settlement and associated infrastructure, including the communities of Petawawa, Deep River, Laurentian Hills, Eganville, Brent, and Douglas (Figure 335). Nearly 41.3% of the ecodistrict is designated as protected areas. Land use in the Brent Ecodistrict is primarily recreational including the provision of services for resource-based tourism. Timber harvesting, aggregate extraction, and some agriculture also occur.

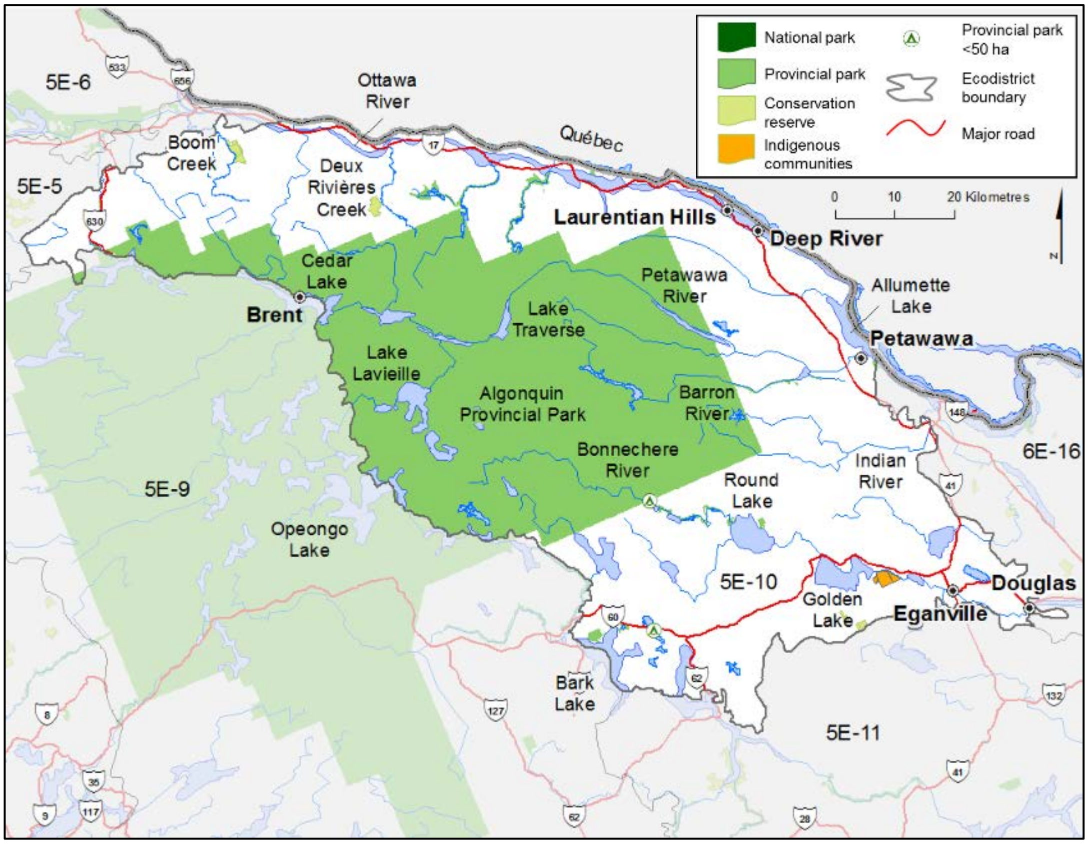


Figure 335. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-10.

Ecodistrict boundary delineation

Ecodistrict 5E-10 is defined in the north by the Ottawa River and the border with Québec. The northwestern boundary with 5E-5 is delineated by the transition from a landscape with more changes in elevation, including areas of rugged terrain in 5E-10 to an undulating topography in 5E-5. Ecodistrict 5E-10 is also drier and has a longer growing season than that in 5E-5 (OMNR 2000). The western boundary with 5E-9 reflects a lower elevation and warmer temperatures in 5E-10 relative to 5E-9. The southern boundary with 5E-11 was refined to the south by Hills (1976) and Brunton (1990b) to more closely follow the transition from acidic bedrock in 5E-10 to base-rich bedrock in 5E-11. The 5E-10/5E-11boundary is also defined by topographic and climatic differences. The topography in Ecodistrict 5E-10 is more irregular and the area is typically cooler than 5E-11 (OMNR 2000). The eastern boundary with 6E-16 is based on ecoregional bedrock, temperature, and precipitation differences. The underlying bedrock in Ecoregion 5E is Precambrian compared with Paleozoic bedrock in the south. Ecoregion 5E is also cooler and wetter than Ecoregion 6E. In addition, the substrates in 6E-16 are deeper and of glaciolacustrine origin compared with 5E-10, which is shallower and dominantly morainal.

The Ottawa-Bonnechere Graben

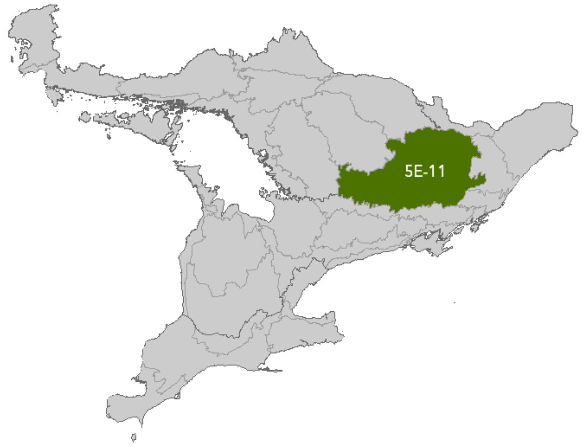
The Ottawa-Bonnechere Graben is a 700 km long ancient rift valley stretching from Lake Nipissing and Lake Timiskaming east to the Montreal area (Figure 336; Kumarapeli 1981). Grabens form when a section of the earth's crust moves downward between two major fault zones, in this case the Mattawa and Petawawa faults.

Large rivers contained within the graben (e.g., Petawawa and Bonnechere) served as major drainage channels for glacial lakes during the last ice age and became a thoroughfare for exploration and trade. The Ottawa-Bonnechere Graben is a major topographic feature in 5E-10 defining major landforms and river drainages.

Figure 336. Ottawa-Bonnechere Graben. K. Musser.

Ecodistrict 5E-11

Bancroft Ecodistrict



Ecodistrict 5E-11 is the largest ecodistrict in Ecoregion 5E, encompassing 1,631,204 ha (21.9% of the ecoregion, 1.7% of the province). It extends from the community of Madoc north to Lake Clear. The eastern boundary is located near Big Rideau Lake, and in the west, the boundary is near the community of Minden. The undulating to rolling topography ranges in elevation from 121 m above sea level east of Big Rideau Lake to 526 m above sea level west of the community of Bancroft.

Figure 337. Mixed forests with a variable layer of mineral material characterize Ecodistrict 5E-11. Sam Brinker, MNRF.

Key features

- Over half of the ecodistrict is covered by mixed and coniferous forests (Figure 337).
- A variable layer of morainal material covers the landscape.
- Large areas of base-rich bedrock support increased floristic diversity (Brunton 1990b).

Geology and substrates

The Bancroft Ecodistrict is characterized by an undulating to rolling landscape covered by a variable layer of acidic, morainal material (Figure 337). Typically moderate in depth, shallow morainal material occurs in the south intermixed with areas of bare bedrock. Deeper deposits are scattered throughout the ecodistrict and include drumlins in the west and north, kame moraines in the east, and the Dummer moraine in the south.

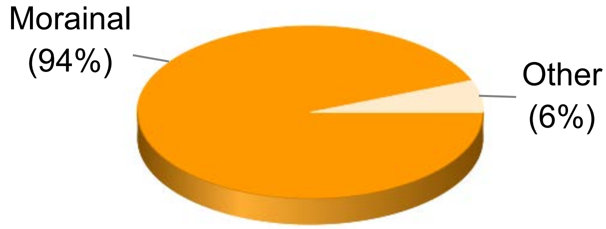


Figure 337. Modes of deposition in Ecodistrict 5E-11.

The landscape is controlled by the underlying Precambrian bedrock (Figure 338). Extensive areas of base-rich (e.g., marble, calc-silicate) bedrock can be found throughout the ecodistrict. Paleozoic outliers occur along the boundary with 6E-9 in addition to northeast and northwest of Black Donald Lake. Calcareous mineral material is typically found in the east. Even though the area is not as heavily faulted as the rest of Ecoregion 5E, it does have several faults including the Mazinaw Lake Fault (Chapman 1975) that add relief. Glaciofluvial deposits are generally restricted to river valleys including the Little Mississippi, Madawaska, and Burnt rivers. The influence of glacial lake Algonquin, that inundated the area nearly 11,000 years ago (Dyke 2004), is limited in Ecodistrict 5E-11, extending from the southwest to approximately the community Minden (Chapman and Putnam 1984). The reworking of mineral material by the glacial lake resulted in the deposition of small pockets of fine-textured glaciolacustrine material in the west. Bedrock outcrops are more common in the south where the morainal material is thinner. Escarpments and cliffs may also occur (White 1993). Organic deposits have formed in shallow bedrock depressions and along rivers and streams. Larger deposits can be found along the York River. Alluvial sediment occurs along rivers and streams including the York and Little Mississippi rivers (Barnett 1989). A small pocket of glaciomarine sediment from the Champlain Sea occurs near White Lake (Brunton 1990b).

Figure 338. Bedrock controlled wetlands of Puzzle Lake Provincial Park, northwest of the community of Verona. Sam Brinker, MNRF.

The dominant substrate types in Ecodistrict 5E-11 are Humo-Ferric Podzols (Figure 339), which have developed in coarse-textured, predominantly morainal material in well drained areas. Melanic Brunisols have developed over one-quarter of the area, reflecting the influence of the underlying base-rich bedrock. Dystric Brunisols and bare bedrock occur in the south, with the former developing in coarse-textured deposits along the boundary. Organic accumulations, typically Mesisols, are scattered throughout the ecodistrict in limited low-lying wet depressions and adjacent to rivers and streams. Gray Brown Luvisols in base-rich fine-textured mineral material and Gray Luvisols in acidic fine-textured mineral material, occur near the community of Madoc and south of Black Donald Lake to the Mississippi River.

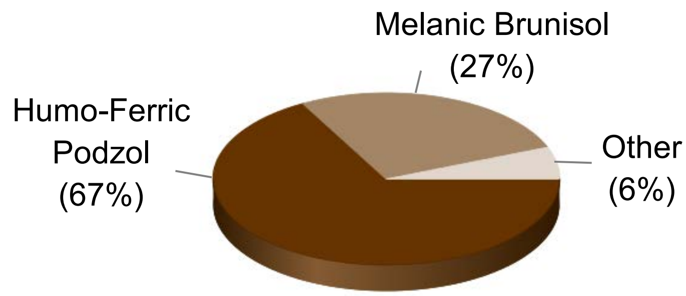


Figure 339. Substrate types in Ecodistrict 5E-11.

Land cover and vegetation

Ecodistrict 5E-11 forms part of the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Middle Ottawa (L.4c) and Georgian Bay (L.4d) sections of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Mixed forests cover more than one-third of the ecodistrict (Figure 340) and are dominated by sugar maple, yellow birch, red maple, and eastern hemlock. Common on drier, warmer sites are eastern white pine, red pine, trembling aspen, paper birch, northern red oak, and bur oak (Brunton 1990b). On upland sites, tree species include large-toothed aspen, American beech, white spruce, balsam fir, and eastern hop-hornbeam. Eastern white cedar, black spruce, black ash, American larch, and balsam poplar are more common in fresh to moist habitats. Southern influences include bitternut hickory, butternut, white oak, American basswood, American elm, green ash, and black cherry. Shallow mineral material typically supports coniferous forests of eastern white pine, jack pine, and red pine. Before the early 1900s, intensive logging removed much of the eastern white pine and red pine that dominated the area. Several pockets of old growth remain and can be found scattered across the ecodistrict. White spruce, eastern hemlock, and balsam fir grow on deeper, moister substrates, and black spruce, American

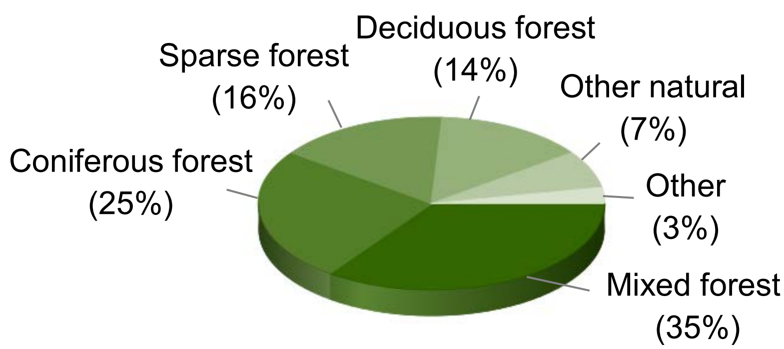


Figure 340. Land cover types in Ecodistrict 5E-11.

larch, and eastern white cedar are common in low-lying areas. Sparse forests are more common in the south where bare bedrock and very shallow mineral material prevail. Extensive sparse forests of oak and common juniper occur in the southwest (Brunton 1990b) as well as northern red oak and eastern white pine. Intense forest fires on many sites have created areas that are now more open than before logging began. Deciduous forests of sugar maple occur on deeper mineral material. Agricultural fields are found in the west and near the community of Madoc. Fen and bog complexes as well as marshes border rivers and small lakes throughout the ecodistrict. In the southwest, alvar communities have developed on Paleozoic bedrock, exposed at the surface or covered by a very shallow layer of mineral material (Jalava et al. 2001). These communities have specialized environmental conditions that support a unique assemblage of plant and animal species including Virginia saxifrage and Seneca snakeroot (Barkley 2016).

The vegetation communities of the Bancroft Ecodistrict are varied and show several geographic affinities. In the southwest, Atlantic coastal plain flora (e.g., bog yellow-eyed-grass, Carey's smartweed, and twin-stemmed bladderwort) occur and vegetation species with grassland affinities (e.g., woodland sunflower and large-pod pinweed) grow on open granitic bedrock conditions (Jalava et al. 2001). Southern species at their northern limits include bear oak and winged sumac (Catling and Brownell 1999). Bands of base-rich bedrock increase the amount of nutrients available in the substrate, resulting in increased plant species richness. Noble (1984) noted that marble outcrops found in the ecodistrict had created suitable habitat conditions for calcareous species, including purple-stemmed cliffbrake, walking fern, and smooth woodsia.

Land use

The provision of services for resource-based tourism, timber harvesting, mining, mineral exploration, aggregate extraction, and agriculture are the primary activities in the Bancroft Ecodistrict. Less than 1% of the ecodistrict is devoted to settlement and associated infrastructure, including the communities of Bancroft, Madoc, Haliburton, Verona, Minden, and Halls Lake (Figure 341). Approximately 5% of the ecodistrict has been identified as protected areas.

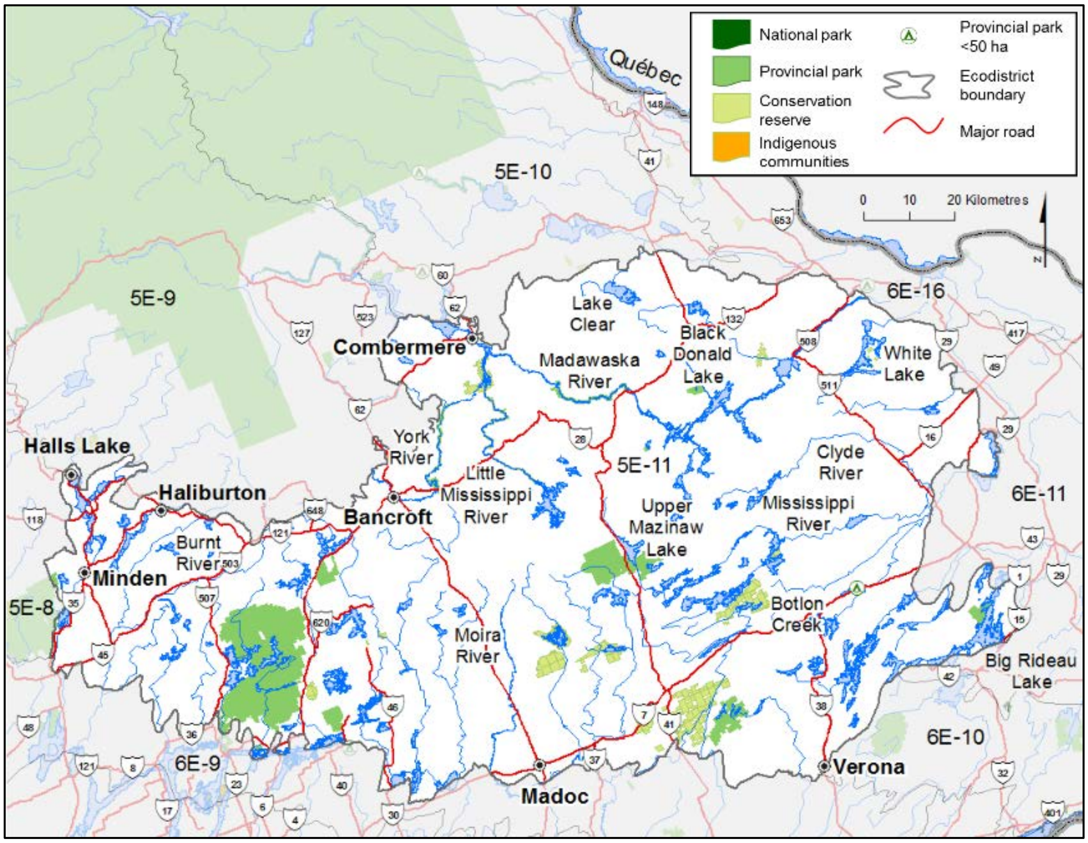


Figure 341. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-11.

Ecodistrict boundary delineation

The southeastern and northern boundaries with 5E-8, 5E-9, and 5E-10 are defined by a warmer climate in 5E-11 and major changes in bedrock types. Ecodistrict 5E-11 is characterized by base-rich carbonate and mafic bedrock from the Neo- to Mesoproterozoic era (0.57 to 1.6 billion years ago). Ecodistrict 5E-8, 5E-9, and 5E-10 are dominated by older acidic bedrock typically from the Mesoproterozoic era (0.9 to 1.6 billion years ago). The original northern boundary with 5E-9 and 5E-10 was farther north (Hills 1959); however, this was adjusted to better define the base-rich bedrock and warmer climate of 5E-11 versus the acidic bedrock and cooler climate of the northern ecodistricts (Hills 1976, Brunton 1990b). The boundary with Ecoregion 6E is based on ecoregional temperature (5E is cooler), precipitation (5E is wetter), and bedrock differences (Precambrian bedrock in 5E compared with Paleozoic bedrock in 6E).

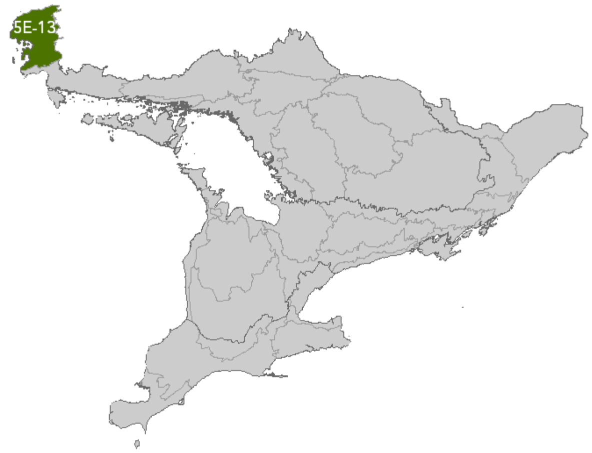
Bancroft Ecodistrict — A rich mining history

Approximately 1,100 million years ago, the landscape surrounding the Bancroft area was the site of a major collision of land masses. Rocks between the two land masses were crushed and heated, forming new rock (Eyles 2002). The collision also folded bedrock and built mountains. Through time the mountains eroded, exposing mineral rich bedrock. Due to the abundance of minerals, the area has a rich mining history (Figure 342) including the first discovery of gold in Ontario in 1866 (Hewitt 1967). The community of Bancroft is referred to as the Mineral Capital of Canada (Eyles 2002).

Figure 342. Corundum mill, Craigmont mine, near the community of Combermere. Archives of Ontario Acc 13281-152.

Ecodistrict 5E-13

Batchawana Ecodistrict



Extending along the shore of Lake Superior, the Batchawana Ecodistrict encompasses 421,496 ha (5.7% of the ecoregion, 0.4% of the province), including Batchawana Island, the Sandy Islands, and Ile Parisienne. The ecodistrict extends from approximately 10 km south of the community of Goulais River north to the Montreal River, and east from Lake Superior to Dismal Lake. The lowest point (179 m above sea level) occurs along the Lake Superior shoreline, while the maximum elevation (665 m above sea level; NRCan 2002) occurs south of Trout Lake.

Figure 343. Deciduous and mixed forests of the Batchawana Ecodistrict. Peter Uhlig, MNRF.

Key features

- Deciduous forests dominated by sugar maple occur over two-thirds of the land base (Figure 343).
- Bedrock, exposed at the surface with a discontinuous, shallow layer of mineral material, dominates.
- Major river valleys were shaped by glacial meltwaters.
- Includes relict shorelines and cobble beaches.

Geology and substrates

The Batchawana Ecodistrict is characterized by a discontinuous, typically shallow layer of acidic, coarse-textured mineral material overlying Precambrian bedrock (Figure 343). A

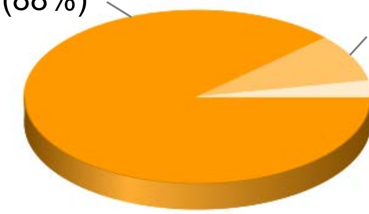


Figure 343. Modes of deposition in Ecodistrict 5E-13.

relatively thin glacier combined with a rapid retreat limited the amount of mineral material deposited at higher elevations. At lower elevations, wave action and variable glacial lake levels removed and modified mineral material. Approximately 11,000 years ago, glacial Lake Algonquin inundated the area from the south up to Alona Bay (Dyke 2004). Nearly 1,000 years later (Dyke 2004), glacial ice remained over Lake Superior except for the southeastern corner where glacial Lake Minong formed, flooding the shoreline (Barnett 1992). Exposed bedrock is common at higher elevations, including cliff systems, and along the Lake Superior shoreline, where high glacial lake levels washed much of the mineral material away. Generally acidic, base-rich bedrock occurs in the northeast as a band from Mamainse Lake to north of Trout Lake and north of the Goulais River. The landscape is typically rolling with several faults and joints, resulting in complex and highly variable terrain (McQuay 1980a). Faults include the Montreal River fault in the north and the Mamainse Lake and Mamainse Point faults in the central part of the ecodistrict (Manson and Halls 1997).

Deep morainal deposits occur in the northeast. Glaciofluvial deposits are a result of the flow of large amounts of meltwater through the river systems, widening the valleys and depositing mineral material. Significant deposits can be found along the Goulais, Batchawana, Chippewa, and Montreal rivers. Glaciolacustrine materials occur along the Lake Superior shoreline and along river valleys including the Montreal and Goulais rivers (Farrand et al. 1984). These deposits often form a complex substrate with fine-textured glaciolacustrine material overlying coarse-textured morainal deposits. Relict shorelines, laid down by glacial lakes, are found along the Lake Superior shoreline and for a short distance inland. These features can be found up to 100 m above the present lake level (Saarnisto 1975, McQuay 1980a). Organic deposits occur in low-lying areas in the bedrock and in poorly drained areas along rivers. Lacustrine and aeolian sediment can be found along the shoreline of Lake Superior. Ecodistrict 5E-13 has some of the most extensive sand beaches and dunes on Lake Superior (Bakowsky 2015, MNRF, pers. comm.). Alluvial deposits occur adjacent to rivers including the Chippewa and Goulais rivers. Limited colluvial material (i.e., talus) can be found at the base of cliffs.

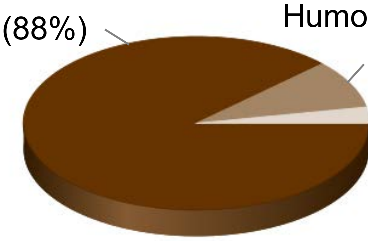


Figure 344. Substrate types in Ecodistrict 5E-13.

The dominant substrate type in Ecodistrict 5E-13 is Precambrian bedrock, typically granite and gneiss, covered by a discontinuous, generally shallow layer of mineral material (Figure 344). Sandstone and shale bedrock (Figure 345) occurs in the south, stretching from the shore and islands of Lake Superior to east of the community of Goulais Bay. Humo-Ferric Podzols have developed in coarse-textured, better drained sites typically associated with morainal and glaciofluvial deposits. In better drained fine-textured mineral material, Grey Luvisols have developed and Gleysols are more common in poorly drained sites. Accumulations of organic material, typically Fibrisols, have developed in poorly drained, low-lying areas associated with bedrock or mineral material. Regosols are associated with lacustrine, aeolian, and alluvial deposits.

Figure 345. Sandstone bedrock on Ile Parisienne. Sam Brinker, MNRF.

Land cover and vegetation

Ecodistrict 5E-13 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Algoma Section (L.10) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972) and supports a diverse array of plants representative of the temperate and boreal vegetation zones. The area is characterized by deciduous forests of sugar maple, yellow birch, and to a lesser extent northern red oak, red maple, large-toothed aspen, eastern hop-hornbeam, trembling aspen, and paper birch (Figure 346). Sugar maple and yellow birch dominate on upper slopes and ridge tops. Poorly drained areas support black ash, American elm, balsam poplar, and occasionally silver maple (OMNR 2005a) on warmer-than-normal

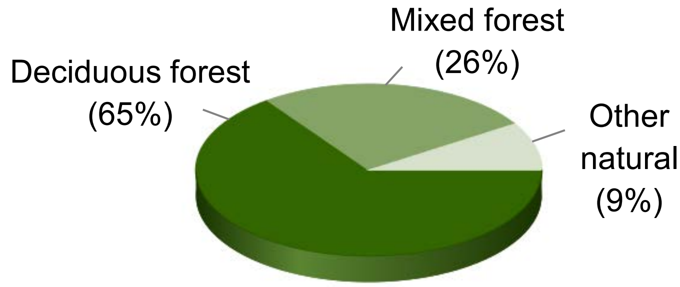


Figure 346. Land cover types in Ecodistrict 5E-13.

sites. Mixed forests are more common in the northeast. On upland sites, red pine, eastern white pine, and jack pine are often mixed with northern red oak. Balsam fir, white spruce, trembling aspen, and paper birch grow on fresh sites. In lowland areas eastern white cedar and black spruce are common associates with black ash. Mixed forest may also include eastern hemlock, which reaches its northern limit in Ecodistrict 5E-13. Coniferous forests of white spruce, balsam fir, and eastern white cedar occur on mid to lower slopes, while black spruce and American larch are more common in low-lying areas. Sparse forests are more common in the northeast. Fen and bog complexes occur in low-lying poorly drained areas. A large wetland complex that has developed on a series of relict beach ridges extends approximately 10 km inland from the mouth of the Goulais River. Marshes are found along the Lake Superior shoreline as well as adjacent to rivers and lakes. Inland, relict cobble beaches of glacial lakes support lichen-bryophyte communities. Areas with active aeolian mineral material support species (e.g., sea lymegrass and beach pea; Henson and Brodribb 2005) that are adapted to active substrates. Exposed rock is limited to bedrock ridges and shorelines, cobble beaches, and cliff and talus systems.

Temperature, precipitation, and humidity differences occur across the ecodistrict due to topographic variability and the proximity to Lake Superior. Plant species at their northern ranges include eastern leatherwood and black huckleberry (Soper and Heimburger 1982). Dwarf bilberry (Soper and Heimburger 1982) and long-leaved aster (Semple et al. 1996) occur at their southern limits. Great Lakes endemic species including dwarf tansy are restricted to sandy and gravelly shores. An increase in plant species diversity may occur where base-rich bedrock near the surface results in higher substrate nutrient availability.

Land use

Timber harvesting, mineral exploration, aggregate extraction, wind power and hydroelectric generation, fishing, hunting, and services associated with resource-based activities occur throughout Ecodistrict 5E-13 (Figure 347). Settlement and associated infrastructure including the communities of Goulais River, Montreal River, and Searchmont cover less than 1% of the total land base. Protected areas comprise nearly 4.9% of the ecodistrict.

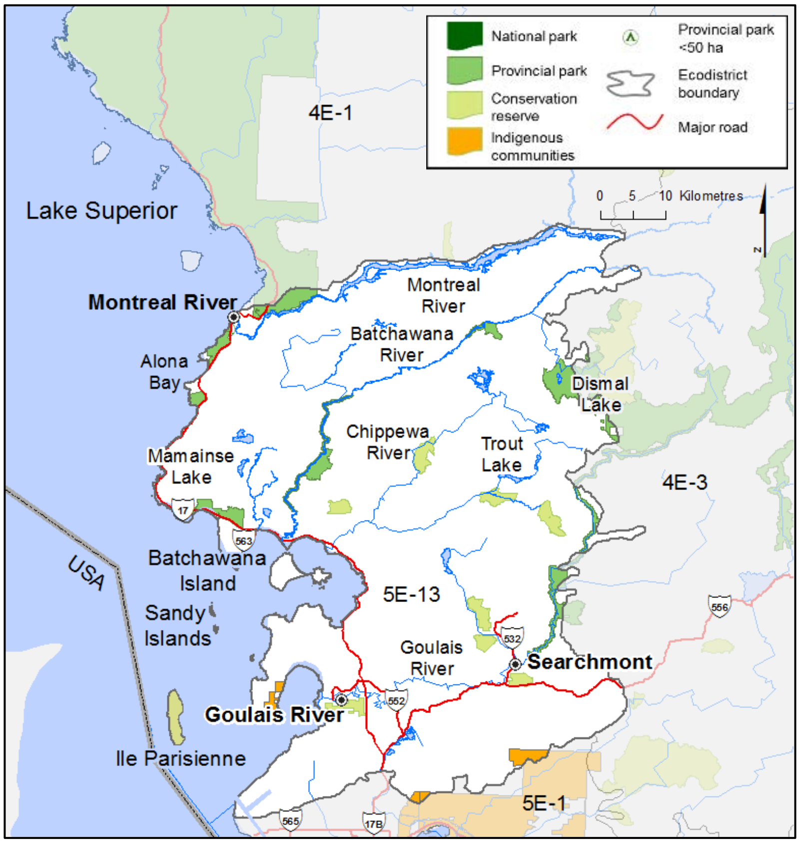


Figure 347. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 5E-13.

Ecodistrict boundary delineation

The Batchawana Ecodistrict was originally described as Site District 4E-2 by Hills (1959); however, the climate and resulting vegetation show a stronger affinity to ecodistricts in Ecoregion 5E than 4E. The boundary with Ecoregion 4E is delineated based on ecoregional variables, where Ecoregion 5E is warmer and in general has a lower elevation than 4E. At the ecodistrict scale, the boundary with Ecodistrict 4E-1 approximately follows the Montreal River, and defines the transition from the suite of foliated tonalite, metasedimentary, and metavolcanic bedrock in 5E-13 to the suite of gneissic tonalite bedrock in 4E-1. Differences that help delineate 5E-13 from 5E-1 include: topography — 5E-13 is more variable with part of the landscape characterized as rugged topography; depth of substrates — 5E-13 typically is shallower than 5E-1; and climate — at the ecodistrict level, 5E-13 is wetter and cooler due to the strong influence of Lake Superior. The western boundary is defined by Lake Superior and adjacent islands to the Ontario-United States border.

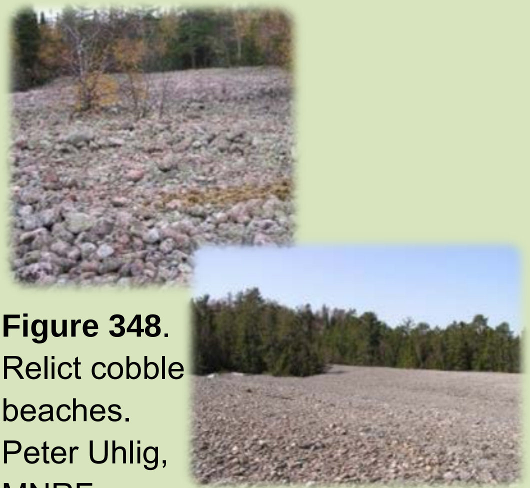


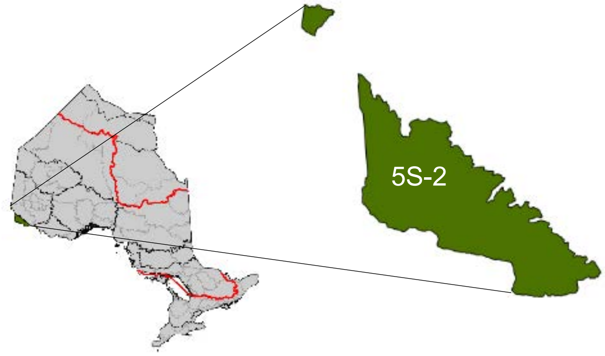
Figure 348. Relict cobble beaches. Peter Uhlig, MNRF.

Relict cobble beaches

South of the Montreal River, several parallel, gently curving ridges of cobble beaches occur nearly 100 m above the present Lake Superior shoreline. The beaches represent successively lower stages of glacial Lake Algonquin and glacial Lake Minong. Protected within Montreal River Provincial Park are extensive relict cobble beaches. The 6,000 year old beaches host significant lichen communities that include foam and reindeer lichen (Ontario Parks 1994, 2010).

Ecoregion 5S

Agassiz Clay Plain Ecoregion



Ecoregion 5S extends from the Ontario-Manitoba border in the west to the community of Fort Frances in the east. The northern boundary extends to Bigsby Island along the southern shore of Lake of the Woods and south to the United States-Ontario border. Located in the Ontario Shield Ecozone, it encompasses 342,520 ha or 0.3% of the province. It includes one ecodistrict — 5S-2: Rainy River.

The gently rolling landscape in Ecoregion 5S is underlain by Precambrian gneissic and metavolcanic bedrock, typically covered by deep, calcareous glaciolacustrine deposits from glacial Lake Agassiz. In the northern part of the ecoregion, varying depths of morainal material occurs.

On moist, fine-textured mineral material, Gleysols have developed. Gray Luvisols occur in areas with better drainage. The next dominant substrate types are Mesisols, which are confined to wet organic deposits. Bedrock and Dystric Brunisols are more common along the northern boundary.

Mostly forested, Ecoregion 5S is situated in an area dominated by temperate species with occurrences of boreal and grassland vegetation. Tree species that reflect the temperate vegetation zone include sugar maple, red maple, green ash, eastern white pine, and American basswood. Common boreal tree species include white spruce, balsam fir, trembling aspen, and jack pine. Grassland affiliates, such as bur oak (Figure 349) and northern pin oak, occur on dry fine-textured mineral material and very shallow bedrock systems along with herbaceous species. Black spruce, eastern white cedar, and American larch grow in wet depressions. Less than one quarter of the area has been cleared and is used for agriculture.

Similar to the flora, fauna characteristic of temperate, boreal, and grassland ecosystems can be found here. Boreal species such as gray jay, American black bear, and boreal chickadee occur with western species such as western meadowlark, Franklin’s ground squirrel, and black-billed magpie, and southern species such as scarlet tanager, American toad, and red-bellied snake. Northern pike, muskellunge, and black crappie inhabit the rivers and lakes.

Figure 349. Rainy River bur oak woodland. Sam Brinker, MNRF.

Ecoregion 5S is predominately wet due to the flat topography, fine-textured mineral material, and poor drainage. Located in the Nelson Watershed, major water bodies that occur here include Rainy River and the southern part of Lake of the Woods.

Land uses include timber harvesting, agriculture, resource-based tourism, and mining. Fort Frances, Rainy River, Emo, and Stratton are four of the main communities that occur along the Highway 11 corridor in this ecoregion.

The Agassiz Clay Plain Ecoregion currently encompasses six types of natural heritage areas (Gray et al. 2009) including Sable Islands Provincial Park, which features a sand beach and dune community, extensive peatlands, and several provincially significant species such as Schweinitz's Flatsedge and northern myotis (Ontario Parks 2003).

The Agassiz Clay Plain Ecoregion is distinguishable from Ecoregion 4S based on temperature variables, elevation, and surficial geology. Ecoregion 5S is warmer and drier, has a lower elevation, and is typically level, dominated by glaciolacustrine deposits. Ecoregion 4S is generally characterized by a rolling, bedrock controlled landscape.

Ecodistrict 5S-2

Rainy River Ecodistrict

The Rainy River Ecodistrict consists of two geographical areas, separated by Lake of Woods. The largest area is delineated in the west and south by the Canada-United States border. The northern extent includes the western part of Big Island, and the eastern boundary is located near the community of Fort Frances. The second area is the southwestern tip of Ontario along the Manitoba border. Ecodistrict 5S-2 encompasses 342,521 ha (0.4% of the province) and is the only ecodistrict in Ecoregion 5S. The lowest point (318 m above sea level) occurs along the south shore of Lake of the Woods and the highest point (412 m above sea level) is north of Pinewood River.

Figure 350. Agricultural and forested landscape of Ecodistrict 5S-2. Dan Rowlinson, MNRF.

Key features

- Sparse forests and agricultural areas (Figure 350) are the primary land cover types.
- Consists of flat to gently rolling topography covered with calcareous, fine-textured, glaciolacustrine deposits.
- Includes barrier islands and several plant species notable in Ontario.

Geology and substrates

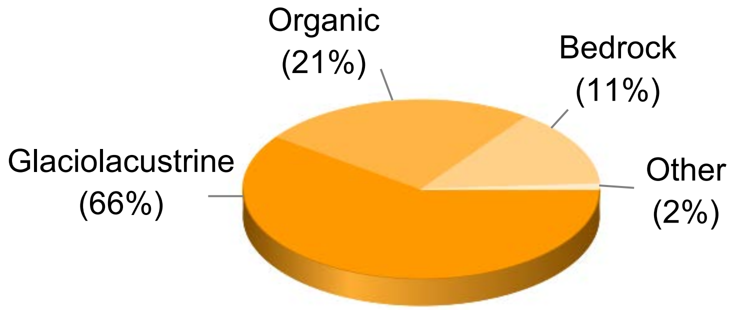


Figure 351. Modes of deposition in Ecodistrict 5S-2.

Ecodistrict 5S-2 is a flat to gently rolling landscape, dominated by glaciolacustrine deposits from glacial Lake Agassiz that inundated the area nearly 11,000 years ago (Dyke 2004; Figure 351). Glacial Lake Agassiz was a very large ice-dammed lake that expanded into Manitoba and northwestern Ontario as the glaciers retreated north. The glaciolacustrine sediment is generally calcareous, derived from mineral material in Manitoba. As the lake receded, shorelines of Lake Agassiz were exposed. Several relict shorelines occur on Big and Bigsby islands (Hallet and Roed 1980), in the southwest (Bajc and Gray 2001), and along the Lake of the Woods-Rainy Lake Moraine near the northern boundary with Ecodistrict 4S-6.

The level topography combined with poor drainage has facilitated the development of extensive organic deposits on fine-textured mineral material. Larger accumulations occur in the west, several of which are protected in provincial parks. Bedrock, exposed at the surface or with a very shallow layer of mineral material is limited, occurring mainly as bedrock outcrops throughout the area and along the northern boundary. Faults, including the Quetico Fault near Abbott Lake, are often hidden by a deep layer of mineral material (Bajc 2001). Morainal deposits are generally restricted to the Lake of the Woods-Rainy Lake Moraine or can be found as a discontinuous layer of shallow to moderately deep mineral material separated by bedrock outcrops. Deeper, level morainal deposits are often interbedded with, or covered by a layer of glaciolacustrine material. Small areas of glaciofluvial sediment occur north and west of Abbott Lake. Alluvial deposits occur along larger rivers and creeks including the Rainy, Pinewood, and La Vallée rivers and Sturgeon Creek. Lacustrine deposits adjacent to the southeast shoreline of Lake of the Woods have formed the Sable Islands (Figure 352), a series of barrier islands. Aeolian modifications to the lacustrine deposits have formed a series of dunes on the islands (Bajc 2001).

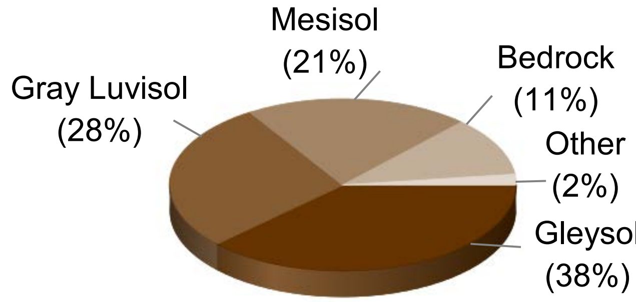


Figure 353. Substrate types in Ecodistrict 5S-2.

In the Rainy River Ecodistrict, Gleysols predominate, having developed in fine-textured, imperfectly to very poorly drained sites (Figure 353). Gray Luvisols occur in better drained fine-textured, typically calcareous, glaciolacustrine deposits. Organic accumulations (e.g., Mesisols) occur as extensive deposits on nearly level glaciolacustrine sediment or as isolated pockets in bedrock controlled areas (Bajc 2001). Acidic bedrock, exposed at the surface or with a very shallow mineral material layer, often interspersed with deeper pockets of mineral material, occurs throughout the area. Areas of base-rich bedrock occur north of the community of Fort Frances, around the Pinewood River, and north of the community of Rainy River. Dystric Brunisols have developed in deeper, coarse-textured morainal material and Regosols can be found associated with active mineral material including aeolian, lacustrine, and alluvial deposits.

Figure 352. Sable Islands, a series of barrier islands with active aeolian deposits. Ontario Parks.

Land cover and vegetation

Ecodistrict 5S-2 is associated with the Eastern Temperate Mixed Forest Vegetation Zone (Baldwin et al. 2018) and the Rainy River Section (L.12) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Sparse forests comprising deciduous and coniferous tree species are scattered throughout the ecodistrict, covering approximately one-quarter of the land base (Figure 354). Throughout the ecodistrict, portions of land have been cleared for pasture and cropland. Deciduous forests composed of trembling aspen and paper birch are more prevalent in the northern half of the ecodistrict. Nutrient rich, moister sites may grow black ash, American elm, and balsam poplar. Black ash is more common in Ecodistrict 5S-2 than in adjacent areas. Tree species more common in the south, including American basswood, northern red oak, red maple, northern pin oak, Canada plum, green ash, silver

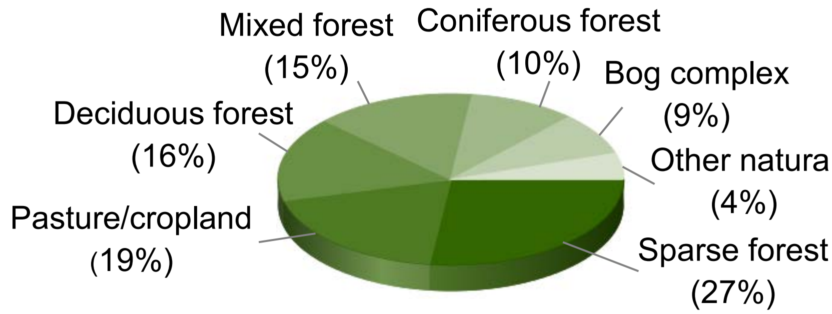


Figure 354. Land cover types in Ecodistrict 5S-2.

maple, Manitoba maple, eastern hop-hornbeam, and bur oak (Noble 1998b), may be found associated with the shore and islands of Lake of the Woods or in the south.

Mixed forests are more common in the eastern portion of the ecodistrict and may include large areas of balsam poplar, white spruce, balsam fir, and scattered American larch along inland rivers (Rowe 1972). Lowland coniferous and hardwood forests (e.g., black spruce, American larch, eastern white cedar, black ash) develop in areas with poor drainage. Eastern white pine and red pine, formerly quite prevalent, are now scattered across the ecodistrict due to past logging pressure and fire, which have led to their almost complete replacement by jack pine (Rowe 1972). An old growth eastern white pine and red pine area occurs in the northeast (OMNR 2009b). Large fen and bog complexes occur in the west, and along the Pinewood and La Vallée rivers. The renaturalization of abandoned agricultural fields by shrub species has occurred in several areas. Exposed bedrock is limited. Marshes may be found in quiet bays of Lake of the Woods and along larger river systems. Fires in Ecodistrict 5S-2 are generally characterized as small and frequent. On occasion, larger high intensity or stand-replacing fires do occur (Van Sleeuwen 2006). In the past, fires were important in maintaining the environment for grassland species and ecosystems.

The Rainy River Ecodistrict is a transition area for three vegetation zones — boreal, temperate, and grassland — contributing to a diverse array of plant species. The modifying local effects of Lake of the Woods increase precipitation and influence temperature resulting in cooler-than-normal summers and warmer-than-normal winters for areas near the lake. Harris and Foster (2004b) found several plant species at their geographical limits, including common hackberry (northern limit), riverbank grape (northwestern limit), marsh ragwort (southern limit), and Assiniboia sedge and plains cottonwood (eastern limit). Ecosystems (i.e., meadows and woodlands) with grassland affinities may occur on warmer-than-normal sites. Plant species found in these ecosystems may include prairie sagebrush, slender beardtongue, and Seneca snakeroot (Bakowsky 2007). Increased plant species richness may occur in areas with calcareous deposits or base-rich bedrock where nutrients in the substrate are more available. Ecodistrict 5S-2 contains one of the very few active aeolian deposits in northwestern Ontario. Associated species that are adapted to active mineral material include woolly beach-heath and tall wormwood (Harris and Foster 2004b).

Land use

Settlement and associated infrastructure, including the communities of Fort Frances, Rainy River, Stratton, and Emo, account for less than 1% of the land base (Figure 355). Activities include agriculture, mineral exploration, mining, timber harvesting, aggregate extraction, hydroelectric generation, fishing, hunting, tourism, and services associated with resource-based activities. Protected areas encompass approximately 6.1% of the ecodistrict.

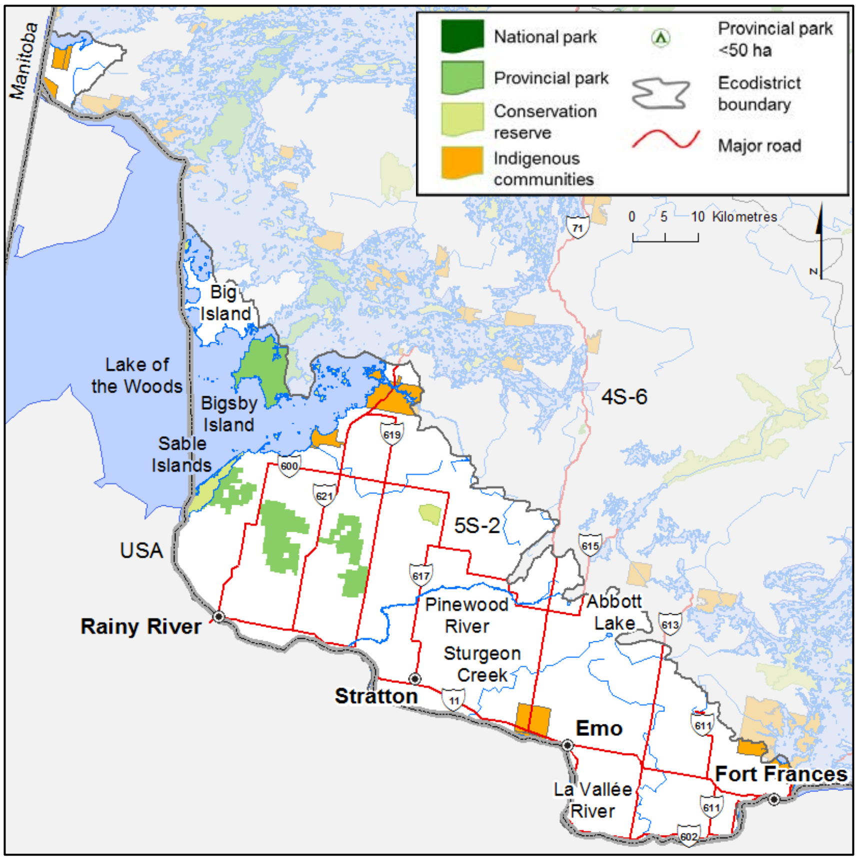


Figure 355. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 5S-2.

Ecodistrict boundary delineation

Ecodistrict 5S-2 is defined by the Manitoba-Ontario border in the northwest and the United States-Ontario border in the south, southwest, and east. The northern boundary is partially defined by the Lake of the Woods-Rainy River Moraine, and reflects the transition from a flat to rolling topography with fine-textured glaciolacustrine mineral material in 5S-2 to the rolling, bedrock controlled landscape generally covered with a shallow to moderately deep layer of morainal material in 4S-6.

Glaciation in northwestern Ontario

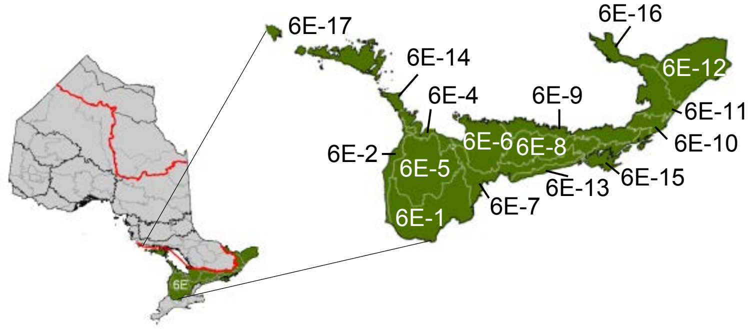
Throughout Ontario glaciers have altered the landscape, widening valleys, scouring and scraping bedrock, and picking up and depositing vast quantities of mineral material sometimes hundreds of kilometres from their point of origin. Covering most of Canada and part of the United States, the Laurentide ice sheet comprised three major sections (Dyke 2004), each subdivided into numerous ice lobes that advanced, retreated, and readvanced across the area. In northwestern Ontario, ice lobes including the Lac Seul, Agutua, Windigo, and Opasquia (Harvey et al. 1980) advanced from the north. Ecodistrict 5S-2 was also affected by the Des Moines lobe that advanced eastward into northwestern Minnesota and Ontario depositing calcareous, fine-textured morainal material (Bajc 2001). In areas that were inundated with glacial Lake Agassiz, morainal deposits form a mosaic with glaciolacustrine materials (Figure 356).

Figure 356. Morainal and glaciolacustrine landscape of Ecodistrict 5S-2. Layken Melnik, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecoregion 6E

Lake Simcoe-Rideau



Located in the Mixedwood Plains Ecozone, the Lake Simcoe-Rideau Ecoregion extends eastward from the shore of Lake Huron to the Ontario-Québec border. The northern boundary follows the northern extent of Paleozoic bedrock in Ontario, and includes St. Joseph's and Manitoulin islands. In the southwest, the boundary occurs near the community of Stratford and continues north to include most of the Lake Ontario shoreline and the St. Lawrence River. It encompasses 6,311,957 ha (6.4% of the province) and is divided into 16 ecodistricts (Table 11).

Table 11. Ecodistricts in Ecoregion 6E.

Ecodistrict	Ecodistrict name
6E-1	Stratford
6E-2	Kincardine
6E-4	Meaford
6E-5	Mount Forest
6E-6	Barrie
6E-7	Oak Ridges
6E-8	Peterborough
6E-9	Havelock
6E-10	Charleston Lake
6E-11	Smith Falls
6E-12	Kemptville
6E-13	Oshawa-Cobourg
6E-14	Tobermory
6E-15	Picton
6E-16	Pembroke
6E-17	Manitoulin

The terrain is gently undulating to rolling. Ecoregion 6E is typically underlain by Paleozoic bedrock, except for the Frontenac Axis which consists of a mixture of Precambrian and Paleozoic bedrock. The Paleozoic bedrock is mostly dolomite and limestone covered with a deep layer of calcareous morainal material. Deeper morainal deposits (e.g., Oak Ridges, Waterloo, and Saugeen moraines) and the Niagara Escarpment provide additional relief to the area. Additional surficial geology features include glaciolacustrine deposits in the west, glaciomarine material in the east, and glaciofluvial sediment along major rivers. Gray Brown Luvisols and Melanic Brunisols have developed over two-thirds of the ecoregion. Gleysols and Humo-Ferric Podzols are more limited.

Located in the Great Lakes Watershed, Ecoregion 6E is generally well drained. Large rivers include the Grand, Rideau, Trent, and Maitland, and inland lakes include Simcoe, Rice, and Rideau as well as the series of Kawartha Lakes.

Over half of the land base has been converted to cropland and pasture. Forest cover is dominated by deciduous and mixed forests with a diverse array of vegetation. Upland tree species include sugar maple, American beech, white ash, and eastern hemlock. In poorly drained areas, typical trees species include green ash, silver maple, red maple, and black ash. Wetlands dominated by organic material are more common in the north. Ecosystems with grassland and alvar species are isolated and occur throughout the area (Figure 357).

Figure 357. Alderville Prairie in Peterborough Ecodistrict. Mike McMurtry, OMNRF.

Characteristic mammal species include white-tailed deer, striped skunk, and woodchuck. A variety of habitats support bird species such as wood duck and great blue heron in wetland areas; field sparrow and eastern meadowlark in open upland environments; and wood thrush, scarlet tanager, and rose-breasted grosbeak in upland forests. Characteristic reptiles, amphibians, and fish include American bullfrog, red-spotted newt, northern watersnake, smallmouth bass, yellow perch, and pearl dace.

Agriculture, business and industry, and resource-based tourism occur throughout the ecoregion. The communities of Ottawa, Barrie, Peterborough, and Cornwall are located here.

Twenty-seven types of natural heritage areas occur in Ecoregion 6E (Gray et al. 2009). Natural heritage areas that occur on the Niagara Escarpment are recognized as part of the Niagara Escarpment Parks and Open Space system. These areas include Nottawasaga Lookout, Mono Cliffs, and Cabot Head provincial parks (NEC 2015).

The transition from Paleozoic bedrock in Ecoregion 6E to Precambrian bedrock in 5E along with a warmer, drier climate in 6E delineates the northern boundary. The southern boundary with Ecoregion 7E reflects climatic and elevation differences. Ecoregion 6E is cooler with a lower evapotranspiration rate and is higher in elevation.

Ecodistrict 6E-1

Stratford Ecodistrict

Located in the central portion of southwestern Ontario, Ecodistrict 6E-1 encompasses 926,054 ha (14.7% of the ecoregion, 0.9% of the province). The boundary extends from near the community of Zurich in the west to the community of Acton in the east. The u-shaped ecodistrict includes the communities of Ingersoll in the south and Grand Valley and the Maitland River in the north. The undulating topography ranges in elevation from 214 m above sea level along the Maitland River to 532 m above sea level east of the community of Grand Valley.

Figure 358. Cropland and deciduous forests of Ecodistrict 6E-1 along the Grand River. Floydian.

Key features

- Cropland and pasture occur over three-quarters of the ecodistrict (Figure 358).
- Morainal deposits can be found over much of the area.
- Glacial features include the Guelph drumlin field and several north-south trending moraines.

Geology and substrates

The geology and substrates in the Stratford Ecodistrict have been shaped by numerous glacial recessions and advances resulting in a landscape dominated by morainal features. In some cases, earlier glacial features have been reworked by later events, often obscuring their influence on the land base. Deglaciation first occurred in Ontario nearly 14,000 years ago (Dyke 2004) along a higher piece of ground in the northwest corner of Ecodistrict 6E-1, eventually extending southwest to the community of Ingersoll (Chapman and Putnam 1984).

Morainal deposits occur over three-quarters of the gently rolling landscape (Figure 359). Generally fine-textured, calcareous, and deep, the materials were deposited as level plains, groups of drumlins in the west, and a series of moraines. These include the Wyoming Moraine in the west, Mitchell, Milverton, and Seaforth moraines in the centre, and Paris, Waterloo, Orangeville, and Galt moraines in the east. Along the southeastern boundary, extending north to the community of Acton, a small area of bare bedrock and shallow morainal material occurs. The underlying Paleozoic bedrock has little influence in Ecodistrict 6E-1 due to the depth of the overlying material. Karst features (i.e., sinkholes) occur in the west (Brunton and Dodge 2008).

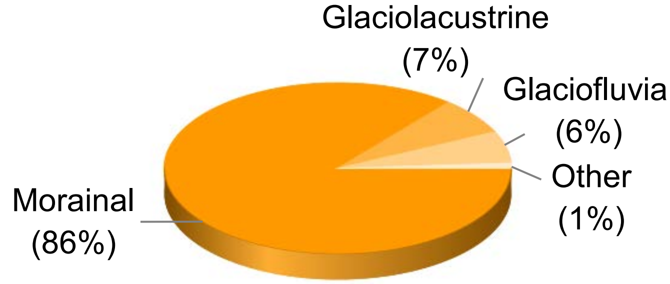


Figure 359. Modes of deposition in Ecodistrict 6E-1.

Due to the height of land in the Stratford Ecodistrict, glacial lakes did not influence the area. Glaciolacustrine features are typically associated with moraines and are the result of local ponding of glacial meltwater. Glaciofluvial features, primarily spillways, deposited coarse-textured material adjacent to moraines and along larger rivers. Organic deposits are widely distributed throughout the ecodistrict, typically in low-lying areas where water accumulates. Alluvial material is associated with larger river systems. Limestone cliffs associated with the Niagara Escarpment are found in the east.

Gray Brown Luvisols are common throughout the ecodistrict having developed in calcareous, well drained, fine-textured morainal material (Figure 360). Gleysols are more common in poorly drained areas associated with glaciolacustrine deposits. Melanic Brunisols are limited to the western and eastern boundaries where the coarse-textured morainal materials associated with the Wyoming and Paris moraines occur. Organic deposits, typically Mesisols and Humisols, have developed in poorly drained areas often found near rivers. Large deposits occur along the South Maitland River, near Black Creek, and east of the community of Cambridge.

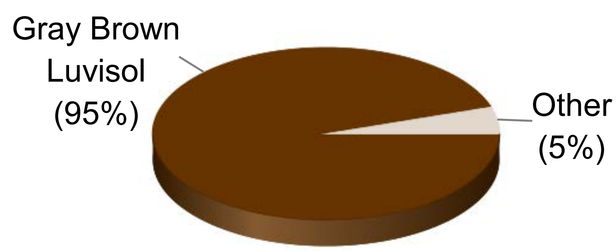


Figure 360. Substrate types in Ecodistrict 6E-1.

Land cover and vegetation

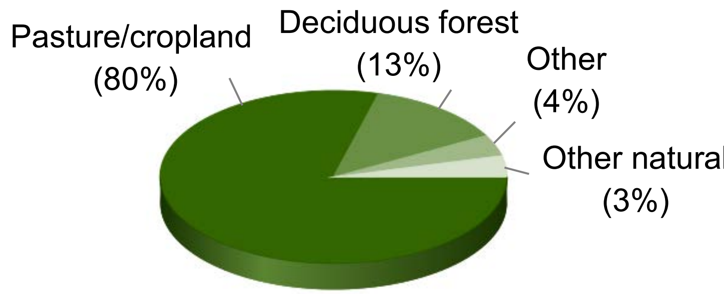


Figure 361. Land cover types in Ecodistrict 6E-1.

The Stratford Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region. The southern and southwestern portions are included in the Niagara Section (D.1) (Rowe 1972). The ecodistrict has been predominately converted to pasture and cropland (Figure 361). Approximately one-fifth of the area is represented by natural or naturalized areas including forests, fen complexes, and marshes. Deciduous forests (Figure 362) dominated by sugar maple, American beech, white ash, and oak species occur on dry to fresh sites, and yellow birch, red maple, silver maple, and ash species are found on wetter environments. Less common associates can include American elm, eastern hop-hornbeam, black maple, large-toothed aspen, butternut, and black cherry.

Mixed and coniferous forests are more prevalent along the eastern and western boundaries of the ecodistrict. Coniferous tree species that inhabit these areas include eastern white pine and red pine on drier sites and eastern hemlock, American larch, white spruce, black spruce, and eastern white cedar in areas with cooler-than-normal, moist to wet conditions. White spruce and eastern white cedar are also associated with abandoned agricultural fields. Wetland vegetation communities (e.g., fen complexes, marshes) are restricted to poorly drained areas where organic matter has accumulated or near larger rivers.

The vegetation communities in the Stratford Ecodistrict are diverse. Ecosystems (e.g., meadows, woodlands) with grassland affiliates can be found but are generally small. Along the eastern boundary, a small alvar community supports shagbark hickory, chinquapin oak, rock elm, and common prickly-ash (Reschke et al. 1999). Northern plant species (e.g., mat muhly, daisy fleabane) grow on the cooler-than-normal aspects of the limestone cliffs and in river valleys. Southern species (e.g., sycamore, blue-beech, spicebush, Goldie's wood fern; Bowles et al. 1998), some of which are at their northern limits, occur in warmer-than-normal valleys carved by glacial meltwater (Ontario Parks 2001b). Plants with western affinities (e.g., big bluestem, yellow Indian-grass) can be found along the Maitland River (Bowles 1999). In the northeast along the Niagara Escarpment, old growth eastern white cedar forests and the largest concentration of ferns in Ontario occur (Ontario Parks 1998).

Figure 362. Deciduous forest in Mono Cliffs Provincial Park. Karen Lomath, Ontario Parks.

Land use

Approximately 2% of the ecodistrict is devoted to settlement and associated infrastructure. Large communities include Kitchener, Cambridge, Guelph, Waterloo, and Ingersoll (Figure 363). Land uses include agriculture, business and industry, aggregate and petroleum extraction, and hydroelectric and wind power generation. Protected areas encompass less than 1% of the ecodistrict.

Ecodistrict boundary delineation

Site District 6E-1 as proposed by Hills (1959) included an area in the southeast that was later reclassified as a distinct site district (Hills 1976). Further analysis indicated that this section had vegetation characteristics more typical of areas to the south, and the area was assigned to Site Region 7E (Jalava et al. 1997). Further modifications to the boundary between 7E-6 and 6E-1 were also recommended by Jalava et al. (1997) to better reflect changes in surficial geology. Morainal deposits with drumlins in 6E-1 were distinguished from morainal material without drumlins in 7E-6 in the southeast, and in the east, very shallow to shallow morainal materials in 6E-1 were separated from deeper morainal material in 7E-6.

The northern boundary with Ecodistrict 6E-5 represents the transition from fine-textured morainal material to coarse-textured morainal material and a higher elevation in 6E-5. The western boundary with 6E-2 is defined by the Wyoming Moraine and the transition from a higher elevation in 6E-1 to the shore of Lake Huron. Along the eastern boundary, 6E-1 transitions from a relatively flat landscape with shallow mineral material to Niagara Escarpment influenced features in 6E-7. The boundary with Ecoregion 7E is defined by climatic and landscape variables. Ecoregion 6E is cooler, with a lower evapotranspiration rate, has a higher elevation, and is dominated by morainal material whereas glaciolacustrine deposits dominate in 7E.

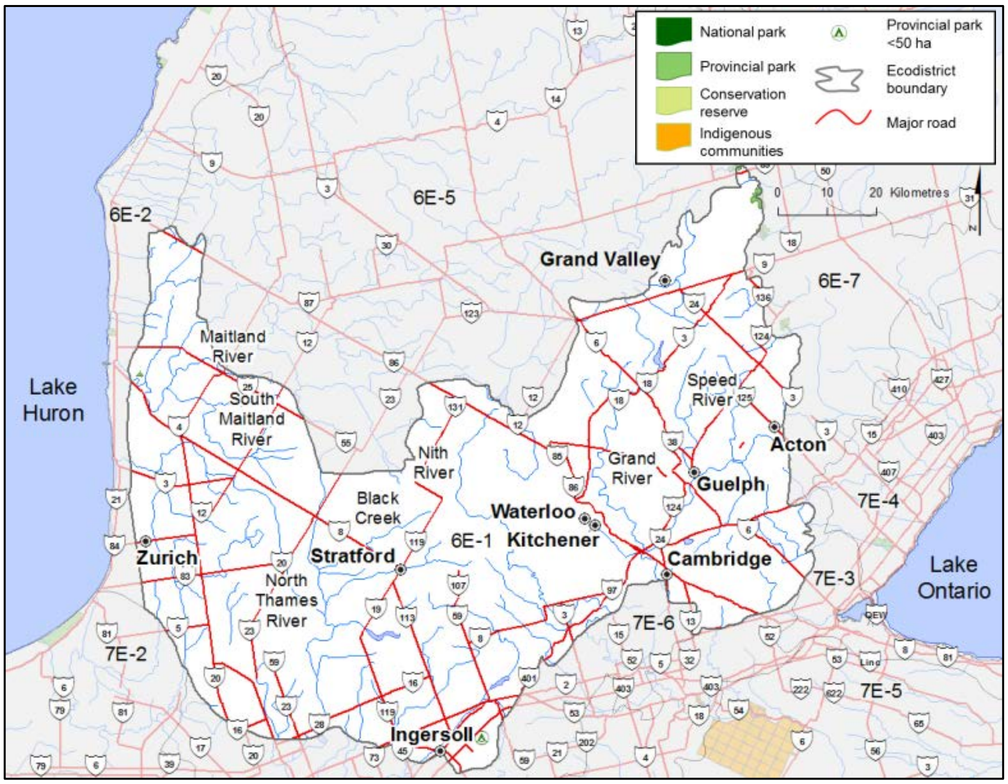


Figure 363. Select communities, natural heritage areas, major roads, and rivers in Ecodistrict 6E-1.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-2

Kincardine Ecodistrict

The Kincardine Ecodistrict is a long narrow strip of land located along the shore of Lake Huron. Ranging from 3 to 25 km wide, the northern boundary is near the community of Howdenvale and the southern boundary is near the community of Dashwood. It encompasses 147,253 ha (2.3% of the ecoregion, 0.2% of the province). The elevation increases from 173 m above sea level along the Lake Huron shoreline to 290 m above sea level north of Andrews Creek.

Figure 364. Cropland and deciduous forests in Ecodistrict 6E-2. Monique Wester. MNRF

Key features

- Three-quarters of the land base has been converted to cropland and pasture (Figure 364).
- Two-thirds of the ecodistrict is overlain by morainal material.
- Features relict shorelines of glacial lakes Warren, Algonquin, and the Nipissing Great Lakes.

Geology and substrates

The Kincardine Ecodistrict is characterized by two distinct landscape patterns (Chapman and Putnam 1984). Adjacent to the shore of Lake Huron, a narrow fringe comprising relict shorelines and wave-cut terraces of glacial lakes Warren, Algonquin, and the Nipissing Great Lakes occurs (Cowan and Pinch 1986). To the east, the ecodistrict slopes gently upward and is dominated by water-washed morainal material.

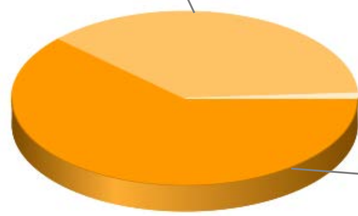


Figure 365. Modes of deposition in Ecodistrict 6E-2.

Ecodistrict 6E-2 is dominated by a gently rolling landscape of deep, calcareous, morainal material overlying Paleozoic bedrock (Figure 365). Beginning approximately 13,000 years ago (Dyke 2004) a series of glacial lakes inundated the area. Glacial lakes Warren, Algonquin, and the Nipissing Great Lakes each influenced the area, modifying the morainal material deposited by the glaciers. Glaciolacustrine deposits are more common along the Lake Huron shoreline and include sand and gravel shorelines of glacial Lake Warren (Cowan and Pinch 1986). Relict boulder, gravel, and sand shorelines as well as bluffs and scoured limestone created by glacial lakes Algonquin and the Nipissing Great Lakes also occur. Organic deposits are limited to low-lying areas with poor drainage. Larger deposits occur north of the Sauble River. Glaciofluvial and alluvial deposits can be found adjacent to larger rivers, while lacustrine and aeolian materials (Figure 366) occur with areas of bare bedrock along the Lake Huron shoreline.

Figure 366. Active aeolian mineral material at Point Farms Provincial Park along the Lake Huron shoreline. Ashely Demers, Ontario Parks.

Gray Brown Luvisols are common throughout the ecodistrict having developed in calcareous, well drained, morainal material with a significant component of fine-textured mineral material (Figure 367). Melanic Brunisols occur primarily inland and in the northern part of the ecodistrict, developing in calcareous, well drained morainal material with a limited amount of fine-textured mineral material. Gleysols are more common in the south, developing in low-lying areas with water accumulation. Mesisols occur in poorly drained areas particularly near lakes and rivers. Regosols are associated with active mineral material along rivers and the shore of Lake Huron.

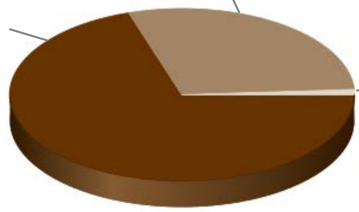


Figure 367. Substrate types in Ecodistrict 6E-2.

Land cover and vegetation

Ecodistrict 6E-2 is found in the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018). The northern portion is associated with the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region, and the southern portion, south of the community of Goderich, is associated with the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Nearly three-quarters of the land base has been converted to pasture and cropland (Figure 368). Natural features are more prominent along the Lake Huron shoreline occurring on shoreline cliffs, beach ridges, and sand dunes along with upland forests, river valley systems, and wetlands (Hanna 1984a).

Deciduous forests dominate the natural areas and occur more frequently near the shore of Lake Huron. In the north, sugar maple and American beech are common on upland sites. Tree associates include American basswood, white ash, yellow birch, and red, white, and bur oak. Large-toothed aspen, trembling aspen, butternut, American elm, eastern hop-hornbeam, and black cherry may also occur. On lowland, wetter sites green ash, red maple, and silver maple are common. In the south, these tree species are interspersed with vegetation more common in Ecoregion 7E including bitternut hickory, black oak, and rock elm.

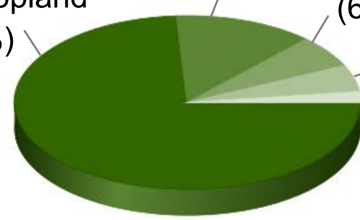


Figure 368. Land cover types in Ecodistrict 6E-2.

On dry sites, mixed forests may include eastern white pine and red pine. Cooler-than-normal, moist to wet areas support eastern hemlock, eastern white cedar, white spruce, black spruce, American larch, and balsam fir. Coniferous forests, including eastern red cedar on rock ridges or on dry substrates, are scattered throughout the ecodistrict. Abandoned agricultural fields may contain eastern white cedar and white spruce. Marshes and fen complexes occur in poorly drained areas or near the shoreline in sheltered embayments and creek mouths.

The proximity of Ecodistrict 6E-2 to Lake Huron results in a lake modified climate that includes higher rates of precipitation, warmer-than-normal winters, and cooler-than-normal summers. Warmer-than-normal conditions support species more common in the south including downy arrowwood and black huckleberry (Soper and Heimburger 1982). Ecosystems found in the area include alvar communities that support a notable group of plant and animal species and Great Lakes meadow marshes where plant species including stiff yellow flax and tuberous Indian-plantain can be found (Argus et al. 1982-1987). Significant beach and dune vegetation communities occur along the shoreline (Henson and Brodribb 2005). Pitcher's thistle, dwarf lake iris, and Great Lakes sandreed, species endemic to the Great Lakes, can be found adjacent to Lake Huron (Henson and Brodribb 2005).

Land use

Settlement and associated infrastructure cover approximately 2% percent of the ecodistrict and includes the communities of Goderich, Port Elgin, Kincardine, and Southampton (Figure 369). Agriculture, business and industry, wind power generation, aggregate and petroleum extraction, mining, and services associated with resource-based activities occur throughout the area. The ecodistrict comprises 1% protected areas.

Figure 369. Select communities, natural heritage areas, major roads, and rivers in Ecodistrict 6E-2.

Ecodistrict boundary delineation

The boundary of Ecodistrict 6E-2 has been modified to include the southwest portion of Hills' (1959) Site District 6E-3 along the Lake Huron shoreline. This area is characterized by deeper, sandy, mineral material consistent with Ecodistrict 6E-2 (Jalava et al. 1997). The northern boundary with 6E-4 reflects the transition from deep mineral material in 6E-2 to very shallow to shallow mineral material as well as an increase in elevation in 6E-4. A change in landscape relief and surficial material distinguishes 6E-2 from 6E-5. In the northern part of Ecodistrict 6E-2, a relatively flat topography, dominated by coarse-textured glaciolacustrine deposits, prevails whereas 6E-5 is characterized by drumlins that add relief to the area and fine-textured morainal deposits. At the southern end of the border between 6E-2 and 6E-5, the transition occurs at the Wyoming Moraine. Slight modifications have been made to this original boundary to better reflect changes in surficial material (Jalava et al. 1997). The southeastern boundary with 6E-1 is defined by the Wyoming Moraine and the transition to a higher elevation in 6E-1. The boundary with Ecoregion 7E is defined by climatic variables (e.g., 6E is cooler and has a lower evapotranspiration rate), elevation (higher elevation in 6E), and surficial geology (6E deposits are primarily morainal, 7E glaciolacustrine).

Lake Huron Alpena-Amberley Ridge

Approximately 11,500 years ago, the water level of Lake Huron was 100 m lower than present day, exposing a narrow ridge of land between northeastern Michigan and southern Ontario, south of the community of Kincardine. The Alpena-Amberley Ridge (Figure 370) was used as a travel corridor by Indigenous people and wildlife, and contains more than 60 stone constructions including a 9,000 year old hunting structure used to hunt caribou. Vegetation at the time included American larch, spruce, and *Sphagnum* mosses. The ridge was flooded 8,000 years ago as lake levels started to rise (O'Shea et al. 2014).

Figure 370. Alpena-Amberley Ridge [NOAA no date].

Ecodistrict 6E-4

Meaford Ecodistrict

Encompassing 171,678 ha (2.7% of the ecoregion, 0.2% of the province), the Meaford Ecodistrict covers much of the south shore of Georgian Bay. It extends from the community of Lion's Head in the northwest to the community of Craigleith in the east. The southern extent is near the community of Kimberley. The gently rolling landscape increases in elevation from 175 m above sea level along the Lake Huron shoreline to 541 m above sea level in the southeastern corner of the ecodistrict.

Figure 371. Agricultural fields and forests in the Meaford Ecodistrict. Monique Wester. MNRF.

Key features

- Cropland and pasture occupy nearly half of the ecodistrict (Figure 371).
- Very shallow to shallow morainal deposits dominate the landscape.
- Features the Niagara Escarpment and Georgian Bay cliffs.

Geology and substrates

The creation of an escarpment, a catastrophic subglacial meltwater flood, recession of glaciers, and glacial lakes has significantly shaped the Meaford Ecodistrict. A major feature of the area is the Niagara Escarpment, a Paleozoic bedrock ridge formed through the differential erosion by ice, water, and wind over millions of years. Associated with the Niagara

Escarpment are a series of bedrock cliffs that are found near or at the present Georgian Bay shoreline.

The Meaford Ecodistrict is dominated by a very shallow to shallow layer of calcareous, coarse-textured morainal material (Figure 372), a result of large volumes of glacial meltwater travelling under the ice and removing most of the morainal sediment (Cowan and Sharpe 2007). The glacial meltwaters also sculpted the landscape, leaving behind potholes and boulders from the Precambrian shield. The Gibraltar and Edenvale moraines in the east, drumlins in the west, and small deposits adjacent to rock knobs constitute deeper morainal deposits.

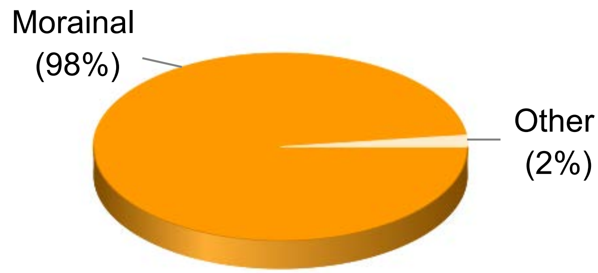


Figure 372. Modes of deposition in Ecodistrict 6E-4.

Glaciolacustrine features of glacial lakes Algonquin and the Nipissing Great Lakes that inundated the area nearly 12,000 years ago (Dyke 2004) are limited. Relict shorelines, terraces, shore bluffs, sea stacks, and shore caves can be found adjacent to the shores of Lake Huron and Georgian Bay. A deep water glaciolacustrine deposit from the Nipissing Great Lakes can be found south of the community of Lion’s Head (Cowan and Sharpe 2007). Organic deposits have developed in low-lying poorly drained areas. Larger organic deposits occur in pockets along the southwestern boundary, especially near the community of Owen Sound. Alluvial materials can be found along larger river systems including the Beaver River. Lacustrine deposits occur along the Georgian Bay and Lake Huron shorelines and on many of the islands. Glaciofluvial features are typically found adjacent to moraines. Additional geological features include karst topography such as sinkholes and solution caves with examples near the community of Lion’s Head (Kor 1992).

The dominant substrate types in Ecodistrict 6E-4 are Melanic Brunisols (Figure 373), which have developed in the widely distributed well drained, calcareous, coarse-textured morainal material. Gleysols are more commonly associated with glaciolacustrine deposits with poor drainage, especially south of the community of Lion’s Head. Gray Brown Luvisols are limited to fine-textured, well drained, morainal materials. Larger organic deposits, typically Mesisols, occur in poorly drained areas south of the community of Lion’s Head and Berford Lake and east of the community of Wiarton. These deposits often occur near lakes and rivers or along the shore of Lake Huron or Georgian Bay. Regosols are associated with active

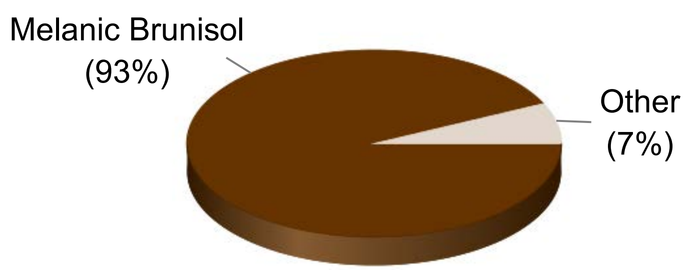


Figure 373. Substrate types in Ecodistrict 6E-4.

shorelines adjacent to Lake Huron, Georgian Bay, and river systems. Small areas of bare bedrock occur throughout the ecodistrict including cliffs and colluvial material (i.e., talus) along the Niagara Escarpment.

Land cover and vegetation

Associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972), natural ecosystems include deciduous, mixed, and coniferous forests, as well as marshes and fens. Approximately half of the land base has been converted to pasture and cropland (Figure 374). Natural land cover in the Meaford Ecodistrict is dominated by deciduous forests. Trees species include sugar maple, American beech, paper birch, eastern hop-hornbeam, white ash, American basswood, oak species, large-toothed aspen, trembling aspen, American elm, and black cherry. Green ash, red maple, black ash, and silver maple grow in wetter habitats.

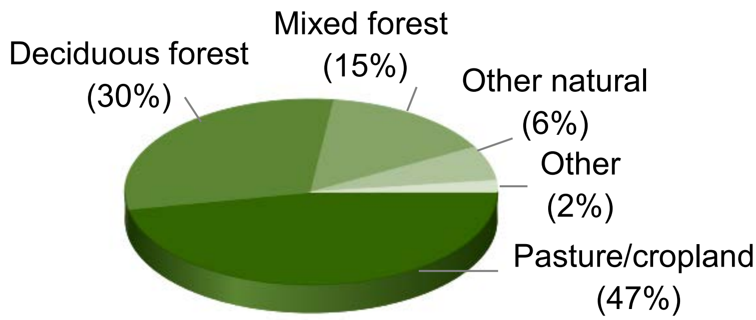


Figure 374. Land cover types in Ecodistrict 6E-4.

Mixed forests occur more frequently in the northern part of the ecodistrict consisting of eastern white pine and red pine on drier sites, and eastern white cedar, eastern hemlock, black spruce, American larch, white spruce, and balsam fir on cooler-than-normal, moist to wet sites with accompanying deciduous species. Coniferous forests occur scattered throughout the ecodistrict, with larger tracts growing in the northwest. Old growth eastern white cedar forests can be found on cliff faces. White spruce and eastern white cedars grow on abandoned agricultural fields. Fen complexes and marshes occur near lakes and rivers or adjacent to the shoreline in quiet embayments. Bare bedrock may be found along the Lake Huron or Georgian Bay shorelines (Figure 375).

A significant portion of Ecodistrict 6E-4 is bounded by Lake Huron resulting in a lake modified climate. Warmer-than-normal winters support the extension of southern species such as butternut and zigzag goldenrod, and cooler-than-normal summers help maintain disjunct boreal and subarctic species (e.g., prickly gooseberry, jack pine). Escarpment slopes with a northern aspect have a cooler microclimate and less evaporation, while southern facing slopes are warmer and drier. Open crevices and crevice caves support rich and sensitive vegetation communities that include bulblet fern and small enchanter's nightshade (Riley et al. 1996). Near Pike Bay, specialized environmental conditions support alvar communities with a unique assemblage of plants and animals including lance-leaved tickseed and Lake

Huron single-spike sedge. Bedrock and shore habitats support western species such as little bluestem and prairie dropseed (Riley et al. 1996).

Figure 375. Bedrock shoreline at Craigleith Provincial Park. Mike McMurtry, MNRF.

Land use

Agriculture, business and industry, aggregate extraction, hydroelectric and wind power generation, and services associated with resource-based activities occur in the ecodistrict. Settlement and associated infrastructure covers approximately 2% of the ecodistrict and includes the communities of Owen Sound, Meaford, Wiarton, and Thornbury (Figure 376). Protected areas encompass approximately 1.4% of the ecodistrict.

Ecodistrict boundary delineation

The western boundary of Ecodistrict 6E-4 has been modified to include the areas of shallow morainal material formerly part of Hills' (1959) Site District 6E-3 (Jalava et al. 1997). In addition, the southeastern boundary was moved slightly to the south to coincide with the physioclimatic boundary recognized by Riley et al. (1996). The northern boundary was extended to include the deeper glaciolacustrine deposits near Lion's Head. Refinements to the western and southern boundaries have occurred to better capture the shallow substrates of the Niagara Escarpment as they transition to morainal deposits. Eastern boundary refinements have occurred to more accurately reflect the transition from Niagara Escarpment slopes to morainal deposits. All the boundary changes were first proposed by Jalava et al. (1997).

Much of the boundary of Ecodistrict 6E-4 is delineated by the shorelines of Lake Huron and Georgian Bay. The northwestern boundary with Ecodistrict 6E-14 reflects the transition from deeper glaciolacustrine and morainal deposits in 6E-4 to very shallow morainal deposits in 6E-14. The southeast boundary with Ecodistrict 6E-5 is defined by a change from very shallow to shallow morainal deposits in 6E-4 to deeper morainal deposits with more relief (drumlins) in 6E-5. In the northeast and southwest, the landscape transitions from the higher elevation of the Niagara Escarpment in Ecodistrict 6E-4 to a lower elevation with deeper mineral material in 6E-2 and 6E-6. The boundary with 6E-7 in the east reflects the change from very shallow to shallow coarse-textured morainal material to deeper fine-textured morainal material.

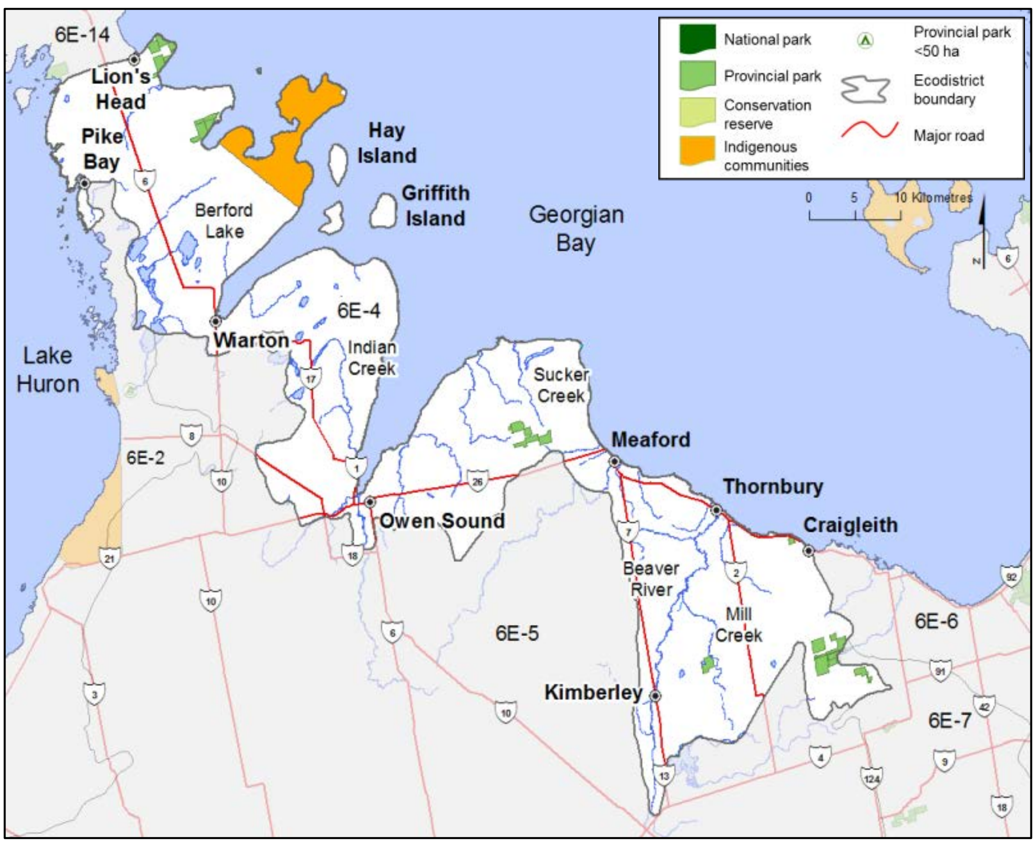


Figure 376. Select communities, natural heritage areas, major roads, lakes, and waterways in Ecodistrict 6E-4.

Ancient eastern white cedar forests

Cliff faces along the Niagara Escarpment are home to an ancient undisturbed forest ecosystem. Eastern white cedar trees older than 700 years have been discovered at several cliff sites along the escarpment. Near the community of Lion's Head, the oldest living tree in Canada east of British Columbia was discovered in 2000 (Figure 377). The eastern white cedar germinated in 952 A.D. making it 1050 years old (Kelly and Larson 2002). Trees along the escarpment tend to be very stunted, having adapted to growing in harsh conditions that may include rockfalls, drought, snow- and ice-loading, and physical abrasions (Kelly et al. 1992).

Figure 377. Ancient eastern white cedar at Lion's Head. Peter Kelly.

Ecodistrict 6E-5

Mount Forest Ecodistrict

The Mount Forest Ecodistrict encompasses 867,659 ha (13.8% of the ecoregion, 0.9% of the province). It extends from the community of Clavering in the north to Monkton in the south and from Bervie in the west to Shelburne in the east. The gently rolling landscape extends from 188 m above sea level in the northwest to 549 m above sea level east of Eugenia Lake.

Figure 378. Agricultural fields and forests of Ecodistrict 6E-5. Monique Wester. MNRF.

Key features

- Approximately three-quarters of the ecodistrict have been converted to cropland and pasture (Figure 378).
- Is dominated by deep morainal deposits.
- Contains large drumlin fields.

Geology and substrates

The Mount Forest Ecodistrict is characterized by a gently rolling topography with deep, calcareous, fine-textured morainal material overlying Paleozoic bedrock (Figure 379). Several moraines and

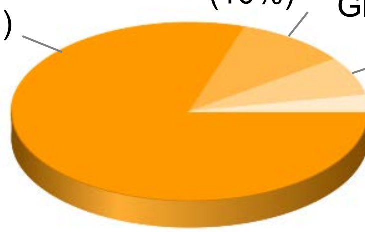


Figure 379. Modes of deposition in Ecodistrict 6E-5.

drumlins occur throughout the ecodistrict adding relief to the landscape, including the Singhampton and Gibraltar moraines in the north and the Teeswater and Arran drumlin fields in the west (Chapman and Putnam 1984). Sharpe (1990) noted that this area had some of the best morainal features in Ontario.

Approximately 14,000 years ago (Dyke 2004), glaciers retreated along three fronts — east, north, and west — leaving behind a series of moraines in a horseshoe pattern. Portions of Ecodistrict 6E-5 were among the first areas to become permanently uncovered as the glacier disappeared. Glacial meltwater was restricted by the ice margin, strongly modifying the adjacent landscape, until flowing south to glacial Lake Maumee. Glaciofluvial features (e.g., spillways, outwash plains) are scattered throughout the ecodistrict and provide the foundation for present day rivers including the Maitland and Saugeen. Eskers are more common here than in adjacent ecodistricts. Typically orientated northwest to southeast, larger esker systems occur north and west of Luther Lake.

Glaciolacustrine deposits are limited. The deepest and largest deposit is in the northwest, in a former bay of glacial Lake Warren. Organic deposits occur in low-lying depressions, remnants of small glacial ponds where water had accumulated. Alluvial deposits are common along the major river systems including the Sauble and Saugeen rivers. Patches of exposed bedrock may occur including areas east of the Bighead River.

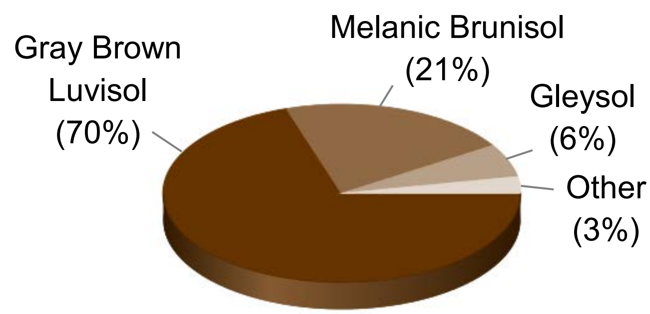


Figure 380. Substrate types in Ecodistrict 6E-5.

Gray Brown Luvisols in fine-textured, well drained, typically morainal material dominate the area (Figure 380). Melanic Brunisols have developed in the north and east in coarse-textured morainal deposits. In poorly drained mineral material, especially north and east of Luther Lake, Gleysols have developed, and where organic material has accumulated Mesisols occur. Regosols can be found in active mineral material including river shorelines.

Land cover and vegetation

Ecodistrict 6E-5 is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Approximately three-quarters of the land base has been converted to pasture and cropland (Figure 381). Deciduous forests of sugar maple, American beech, and oak and ash species dominate the natural areas. Associates can include eastern hop-hornbeam, American basswood, large-toothed aspen, paper birch, yellow birch, American elm, and black cherry, and to a lesser extent bitternut hickory, butternut, blue-beech, and black walnut. Forests of green ash, black ash, red maple, and silver maple grow on moister sites. Large areas of deciduous swamps occur around Luther Lake and east of the community of Bervie.

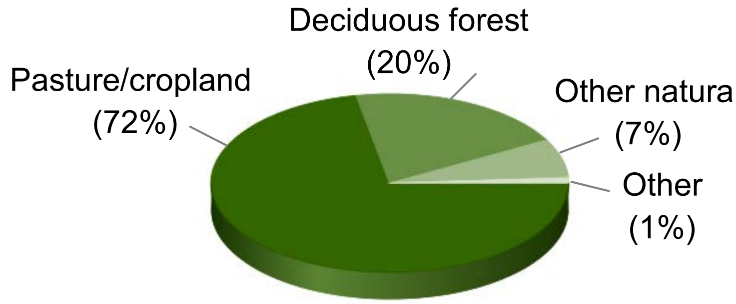


Figure 381. Land cover types in Ecodistrict 6E-5.

Mixed and coniferous forests are scattered through the ecodistrict. On drier sites, eastern white pine and red pine grow. Spruce species, eastern hemlock, balsam fir, American larch, and eastern white cedar are more common on cooler-than-normal, moist to wet sites. Eastern white cedar and white spruce may be found on abandoned agricultural fields. Marsh, fen, and bog complexes occur adjacent to lakes and rivers. Surrounding Luther Lake, the 5,680 ha Luther Marsh (Figure 382; GRCA and OMNR no date) contains one of the largest inland marshes (Lindsay 1984a) and bog (Riley 1988) in southern Ontario.

Figure 382. Luther Marsh Wildlife Management Area. Carl Hiebert/Grand River Conservation Authority.

Ecodistrict 6E-5 gently slopes from the Niagara Escarpment down to the west and represents the highest elevation in the area. The higher elevation creates a cooler and wetter environment compared with that in other ecodistricts in Ecoregion 6E (OMNR 2000). Cooler-than-normal environments that support plant species at their southern limits include wetlands (e.g., common Labrador tea, steeplebush; Waldron 1971) and moist sheltered valleys or north-facing slopes (e.g., mountain sweet cicely; Henson and Brodribb 2005). Plant species with western affinities that occur in the ecodistrict include male fern and northern holly fern (Henson and Brodribb 2005).

Land use

Settlement and associated infrastructure covers approximately 1% percent of the ecodistrict and includes the communities of Hanover, Listowel, Walkerton, Mount Forest, and Shelburne (Figure 383). Agriculture, business and industry, hydroelectric and wind power generation, aggregate and petroleum extraction, and services associated with resource-based activities occur throughout the ecodistrict. Protected areas make up less than 1% of the ecodistrict.

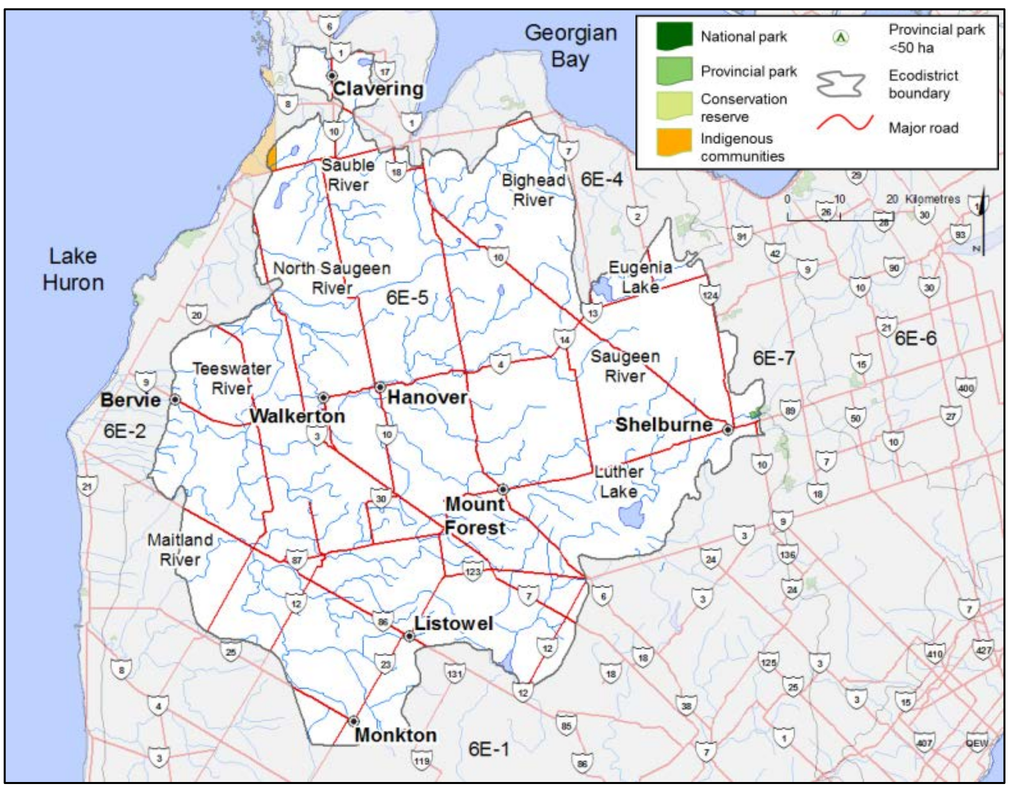


Figure 383. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 6E-5.

Ecodistrict boundary delineation

Proposed boundary changes to Site District 6E-5 by Jalava et al. (1997) have been adopted here to better reflect the transition from one ecodistrict to another. The northwestern boundary was shifted north to incorporate the deeper morainal materials (including drumlins) that were once part of Hills' (1959) Site District 6E-3. The northern boundary with 6E-4 was adjusted to better define the change from deeper morainal deposits with more relief (drumlins) in 6E-5 to very shallow to shallow morainal material. The southern boundary with 6E-1 has also been closely refined and signifies a change from coarse-textured morainal material at a higher elevation in 6E-5 to an area dominated by fine-textured morainal material. The boundary with 6E-2 has been adjusted to better reflect the transition from fine-textured glaciolacustrine and morainal material in 6E-5 to coarse-textured glaciolacustrine material. The boundary with 6E-7 occurs along the Gibraltar Moraine and the Niagara Escarpment.

Ontario Island and horseshoe moraines

The complex landscape of southern Ontario was partially shaped by glaciers. Glacial retreat typically occurs from south to north, but in southern Ontario it began from the east, north, and west. Nearly 14,000 years ago (Dyke 2004), the first split of several lobes of ice occurred near the community of Orangeville. As the glaciers melted, 'Ontario Island' was the first piece of land uncovered (Figure 384). Subsequent glacial retreat created a series of concentric horseshoe-shaped moraines around the island. Associated with the moraines are level areas of morainal material and glaciofluvial spillways (Chapman and Putnam 1984).

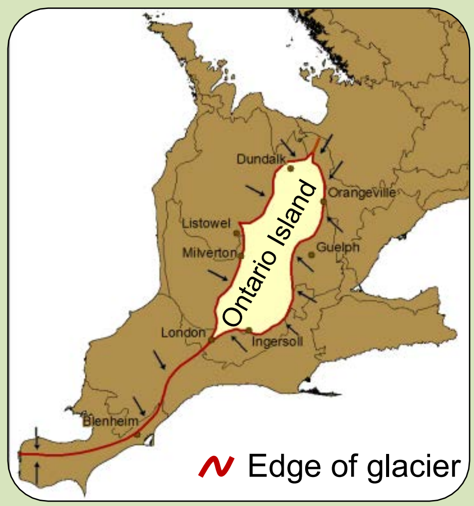


Figure 384. The creation of 'Ontario Island'. (Adapted from Chapman and Putnam 1984).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-6

Barrie Ecodistrict

Extending from the community of Collingwood in the west to the community of Bolsover in the east, the Barrie Ecodistrict encompasses 560,878 ha (8.9% of the ecoregion, 0.6% of the province) and includes Christian and Giants Tomb islands. The northern and southern extents are marked by the communities of Sawlog Bay and Aurora, respectively. The gently rolling landscape reaches a minimum elevation of 170 m above sea level near the North River and a maximum elevation of 415 m above sea level north of the community of Barrie.

Figure 385. Agricultural and forested areas adjacent to the community of Wasaga Beach. Joe Mabel.

Key features

- Over half of the land base has been converted to cropland and pasture (Figure 385).
- Glaciolacustrine deposits cover about half of the ecodistrict.
- Includes extensive areas of remnant lake beds from glacial lake Algonquin and the Nipissing Great Lakes as well as relict shorelines and shore cliffs.

Geology and substrates

The Barrie Ecodistrict is characterized by a gently rolling topography consisting of deep glaciolacustrine and morainal deposits overlying Paleozoic bedrock (Figure 386). While both deposits are calcareous, glaciolacustrine material is typically more calcareous. Strongly influenced by glacial lake Algonquin and the Nipissing Great Lakes nearly 12,000 years ago

(Dyke 2004), remnant lake beds consisting of deep, fine-textured glaciolacustrine mineral material are common. Numerous relict shorelines, cobble terraces, and shore cliffs encircle morainal material, indicating that these deposits were once islands in the glacial lakes (Chapman and Putnam 1984). Morainal features that provide additional relief include the Edenvale Moraine northwest of Barrie, the Oro Moraine north of Barrie, and small drumlin fields east of Lake Couchiching and along the southern boundary (Chapman and Putnam 1984).

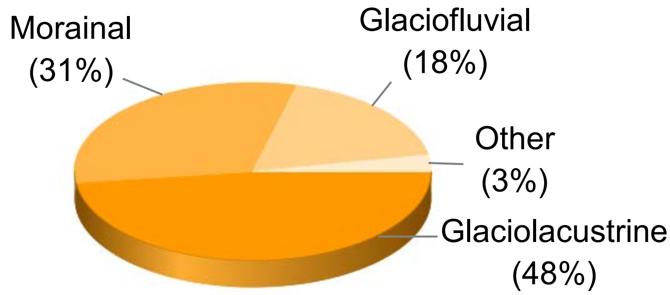


Figure 386. Modes of deposition in Ecodistrict 6E-6.

Glaciofluvial material can be found west of Lake Simcoe, typically adjacent to morainal sediment (Sado et al. 1993). Organic deposits typically occur on flat, low-lying, poorly drained materials and are scattered throughout the area. Larger deposits occur south along the Holland and Nottawasaga rivers. Several areas of organic material have been diked and drained creating productive, farmable land (e.g., Holland Marsh). Lacustrine and aeolian deposits occur along the shore of Georgian Bay and to a limited extent Lake Simcoe. Alluvial material has accumulated along larger rivers systems including the Mad and Nottawasaga rivers. Small areas of exposed bedrock with a discontinuous layer of very shallow mineral material occur west of Lake Couchiching and east of Lake Simcoe. Typically Paleozoic, Precambrian bedrock can be found along the northern boundary with ecodistricts 5E-7 and 5E-8. Aeolian deposits and cobble and boulder beaches are components of the Georgian Bay shoreline.

The dominant substrate types are Gray Brown Luvisols that have developed in fine-textured, well drained mineral material (Figure 387). Melanic Brunisols have developed in the northwest, on the eastern side of Lake Simcoe, and east of the community of Wasaga Beach, generally in coarse-textured deposits. Gleysols occur in poorly drained areas on fine-textured mineral material, including along the north shore of Lake Simcoe and northwest of Barrie. Mesisols have developed where organic materials have accumulated. Regosols are associated with active mineral material including lacustrine, aeolian, and alluvial deposits. Bedrock is limited across the landscape occurring more frequently in the northeast.

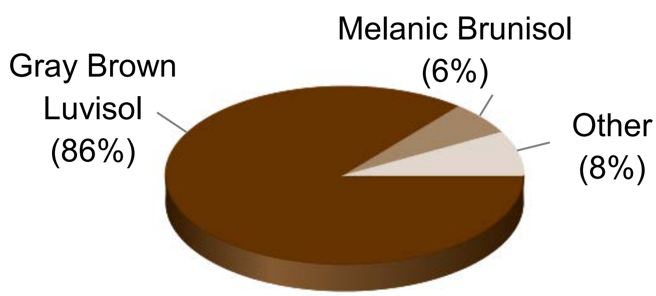


Figure 387. Substrate types in Ecodistrict 6E-6.

Land cover and vegetation

The Barrie Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Over half of the area has been cleared, creating agricultural fields for pasture and crops (Figure 388). The remaining landscape is dominated by a mix of upland and lowland forests, including areas on Christian Island and along the Georgian Bay shoreline near the community of Sawlog Bay. Several old growth forests have been identified in the south (OMNR 2009b). Sugar maple with American beech and northern red oak dominate the upland deciduous forests. Tree species associates include yellow birch, white ash, American basswood, white oak, black cherry, American elm, balsam poplar, and eastern hop-hornbeam. Younger sites support paper birch, trembling aspen, and large-toothed aspen. Less common tree species include butternut and blue-beech. Tree species growing in lowland deciduous forests include red maple, silver maple, black ash, bur oak, and green ash (Figure 389). Mixed and coniferous forests may include eastern hemlock, spruce species, eastern white cedar, balsam fir, and American larch on cooler-than-normal, moist to wet sites. Forests of eastern white pine and red pine are typically found on deep, dry, glaciolacustrine deposits in the south (Varga 1992) and near the community of Wasaga Beach (Brunton 1989, North-South Environmental Inc. 2005). Abandoned agricultural fields may contain white spruce and eastern white cedar. Marsh and fen complexes occur adjacent to lakes and rivers including shoreline wetlands along Georgian Bay and Lake Simcoe. Areas of very shallow substrates and bedrock in the northeast may support alvar ecosystems. Active sand beaches and dunes occur in the west along the Georgian Bay shoreline and on Giants Tomb Island. American beachgrass and American sea rocket, two species more commonly found in the east, may occur in these areas (Brunton 1989, Kamstra and Spisani 2009). Grassland ecosystems (e.g., meadows, woodlands) more commonly found in the central United States may occur in the southern portions of Ecodistrict 6E-6. Plant species that occur in these areas include big bluestem and prairie buttercup (Korol 2008).

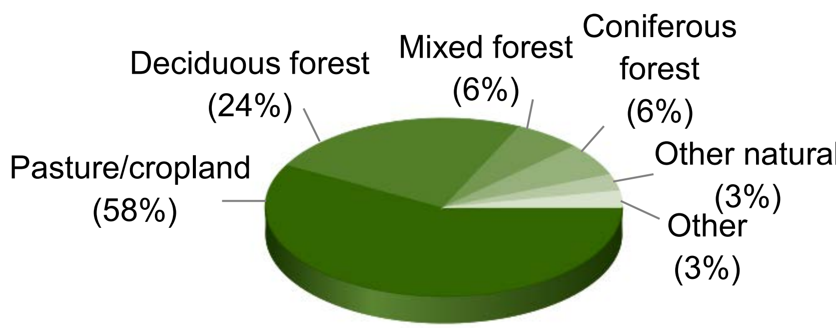


Figure 388. Land cover types in Ecodistrict 6E-6.

The moderating effects of Georgian Bay increases humidity and precipitation while creating cooler spring conditions and extending the summer growing season, especially in areas adjacent to the shore. These effects allow plant species such as poison sumac and New Jersey Tea to grow near their northern extents (Soper and Heimburger 1982). Along the Nottawasaga River, west of the community of Barrie, a large wetland complex consisting of swamp, marsh, and fen communities occurs, providing habitats for boreal and temperate plant species beyond their normal range. Conifer swamps more typical of northern Ontario occur and tree species found in the south such as common hackberry grow here as well (Bowles et al. 2007).

Figure 389. Silver maple swamp near Lake Simcoe. Wasyl Bakowsky, MNRF.

Land use

Large communities (i.e., populations greater than 15,000) in Ecodistrict 6E-6 include Barrie, Newmarket, Aurora, Georgina, Orillia, and Collingwood (Figure 390). Settlement and associated infrastructure occupy 2% percent of the area. Agriculture, recreation and services associated with resource-based activities, business and industry, wind power generation, and aggregate extraction occur throughout. Less than 1% of the ecodistrict comprises protected areas.

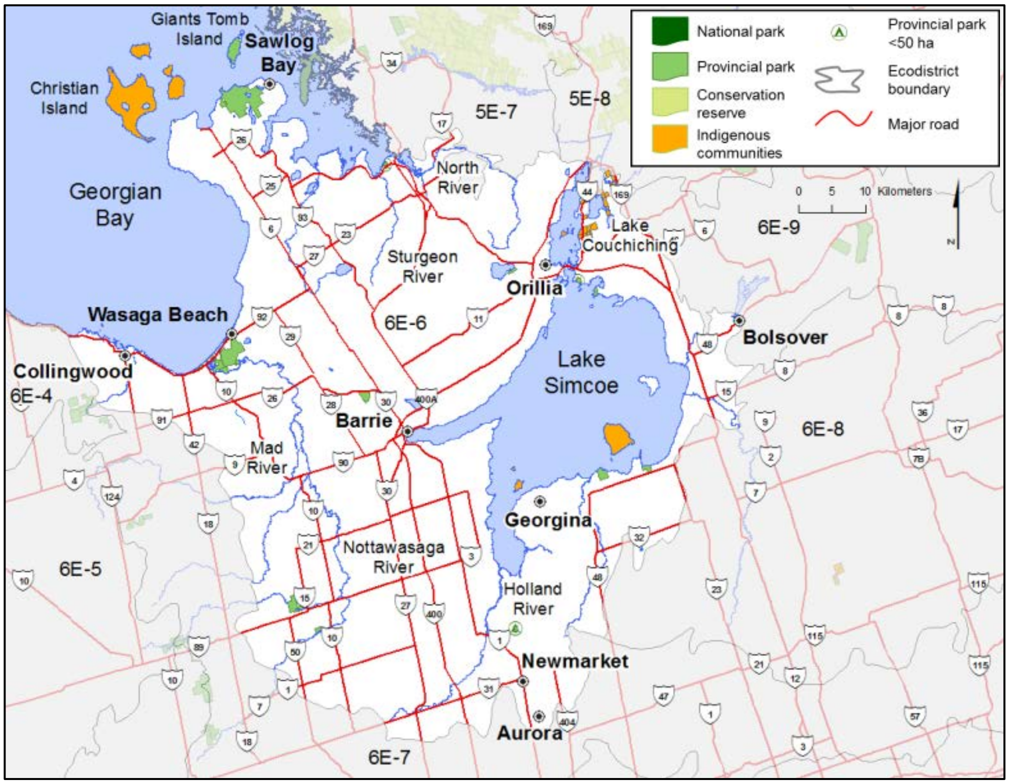


Figure 390. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 6E-6.

Ecodistrict boundary delineation

Based on the recommendation of Jalava et al. (1997) several boundary changes have been made to Ecodistrict 6E-6 since the publication of Hills' (1959) site districts. The northern boundary with Ecodistrict 5E-7 was refined to better reflect the transitions from fine-textured mineral material and Paleozoic bedrock features of 6E-6 to shallow morainal deposits and Precambrian bedrock in 5E-7. The eastern boundary was altered to more closely follow the deep fine-textured deposits of 6E-6 as they change to shallow mineral material in 6E-9 and coarse-textured morainal deposits in 6E-8. The southeast boundary of the Barrie Ecodistrict has been adjusted to include the glaciolacustrine deposits originally included in 6E-8. The boundary with 6E-7 has been adjusted to better reflect the change from glaciolacustrine and morainal deposits with little relief in 6E-6 to morainal deposits with relief, glaciofluvial features, and the lower slopes of the Niagara Escarpment in 6E-7. In additional to minor adjustments, the shift has resulted in the allocation of two fine-textured deposits in the south from 6E-7 to 6E-6.

The northeast boundary with 6E-9 reflects the transition from deep mineral material in 6E-6 to very shallow mineral material in 6E-9 as well as an increase in elevation. The eastern boundary with 6E-8 is defined by the change from glaciolacustrine deposits in 6E-6 to morainal deposits in 6E-8. The boundary with 6E-7 occurs along the Oak Ridges Moraine. In the west, the landscape transitions from a lower elevation with a thicker overburden in 6E-6 to the higher elevation of the Niagara Escarpment in 6E-4. The northwestern boundary is delineated by Georgian Bay. The northern boundary with 5E-7 and 5E-8 is based on ecoregional temperature, precipitation, and bedrock differences. Ecoregion 6E is warmer and drier than Ecoregion 5E, and the underlying bedrock is Paleozoic compared with Precambrian bedrock in the north.

Ramsar Convention Sites - Minesing Wetlands and Matchedash Bay

In 1996, two wetlands of international importance were designated in Ecodistrict 6E-6 under the Ramsar Convention (Figure 391), an international treaty providing a framework for conservation and wise use of wetlands. The Minesing Wetlands, approximately 16 km west of the community of Barrie, and Matchedash Bay, east of the Sturgeon River, are wetland complexes consisting of swamp, marsh, and fen communities that host diverse populations of plants and animals. The wetlands support rare plants (e.g., eastern prairie fringed orchid, Figure 392); marsh valerian, Figure 393) and animals, include major staging areas for migratory birds, provide breeding habitat, and are movement corridors for large mammals (Bowles et al. 2007).

Figure 391. Ramsar sites in Ecodistrict 6E-6.

Figure 392. Eastern prairie fringed orchid. Mike Oldham, MNRF.

Figure 393. Marsh valerian. Wasyl Bakowsky, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-7

Oak Ridges Ecodistrict

Encompassing 442,544 ha (7.0% of the ecoregion, 0.5% of the province), Ecodistrict 6E-7 forms a narrow band from the community of Orangeville in the west to the community of Hilton in the east. The northern and southern extents occur near the communities of Duntroon and Halton Hills. The Oak Ridges Ecodistrict reaches it minimum elevation (105 m above sea level) east of the community of Hilton, and maximum elevation (545 m above sea level) in the northwest corner, west of the community of Duntroon.

Figure 394. Agricultural fields and forests of Ecodistrict 6E-7. Corina Brdar, Ontario Parks.

Key features

- Over half of the ecodistrict has been converted to cropland and pasture (Figure 394).
- The mostly gently rolling to hilly landscape is dominated by deep morainal material.
- Features the Oak Ridges Moraine, one of the province's largest moraines.

Geology and substrates

Morainal deposits, glaciofluvial modifications, and glaciolacustrine influences have shaped the landscape of Ecodistrict 6E-7. Deep, calcareous, morainal deposits on Paleozoic bedrock dominate the ecodistrict (Figure 395). The Niagara Escarpment, a large ridge that was formed through the differential erosion of Paleozoic bedrock over millions of years by ice, water, and wind occurs in the west. Associated with the escarpment are cliff, talus, and crevice systems, including a 25 m deep crevice cave (Riley et al. 1996). In the south, a relatively level landscape of morainal material with drumlins can be found. In the north and west, morainal deposits are deeper, forming larger systems including the Orangeville, Singhampton, Gibraltar, and Oak Ridges moraines (Chapman and Putnam 1984).

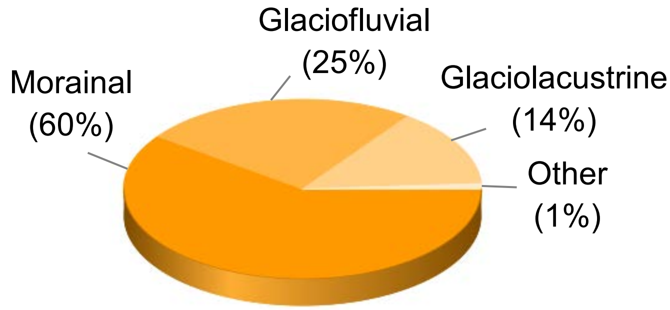


Figure 395. Modes of deposition in Ecodistrict 6E-7.

The Oak Ridges moraine is a prominent feature in Ecodistrict 6E-7, representing the most distinct stratified morainal system in southern Ontario (Barnett et al. 1998). Nearly 13,000 years ago (Dyke 2004), the Oak Ridges Moraine was formed under and between four ice lobes (Kor et al. 2013b), resulting in a mix of glaciofluvial, glaciolacustrine, and morainal sediment. Glacial meltwater flowing beneath the ice deposited glaciofluvial material. During glacial retreat, the glacier overlying the moraine split into a southern and northern lobe. Glacial meltwaters, restricted by the Niagara Escarpment in the west and the ice margins, flooded portions of the area modifying the existing deposits and blanketing the area with glaciolacustrine material. At the glacier edges, morainal sediments were deposited. A minor glacial readvance covered the southern edge of the Oak Ridges Moraine resulting in topography that supports an extensive system of kettle wetlands (Barnett et al. 1998). As the glacier melted, water flowed to the south developing a succession of meltwater channels and carving out several valley systems. One of the province’s largest post-glacial meltwater channels flowed through this area, depositing glaciofluvial material on the Niagara Escarpment (Riley et al. 1996).

The largest concentration of glaciolacustrine material occurs in the east in a former embayment of glacial Lake Iroquois (Chapman and Putnam 1984). Smaller areas can be found on the Oak Ridges Moraine in places affected by brief standing or slow moving meltwater. Organic deposits are scattered in small patches throughout the ecodistrict in low-lying areas where water accumulates. Alluvial material can be found along river systems including the Humber and Credit rivers. Very shallow to bare bedrock occurs in the west, typically along sections of the Niagara Escarpment.

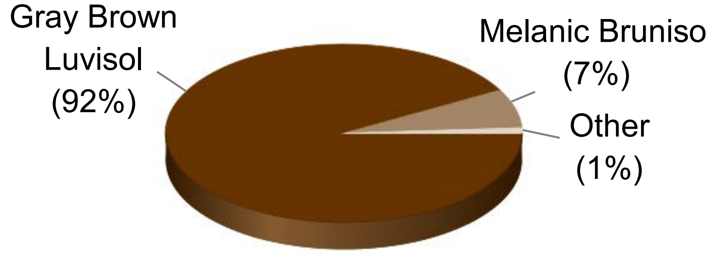


Figure 396. Substrate types in Ecodistrict 6E-7.

Gray Brown Luvisols dominate the area occurring in fine-textured, well drained mineral material (Figure 396). On coarse-textured glaciofluvial deposits east of Highway 48, Melanic Brunisols are common. Gleysols are limited across the land base occurring in fine-textured mineral material, typically in low-lying areas where water can accumulate. Organic materials, typically Mesisols, are scattered throughout the ecodistrict. Regosols are associated with alluvial deposits along rivers. Patches of bare bedrock are restricted to the west.

Land cover and vegetation

The Oak Ridges Ecodistrict is found in the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018). It is also primarily associated with the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region with the southern portion found in the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Approximately two-thirds of the land cover in Ecodistrict 6E-7 has been converted to agriculture land (Figure 397). Larger tracts of forest are generally restricted to the Oak Ridges Moraine and the Niagara Escarpment. Deciduous forests dominate, consisting of sugar maple, American beech, red maple, oak species, poplar species, paper birch, ash species, and yellow birch. Associates include American basswood, eastern hop-hornbeam, black cherry, and in moist areas silver maple, American elm, and green ash. In the south, bitternut hickory, butternut, black walnut, and blue-beech can occur. Black oak may be found in the east. The Oak Ridges Moraine supports several old growth forests (OMNR 2009b).

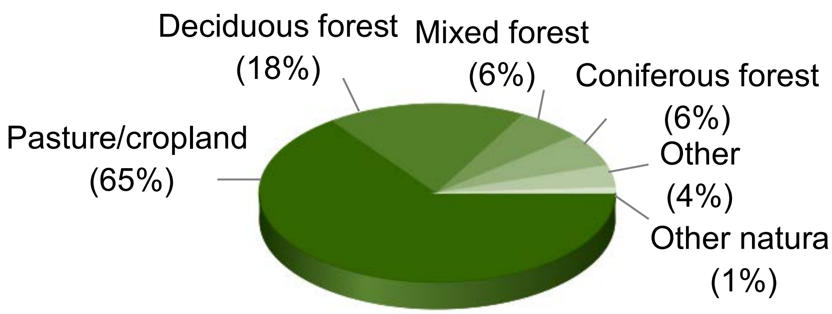


Figure 397. Land cover types in Ecodistrict 6E-7.

Mixed forests (Figure 398) are variable but generally comprise maple, American beech, and eastern hemlock when cooler-than-normal, humid conditions prevail. Eastern white pine is a common component of mixed forests on dry sites. Spruce species and balsam fir occur across the ecodistrict on cooler-than-normal sites. Coniferous forests on cooler-than-normal, wetter sites are dominated by eastern white cedar, black spruce, and American larch. White spruce and eastern white cedar are assoicated with abandoned agricultural fields. Small bog and fen complexes and marshes are scattered across the landscape; many having formed in depressions or kettles along the western half of the Oak Ridges Moraine (Lindsay 1984b; OMNR 2001b, d). Bog and fen complexes found in kettles along the moraine (i.e., kettle peatlands) are some of the best examples in the province. Wetland complexes on cooler-than-normal sites support northern species (e.g., rose pogonia, northern bog rosemary, and pale laurel; OMNR 2001d).

Meadow and woodland ecosystems with grassland affiliates are limited within the ecodistrict. Small pockets occur in the east, including woodlands dominated by black oak and Pennsylvania sedge and meadows with yellow Indian-grass, big bluestem, and prairie buttercup. The area also supports an 'older-growth' forest with sugar maple, white oak, northern red oak, eastern white pine, American beech, and white ash (Ontario Parks 2009a).

Figure 398. Mixed forest in Peter's Woods Provincial Park. Sam Brinker, MNRF.

Warmer-than-normal, dry south-facing slopes support a variety of southern species including American witch-hazel and woodland sunflower (OMNR 2001d). Northern species near their southern limits, including dusty-spike sedge, fringed black bindweed, and mountain sweet cicely (Riley et al. 1996), are limited to cooler-than-normal habitats such as wet, sheltered valleys or moist north-facing slopes. Niagara Escarpment cliffs support old-growth eastern white cedar and crevice floors are herb rich, growing species such as evergreen wood fern, American spikenard, and bulblet fern (Riley et al. 1996).

Land use

Settlement and associated infrastructure covers approximately 2% of the ecodistrict and includes the communities of Vaughan, Halton Hills, Caledon, Georgetown, and Orangeville (Figure 399). Agriculture, business and industry, wind power generation, aggregate and petroleum extraction, and services associated with resource-based activities occur throughout the ecodistrict. Less than 1% of the ecodistrict has been designated as protected areas.

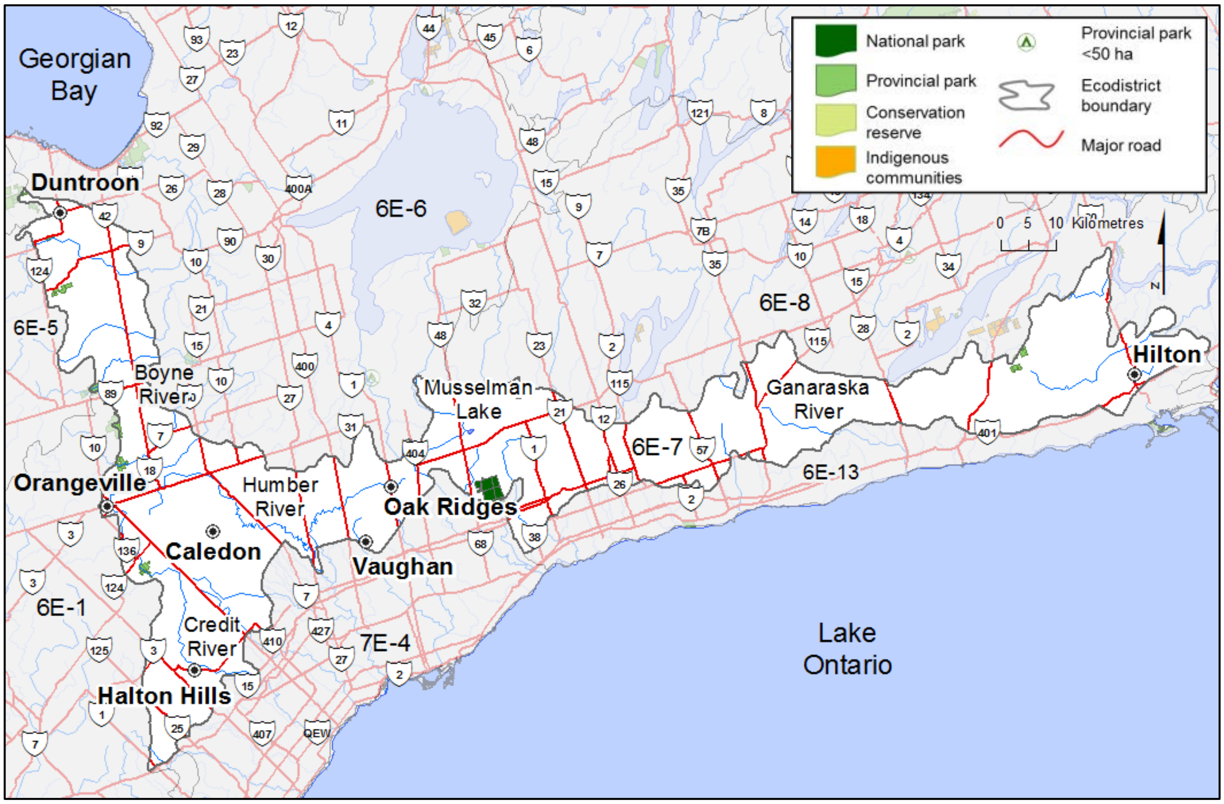


Figure 399. Select communities, natural heritage areas, major roads, and rivers in Ecodistrict 6E-7.

Ecodistrict boundary delineation

The boundaries of the Oak Ridges Ecodistrict have been refined since the original site districts were published by Hills (1959). The western boundary and northwest portion more closely follow the Niagara Escarpment and glaciofluvial features in the area (Jalava et al. 1997). The extreme northwestern boundary with Ecodistrict 6E-4 has been adjusted to coincide with the physioclimatic boundary recognized by Riley et al. (1996). The boundary also reflects the change from deeper fine-textured morainal material in 6E-7 to very shallow to shallow coarse-textured morainal material in 6E-4. The northern boundary more closely follows the Oak Ridges Moraine (Jalava et al. 1997), distinguishing 6E-7 from the fine-textured deposits in 6E-6 and areas of drumlins in 6E-6 and 6E-8. The southeastern boundary with 6E-13 has been modified to better reflect the transition from morainal to glaciolacustrine deposits (Jalava et al. 1997). Along the western boundary with 6E-1, the higher elevation, deeper substrates, and Niagara Escarpment influenced features of 6E-7 change to a relatively flat landscape with shallow mineral material. The boundary with 6E-5 occurs along the Gibraltar Moraine and the Niagara Escarpment. The boundary with Ecoregion 7E is defined by climatic variables (i.e., 6E is cooler and has a lower evapotranspiration rate), elevation (higher elevation in 6E), and surficial geology (6E is predominately morainal material and 7E is glaciolacustrine). Adjustments have also clarified the transition from morainal deposits with relief in 6E-7 to morainal deposits without relief in 7E-4 (Jalava et al. 1997).

Kettle lakes and wetlands

The Oak Ridges Moraine represents a unique collection of environmental, geological, and hydrological features. Covering an area of 190,000 ha, it hosts a diverse range of fauna and flora, some of which are provincially and nationally rare (OMMAH 2002) and is the source for 60 watersheds (Varga 2001). Scattered throughout the western part of the moraine are kettle lakes that formed when huge blocks of ice, left behind when the glaciers retreated, melted leaving a hollow space that was eventually filled with water (Figure 400). Although small, the kettles support a range of wetlands including treed and thicket swamps, marshes, open water habitat, fens, and bogs (OMNR 2001d). Rare in southern Ontario (Bakowsky 1996), kettle peatlands (i.e., bogs and fens) are highly specialized vegetation types hosting plant species adapted to acidic and often cooler-than-normal conditions.

Figure 400. Musselman Lake kame and kettle complex. David Webster, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-8

Peterborough Ecodistrict

The Peterborough Ecodistrict extends from the community of Fenelon Falls in the north to the community of Trenton in the south. The eastern boundary is near the community of Plainfield and the western extent is marked by the community of Mount Albert. The ecodistrict encompasses 532,069 ha (8.4% of the ecoregion, 0.5% of the province). The gently rolling landscape reaches its minimum elevation of 80 m above sea level near the community of Trenton and maximum elevation of 399 m above sea level east of Lake Scugog.

Figure 401. Drumlin landscape near the Trent River. Sam Brinker, MNRF.

Key features

- Cropland and pasture occur over nearly two-thirds of the ecodistrict (Figure 401).
- Deep substrates of morainal origin dominate the area.
- Features extensive drumlin fields.

Geology and substrates

Ecodistrict 6E-8 is a gently rolling landscape of Paleozoic bedrock overlain with calcareous morainal material (Figure 402). The thickness of morainal deposits is variable, grading from very shallow to shallow in the north to deep in the south. The landscape is interspersed with thousands of drumlins, with two or three occurring in a square kilometre (Gillespie and Acton

1981). Several moraines also occur in the area including one east of Sturgeon Lake and two additional ridges farther east (Marich 2016).

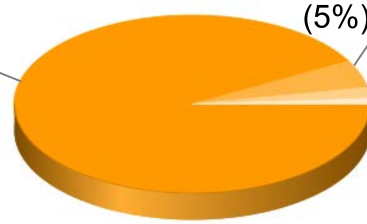


Figure 402. Modes of deposition in Ecodistrict 6E-8.

Glaciofluvial or glaciolacustrine deposits are often found in areas where the drumlins are more widely spaced (Gillespie and Acton 1981). In the east, a large glaciolacustrine deposit represents a former embayment of glacial Lake Iroquois (Chapman and Putnam 1984) that inundated the area nearly 12,000 years ago (Dyke 2004). In the west, glaciolacustrine material can be found to the north and south of Lake Scugog (Sado et al. 1993). Relict beach features of glacial Lake Iroquois (e.g., shore cliffs and terraces) occur near Oak Lake and north of the community of Trenton. Glaciofluvial features, (e.g., eskers, spillways) are limited. Eskers cover a small area in the ecodistrict but are notable (Figure 403; Chapman and Putnam 1984). Examples occur east and west of the Pigeon River, south of the community of Fenelon Falls, west of the Ouse River, and east of the Trent River. Spillways occur in large river valleys, former post-glacial rivers, which now form major river system in the ecodistrict (e.g., Indian and Ouse rivers). Organic deposits typically occur adjacent to lakes or river systems. Areas of very shallow to bare bedrock occur in the north and east (Sado et al. 1993) where glaciers removed much of the overlying material. Lacustrine deposits can be found along lake shores including Sturgeon Lake and Lake Scugog. River systems may contain alluvial material.

Figure 403. Esker south of the community of Fenelon Falls. Monique Wester, MNRF.

Gray Brown Luvisols and Melanic Brunisols occur over much of the ecodistrict (Figure 404). Gray Brown Luvisols are more common in the south in deep fine-textured, well drained mineral material. Melanic Brunisols occur in the north in coarse-textured, well drained mineral material. In the east, Gleysols have developed in low-lying areas with poor drainage. Organic deposits, typically Mesisols or Humisols (Gillespie and Acton 1981), occur in low-lying areas adjacent to rivers and lakes. Patches of bare bedrock occur in the north and east. Regosols are associated with lacustrine and alluvial deposits adjacent to lakes and rivers.

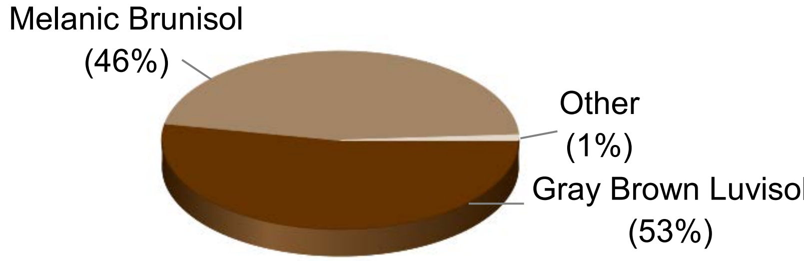


Figure 404. Substrate types in Ecodistrict 6E-8.

Land cover and vegetation

Ecodistrict 6E-8 occurs in the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) included most of the ecodistrict in the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region. The southeastern portion, which includes the Trent River and the communities of Plainfield and Trenton and the southern tip of Rice Lake, is associated with the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972).

Cropland and pasture occupy approximately two-thirds of the ecodistrict (Figure 405). Deciduous forests are the most common forest type. Scattered throughout the ecodistrict, these forests typically comprise sugar maple, American beech, red maple, oak species, white ash, eastern hop-hornbeam, poplar species, paper birch, yellow birch, American basswood, and black cherry. Moist deciduous sites support silver maple, American elm, black ash, and green ash. Larger deciduous swamps, typically with silver maple, occur along the Trent and Beaver rivers and at the southern tip of Lake Scugog. Species more common to the south, such as bitternut hickory, shagbark hickory, butternut, blue-beech, and black maple may be found in the southern portion of the ecodistrict. Old growth forests have been identified in the southwest (OMNR 2009b). Mixed and coniferous forests with eastern hemlock occur on cooler-than-normal sites. Drier conditions support eastern white pine and eastern red cedar. Eastern white cedar with

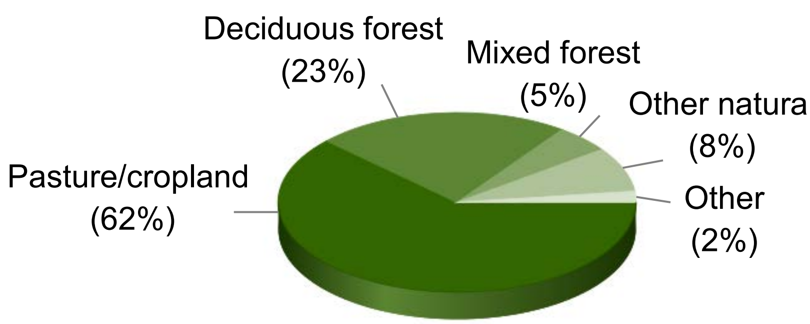


Figure 405. Land cover types in Ecodistrict 6E-8.

American larch, black spruce, white spruce and balsam fir, species more common farther north are generally found on cooler-than-normal moist to wet sites. Abandoned agricultural land may include eastern white cedar and white spruce. Marshes have formed along the shores of lakes and large river systems. Large marsh complexes, south of Lake Scugog, south of the Trent River, and along the Beaver River, provide habitat for a diversity of plant and animal species. Limited across the ecodistrict are bog and fen complexes. The Derryville Bog, north of the community of Sunderland, was recognized by Riley (1988) as one of the 12 largest bogs (>75 ha) in Ontario not on the Canadian Shield. The cool, acidic, wet conditions of the bog support a low diversity of plant species (e.g., sheep laurel, small cranberry; Gould 1988) more commonly found to the north. Meadow and woodland ecosystems containing grassland species more common to the central United States occur along the eastern boundary near the community of Trenton (Brownell and Blaney 1995, 1996) and east of Rice Lake (Bakowsky 1993). Grassland species in these ecosystems include little bluestem, big bluestem, round-headed bush-clover, and prairie redroot.

Land use

Approximately 1% of the area is devoted to settlement and associated infrastructure including the communities of Peterborough, Trenton, and Lindsay (Figure 406). Agriculture, business and industry, aggregate extraction, wind power and hydroelectric generation, and services associated with resource-based activities occur throughout the ecodistrict. Less than 1% of the ecodistrict is designated as protected areas.

Ecodistrict boundary delineation

The boundaries of the Peterborough Ecodistrict have been adjusted to more closely follow the prevailing landform features (Jalava et al. 1997). The northern boundary as represented by Hills (1959) has been refined to follow the transition between morainal deposits punctuated by drumlins in 6E-8 to the Dummer Moraine (northeast) and very shallow bedrock controlled landscape (northwest) of Ecodistrict 6E-9. The southern boundary with 6E-7 has been more closely aligned with the Oak Ridges Moraine. The western boundary has been refined to better define the transition from coarse-textured morainal material in 6E-8 to deep fine-textured mostly glaciolacustrine deposits of 6E-6. This includes the incorporation of glaciolacustrine deposit in the northwestern part of 6E-8. Minor adjustments were made to the southern boundary with 6E-15 to better define morainal deposits with relief (e.g., drumlins) in 6E-8 with morainal deposits with little to no relief in 6E-15.

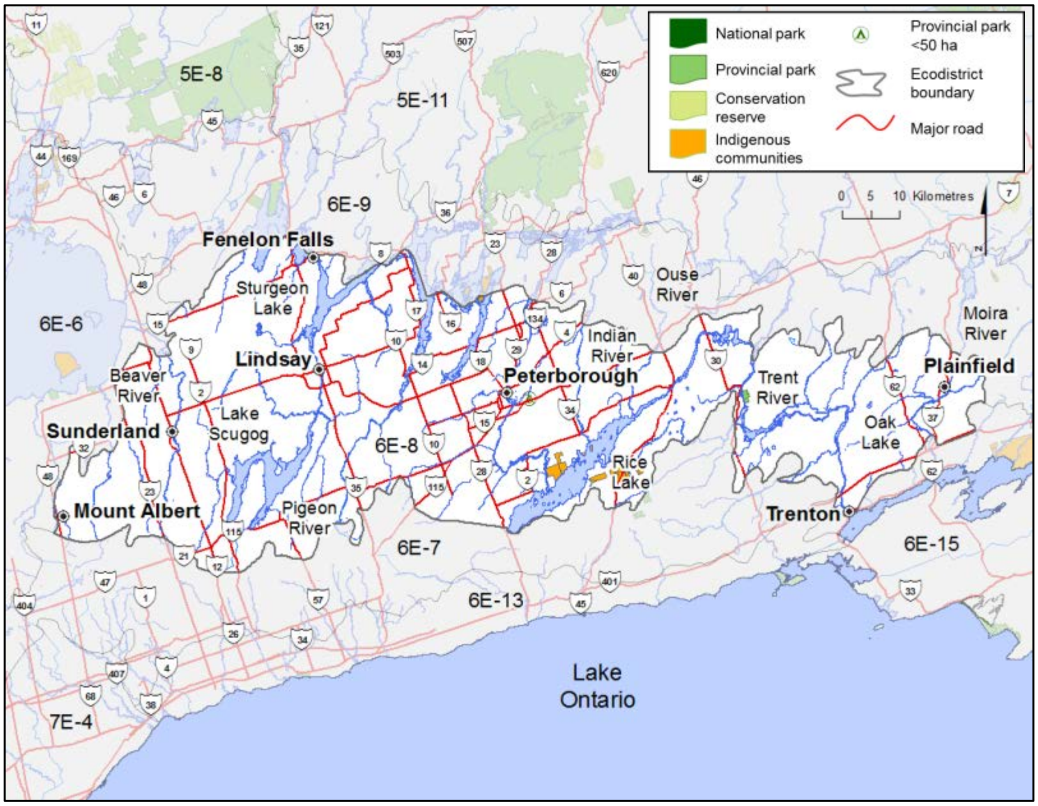


Figure 406. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 6E-8.

Figure 407. 330+ year old sugar maple. Wasyl Bakowsky, MNRF.

Old growth deciduous trees

A walk through the forests of Ecodistrict 6E-8 will reveal a rich history of old growth trees. Though much of the area in southern Ontario has been logged or cleared for agriculture, some areas remain relatively untouched. In 2012, several trees with old growth characteristics were aged in Mark S. Burnham Provincial Park, east of Peterborough. The oldest tree found was a sugar maple aged at 330 years (Bakowsky 2013). Compared with the stunted old growth eastern white cedar along the Niagara Escarpment, old growth deciduous trees (>250 years) are tall with smooth or balding bark in the bottom section and consistent diameter along the stem; have large, thick, gnarled branches; and often have damaged crowns (Pedersen 2010).

Ecodistrict 6E-9

Havelock Ecodistrict

Extending from Highway 169 in the west to the community of Sunbury in the east, Ecodistrict 6E-9 is a long narrow band of land encompassing 421,168 ha (6.7% of the ecoregion, 0.4% of the province). With a maximum width of approximately 30 km, the northern limit of the ecodistrict occurs at the community of Norland and the southern boundary near the community of Odessa. The elevation of the gently rolling landscape ranges from 76 m above sea level southwest of the community of Odessa to 338 m above sea level east of the community of Norland.

Figure 408. Pasture and deciduous forests south of the community of Norland. Monique Wester, MNRF.

Key features

- Cropland or pasture and deciduous forest each occupy approximately one-third of the area (Figure 408).
- Morainal deposits occur throughout the ecodistrict.
- Is home to the Fenelon Falls outlet, an early drainage pathway for glacial Lake Algonquin.

Geology and substrates

The landscape of Ecodistrict 6E-9 is dominated by deep, typically calcareous, morainal deposits, flanked on either end with shallower morainal material (Figure 409). Covering an area of approximately 180 km long and 24 km wide, the Dummer Moraine is a series of ridges characterized by mineral material with large angular blocks of limestone and Precambrian

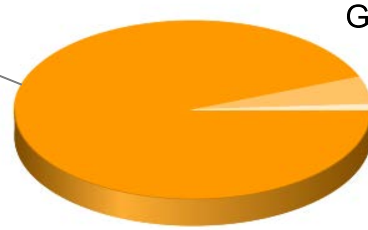


Figure 409. Modes in deposition Ecodistrict 6E-9.

bedrock (Marich 2016). The bedrock materials were carried by glaciers from the Precambrian Shield, which borders the northern edge of the ecodistrict, and deposited farther south. Additional morainal features include drumlins that are interspersed throughout the area. In the east, shallow morainal deposits are the result of glaciers removing most of the previous overburden. In the west, approximately 12,000 years ago (Dyke 2004) through wave action and fluctuating lake levels, glacial Lake Algonquin removed much of the overlying materials. Marich (2016) also noted the presence of glacial Lake Iroquois in the east. The gently rolling landscape is broken by faulted river valleys along the Salmon and Napanee rivers, and several escarpments in the north where Paleozoic and Precambrian bedrock meet (Chapman and Putnam 1984). The underlying bedrock is typically Paleozoic but Precambrian bedrock occurs near the northern boundary with Ecodistrict 5E-11.

Glaciolacustrine deposits corresponding to relict shorelines and offshore sand deposits of glacial Lake Algonquin occur in the west (Chapman and Putnam 1984). As the glaciers retreated, the Fenelon Falls outlet opened west of the community of Kirkfield. Meltwater travelled east along the north end of the Dummer Moraine and then south through the moraine itself, depositing glaciofluvial material along the Burnt and Indian rivers. Glaciofluvial deposits (e.g., eskers) occur near the communities of Tweed and Havelock and west of the Burnt River. The meltwater also shaped many river valleys in Ecodistrict 6E-9 resulting in the formation of limestone cliffs, caves, and underground channels. Areas of bedrock typically occur in the east and west where the overlying substrate is thin. Organic deposits occur in low-lying areas along larger rivers (e.g., Napanee, Ouse, and Moira). Along the Moira, Indian, and Salmon rivers, karst topography including sinkholes, solution caves, underground streams, and flower pots have formed (Lindsay 1986). Lacustrine and alluvial material may occur adjacent to lakes and rivers.

Ecodistrict 6E-9 is dominated by Melanic Brunisols that have developed in calcareous coarse-textured well drained mineral material (Figure 410). Gray Brown Luvisols occur in the southeast in calcareous fine-textured mineral material. Humo-Ferric Podzols have developed in acidic shallow morainal material in the northeast and Gleysols can be found in the southeast in poorly drained mineral material. Gray Luvisols and Dystric Brunisols cover a

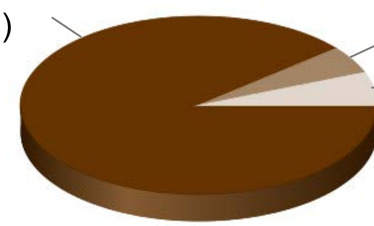


Figure 410. Substrate types in Ecodistrict 6E-9.

small percentage of the landscape with the former found in the southeast in slightly acidic to acidic substrates, and the latter north of Havelock in moderately well to imperfectly drained mineral material. Organic substrates, typically Mesisols and Humisols have accumulated in shallow depressions between bedrock and moraines or along creeks, rivers, and lakes. Regosols are associated with lacustrine and alluvial deposits.

Land cover and vegetation

The Havelock Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Due to the presence of large stones deposited by the glaciers and shallow soils in many areas, only one-third of the land has been converted to cropland and pasture (Figure 411). Deciduous forests are scattered throughout the ecodistrict, with larger areas occurring in the west, dominated by sugar maple, American beech, American basswood, white ash, red maple, paper birch, yellow birch, trembling aspen, large-toothed aspen, and oak species. Associates can include black cherry, eastern hop-hornbeam, butternut, shagbark hickory, and bitternut hickory. Blue-beech, black maple, and slippery elm also occur, but are at or near their northern limits (Brunton 1990a). Low-lying areas support forests of silver maple, American elm, black ash, green ash, and balsam poplar.

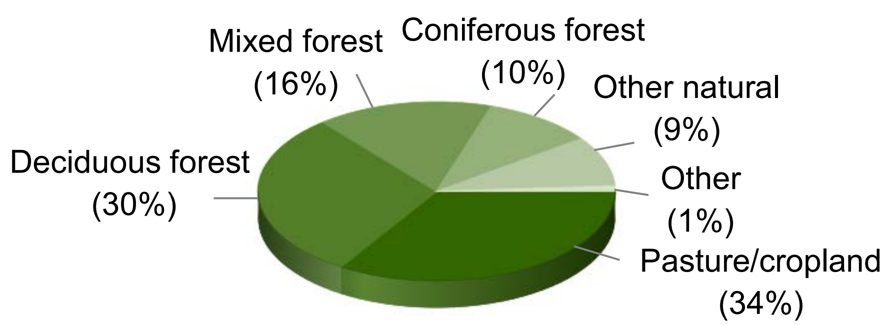


Figure 411. Land cover types in Ecodistrict 6E-9.

On upland, dry sites, mixed forests include eastern white pine and red pine. Cooler-than-normal moist to wet conditions provide habitat for balsam fir, eastern hemlock, eastern white cedar, Americn larch, black spruce, and white spruce that grow in conifer dominated or mixed forests. On very shallow to shallow substrates, eastern red cedar can occur. White spruce and eastern white cedar may grow on abandoned agricultural fields. Sparse treed ecosystems occur on very shallow to shallow bedrock in the east and west along with bare bedrock. Marshes have developed in slow moving or standing water at the edges of lakes and rivers. Small patches of fen and bog complexes are scattered throughout the ecodistrict bordering streams and small lakes.

Alvar communities have formed on bare bedrock to very shallow mineral material northwest of the communities of Kirkfield and Odessa (Figure 412). These communities have specialized environmental conditions that support a unique assemblage of plant and animal species including juniper sedge (Reschke et al. 1999), upland white goldenrod, and flat-stemmed spikerush (Holt 2009). Cliffs along river valleys may have a diverse array of species. Southwest facing, warmer-than-normal cliff faces support eastern posion ivy and rock spikemoss while Steller’s rockbrake and walking fern are more common on cooler-than-normal sites. Species with northern affinities occurring at or near their southern limit include Bicknell’s geranium, and species more commonly found farther south include white avens and false pennyroyal (Brunton 1990a).

Figure 412. Carden Alvar. Wasyl Bakowsky, MNRF.

Land use

Settlement and associated infrastructure in Ecodistrict 6E-9 account for less than 1% of the area. Communities include Bobcaygeon, Tweed, Havelock, and Odessa (Figure 413). Agriculture, business and industry, aggregate extraction, hydroelectric generation, and services associated with resource-based activities occur throughout the ecodistrict. Protected areas make up 1.2% of the ecodistrict.

Ecodistrict boundary delineation

The original boundaries for the Havelock Ecodistrict as described by Hills (1959) have been refined to better reflect the surficial and bedrock geology of the area (Jalava et al. 1997). The northern boundary with Ecoregion 5E more closely follows the transition from Paleozoic bedrock in Ecoregion 6E to Precambrian bedrock in 5E (Jalava et al. 1997). The northern boundary also reflects ecoregional temperature and precipitation differences (Ecoregion 6E is warmer and drier). The Paleozoic bedrock of 6E-9 distinguishes it from the Precambrian bedrock in Ecodistrict 6E-10. The eastern and southeastern boundaries with 6E-15 are defined by the transition from very shallow morainal mineral materials in 6E-9 to deeper glaciolacustrine mineral materials in 6E-15. The southwestern boundary follows the change between the Dummer Moraine and very shallow bedrock controlled landscape of 6E-9 to morainal deposits punctuated by drumlins in 6E-8. The western boundary with 6E-6 reflects the transition from very shallow mineral material in 6E-9 as well as an increase in elevation to deep mineral material in 6E-6.

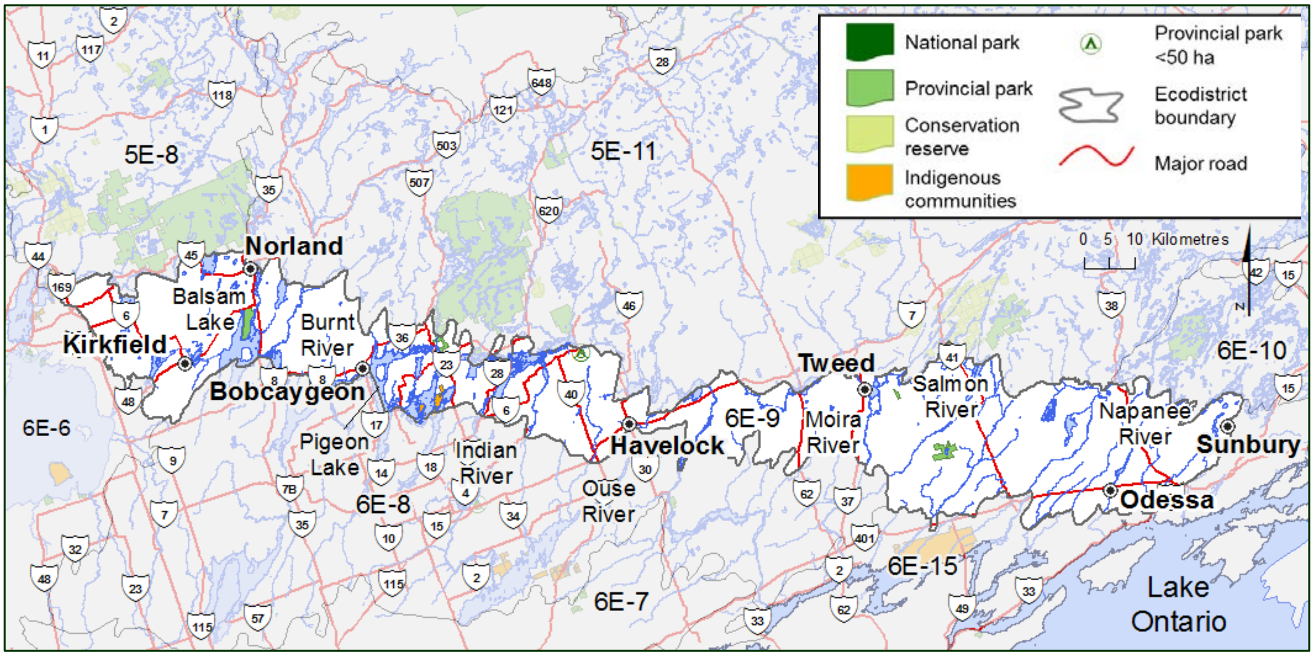


Figure 413. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 6E-9.

Fenelon Falls Outlet and the Warsaw Caves

Nearly 12,000 years ago, glacial meltwater began to flow across the landscape. As the glaciers retreated, an outlet was opened at Fenelon Falls near the community of Kirkfield (Barnett 1992). Large quantities of water flowed across the north end of the Dummer Moraine and then south, carving out several river valleys in the Paleozoic bedrock. Isostatic rebound closed the outlet after about 700 years (Barnett 1992).

Situated along the Indian River, the Warsaw Caves are one of the unique karst features in Ecodistrict 6E-9. The caves were created when large quantities of water flowed through the river, eroding the Paleozoic bedrock and creating deep fissures, kettles (Figure 414), underground river channels, and sinkholes. Isostatic rebound and subsequent erosion shifted bedrock and collapsed river channels creating caves and a landscape of broken bedrock (ORCA no date).

Figure 414. Kettle, Warsaw Cave Conservation Area. Mike McMurtry, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-10

Charleston Lake Ecodistrict

The Charleston Lake Ecodistrict encompasses 149,891 ha (2.4% of the ecoregion, 0.2% of the province). It extends from the Ontario-United States border and the islands in the St. Lawrence River in the east to Hambly Lake in the west. The northern boundary occurs near the northern shore of Newboro Lake and the southern extent can be found near the community of Gananoque. The undulating to hilly topography reaches a minimum elevation (70 m above sea level) along the St. Lawrence River and maximum elevation (208 m above sea level) west of Devil Lake.

Figure 415. Deciduous and mixed forests of Ecodistrict 6E-10 near Cranberry Lake. Marinas.com.

Key features

- Deciduous forests of sugar maple and American beech are common (Figure 415).
- Shallow non-calcareous morainal deposits dominate.
- Underlain by Precambrian bedrock.
- Includes the Frontenac Arch and the Thousand Islands archipelago.

Geology and substrates

White (1993) described the Charleston Lake Ecodistrict as an area with thin substrates, numerous various sized lakes, exposed bedrock, cliffs, and escarpments resulting in bedrock ridges with valleys of forests and wetlands. Unlike the rest of Ecoregion 6E, Ecodistrict 6E-10 is underlain by Precambrian bedrock, a southern extension of the bedrock in Ecoregion 5E that stretches into northern New York State. The bedrock formation, referred to as the Frontenac Arch, was formed billions of years ago during the movement of tectonic plates. The area is part of a mountain range that extended from Labrador to Texas. Over time, water, wind, and ice eroded the bedrock into an undulating to rolling topography. Added relief occurs in the ecodistrict due to two large fault systems. The Rideau Fault runs northeast to southwest across the ecodistrict starting west of Newboro Lake and a series of faults occur within and along the shore of the St. Lawrence River, forming the St. Lawrence rift valley. Another feature in the area is the Thousands Islands archipelago. Located in the St. Lawrence River, the islands were created by the scouring and sculpting action of glaciers. After glaciation, water flowed through the St. Lawrence River further shaping the rock and flooding the area, creating islands from the higher rock knobs.

Glacial activity has stripped away most of the overlying substrate reducing it to a very shallow to shallow blanket of acidic morainal material (Figure 416). Glacial Lake Iroquois, which inundated the area nearly 12,000 years ago (Dyke 2004), also affected the landscape. In the east, waves from the glacial lake removed the overlying substrate from the bedrock, reworked the material and deposited it in shallow bays, resulting in areas with deeper fine-textured glaciolacustrine mineral material interspersed with rock knobs (Chapman and Putnam 1984). The western extent of the Champlain Sea also occurred along the eastern edge of Ecodistrict 6E-10. As the glaciers retreated, the rise in sea level occurred faster than the isostatic rebound of the land, flooding much of eastern Ontario with marine water and depositing fine-textured glaciomarine material. Glaciomarine deposits occur northeast of the community of Mallorytown Landing (Greggs and Gorman 1976).

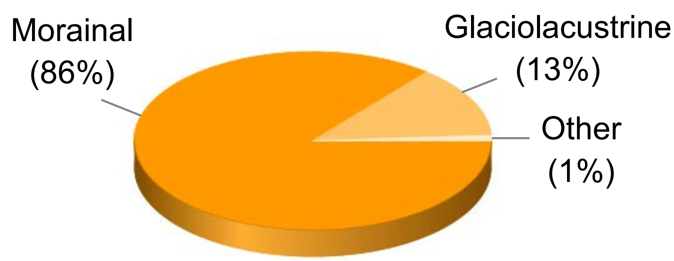


Figure 416. Modes of deposition in Ecodistrict 6E-10.

Organic deposits have accumulated in bedrock depressions with imperfect drainage. Glaciofluvial features are limited, occurring northeast of Cranberry Lake. Outcrops, bare bedrock ridges, escarpments, and cliffs occur throughout the ecodistrict. Abundant base-rich Precambrian bedrock can be found, but some Paleozoic bedrock is also present. Alluvial material is found along rivers.

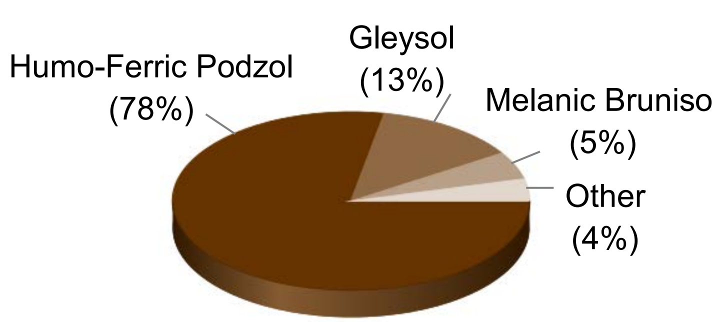


Figure 417. Substrate types in Ecodistrict 6E-10.

Humo-Ferric Podzols have developed in acidic, shallow morainal material over much of the ecodistrict (Figure

417). Gleysols occur mainly in the east, in glaciolacustrine materials in shallow depressions or on flat landscapes. Melanic Brunisols have developed where the mineral material is calcareous. Gray Brown Luvisols and Gray Luvisols occur over limited areas in the south near Loughborough Lake. Organic substrates, typically Mesisols and Humisols, occur adjacent to lakes, rivers, and creeks, including a large deposit along Wiltse Creek that flows to the Gananoque River. Bare bedrock ridges are more common in the northwest. Regosols are found adjacent to river systems associated with alluvial material.

Land cover and vegetation

The Charleston Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Middle Ottawa Section (L.4c) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). The southern extensions near the community of Gananoque and Hambly Lake are part of the Huron-Ontario Section (L.1) (Rowe 1972). Deciduous forests dominate the landscape (Figure 418), typically consisting of sugar maple, American beech, white ash, northern red oak, white oak, American elm, shagbark hickory, bur oak, black cherry, bitternut hickory, and butternut. Due to the mosaic of rock outcrops, shallow substrates, and numerous lakes, only a small portion of the ecodistrict has been modified for farming. Mixed forests found on upland dry to fresh sites grow sugar maple, northern red oak, eastern hop-horn beam, white ash, large-toothed aspen, American basswood, eastern white pine, and red pine. Yellow birch, balsam poplar, black ash, paper birch, silver maple, red maple, slippery elm, green ash, and eastern white cedar occur on fresh to moist conditions. Bedrock ridges support mixed forests of red oak and eastern white pine, especially on the eastern shore of Charleston Lake (White 1993) and coniferous forests of eastern white pine and red pine. Black spruce, balsam fir, and American larch occur on cooler-than-normal, moist to wet sites. Disjunct populations of pitch pine, the only known occurrences in Ontario, can be found on dry slopes and ridges on the Thousand Islands archipelago in the St. Lawrence River as well as the Charleston Lake area (White 1993). Coniferous and mixed forests on cooler-than-normal, fresh sites contain eastern hemlock. Other tree species include eastern red cedar, gray birch, and trembling aspen on abandoned fields and black maple, which occurs at its northern limit in Ecodistrict 6E-10. Bedrock ridges support sparse forests (Figure 419), while marsh and fen complexes occur adjacent to lakes and rivers in the 'valleys' between ridges.

Biological diversity is high in the Charleston Lake Ecodistrict due to topography, climate, and location. The rugged topography

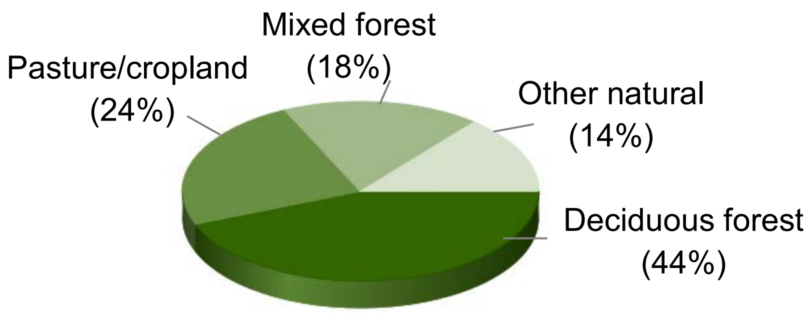


Figure 418. Land cover types in Ecodistrict 6E-10.

creates microclimates capable of sustaining a variety of plant species. In the south, the close proximity of Lake Ontario has a warming effect on the climate and has resulted in the establishment of flora with southern affinities (e.g., pitch pine and deerberry; Reichl 2002). The location of Ecodistrict 6E-10 situates it at the crossroads of the north-south migration route from the Algonquin highlands to the Adirondack Mountains in the United States, and a west-east route via the St. Lawrence River linking the Great Lakes to the Atlantic coast. Flora occurring here as a result of these effects includes gray birch and red spruce, typical of the Atlantic forest; pignut hickory and eastern buttonbush, species commonly found in the south; boreal species sweet gale and barren strawberry; and hobblebush, which is a typical Applachian species (Frontenac Arch Biosphere 2013). Increased plant species richness may occur in areas of base-rich bedrock where substrate nutrient availability is higher.

Figure 419. Precambrian bedrock and coniferous sparse forests of Charleston Lake Provincial Park. Ontario Parks.

Land use

Settlement is limited in the Charleston Lake Ecodistrict, generally due to poor agricultural potential and rugged terrain (White 1993). Gananoque is the largest community (Figure 420). Business and industry, services associated with resource-based activities, aggregate extraction, hydroelectric generation, mining, and agriculture occur throughout the area. Approximately 5.7% of the ecodistrict is designated as protected areas.

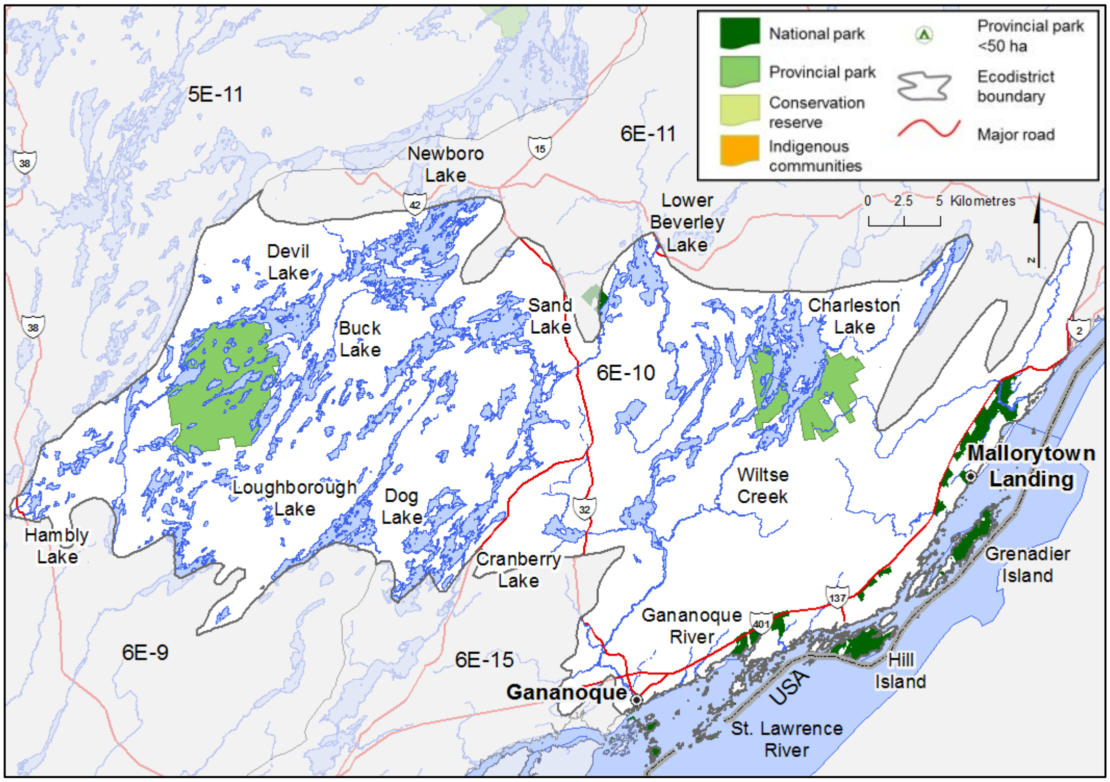


Figure 420. Select communities, natural heritage areas, major roads, lakes, and waterways in Ecodistrict 6E-10.

Ecodistrict boundary delineation

Adjustments have been made to the original boundaries as described by Hills (1959). In the west, Hills (1959) included a large area of shallow mineral material over bedrock in Ecodistrict 6E-10. This area is now classified as part of 5E-11 to follow the revised 5E/6E ecoregional boundaries that reflect climatic differences (Jalava et al. 1997). A portion of Hills (1959) Site District 6E-10 has been removed from Ecodistrict 6E-10 and allocated to 6E-11 to better define the transition from Precambrian bedrock to Paleozoic bedrock. The presence of Precambrian bedrock in 6E-10 helps to distinguish the ecodistrict from adjacent areas (e.g., 6E-9, 6E-11, and 6E-15). The eastern boundary is defined by the Ontario-United States border. The northwestern and western boundaries reflect ecoregional temperature and precipitation differences (Ecoregion 6E is warmer and drier than Ecoregion 5E).

Frontenac Arch Biosphere

The Frontenac Arch Biosphere is one of 16 biosphere reserves in Canada recognized by the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Man and the Biosphere Programme (Gray et al. 2009). Officially recognized in 2002, the Frontenac Arch Biosphere was established to promote sustainable development through the balance of economic and social development and the conservation of biological and cultural diversity. Covering an area of approximately 270,000 ha (Frontenac Arch Biosphere 2013), the biosphere's network of core and buffer areas highlights the unique ecology, cultural history, scenic character, and way of life in the region (UNESCO 2015).

Figure 421. Frontenac Arch Biosphere Reserve. Don Ross, Frontenac Arch Biosphere Network.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-11

Smiths Falls Ecodistrict

The Smiths Falls Ecodistrict extends from Highway 417 in the north to Upper Beverley Lake in the south. The western boundary includes the Mississippi River and the community of Burritts Rapids is just inside the eastern border. The southeastern limit of Ecodistrict 6E-11 occurs at the Ontario-United States border. The area encompasses 353,567 ha (5.6% of the ecoregion, 0.4% of the province). Elevation ranges from 72 m above sea level along the St. Lawrence River to 196 m above sea level west of Upper Rideau Lake.

Figure 422. Cropland and deciduous forests near the community of Burritts Rapids. Marinas.com.

Key features

- Cropland or pasture and deciduous forests each occupy about one-third of the area (Figure 422).
- Shallow calcareous morainal materials dominate.
- Extensive organic deposits occur across the landscape.

Geology and substrates

The Smiths Falls Ecodistrict encompasses the largest and most continuous tract of shallow substrate over Paleozoic bedrock (Chapman and Putnam 1984). The landscape was shaped by glaciers that removed most of the overlying sediment, leaving behind a layer of shallow calcareous morainal material (Figure 423). The gently rolling topography is broken by drumlins east and west of the community of Smiths Falls, and occasional escarpments and cliffs in the southwest and in the north (White 1992). Several faults occur across the landscape, including the Rideau Fault, which runs northeast to southwest, south of the community of Smiths Falls, and the Pakenham and Lake Dorè faults that run northwest to southwest through the northern portion of the ecodistrict.

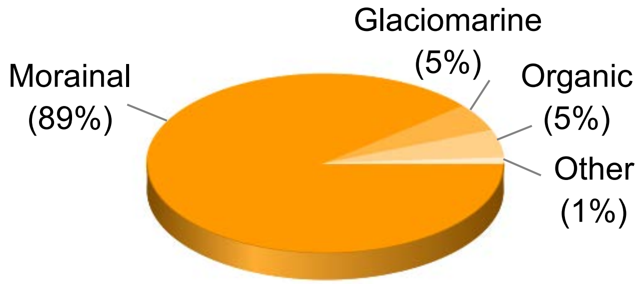


Figure 423. Modes of deposition in Ecodistrict 6E-11.

Approximately 11,500 years ago (Dyke 2004), with the retreat of the glaciers from the St. Lawrence River valley, lake levels in glacial Lake Iroquois (the precursor to Lake Ontario) dropped (Barnett 1992). Marine water inundated the isostatically depressed area creating the Champlain Sea. Glaciomarine deposits (e.g., remnant lake bed, relict shorelines) of the Champlain Sea are evident in the east and north (Gadd et al. 1993, OGS 1997). Typically fine-textured, the mineral material often contains the shells of marine molluscs.

Organic materials occur in isolated pockets and as extensive deposits throughout the ecodistrict, having developed in shallow bedrock depressions with limited drainage (White 1992). Larger accumulations have formed near Cranberry Lake, north of the community of Burritts Rapids and along the Jock River. Glaciofluvial deposits are limited across the landscape. A small esker occurs northwest of the community of Perth. Bedrock exposures occur in areas of very shallow substrates. Typically Paleozoic, areas of Precambrian bedrock occur along the western boundary. Lakes, including the Lower Rideau and Mississippi, may contain lacustrine deposits. Alluvial material can be found along river systems.

Melanic Brunisols form the dominant substrate types in Ecodistrict 6E-11 in calcareous, well drained mineral material (Figure 424). Gray Brown Luvisols have developed in fine-textured substrates. Mesisols have accumulated in wet depressions, and along rivers and lakes. In the west, Humo-Ferric Podzols and Gray Luvisols have developed in acidic mineral substrates, and small patches of Gleysols occur in mineral material where drainage is poor. Exposed bedrock is limited. Regosols are associated with newly deposited mineral material adjacent to lakes and rivers.

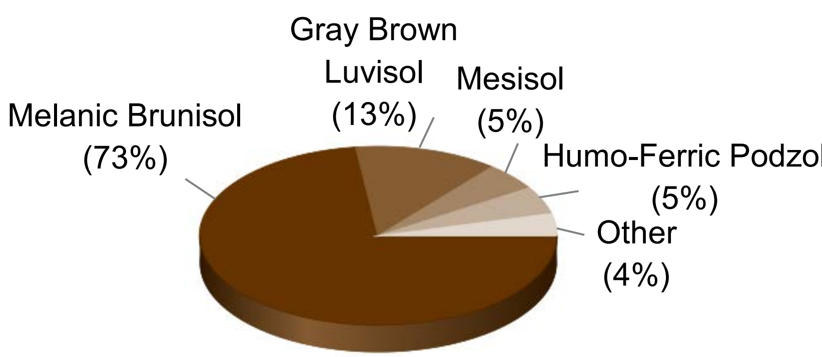


Figure 424 Substrate types in Ecodistrict 6E-11.

Land cover and vegetation

Ecodistrict 6E-11 is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) related most of the Smiths Falls Ecodistrict with the Upper St. Lawrence Region (L.2) of the Great Lakes-St. Lawrence Forest Region. The western edge was allocated as a portion of the Middle Ottawa Section (L.4c).

Shallow substrates have confined pasture and cropland to one-third of the land base (Figure 425) in areas where deeper mineral material was deposited, including along the Rideau River and the Mississippi River north of the community of Carleton Place. The forest cover is characteristically temperate, dominated by sugar maple and American beech. Yellow birch, American basswood, white ash, large-toothed aspen, trembling aspen, bur oak, black cherry, paper birch, northern red oak, eastern hop horn-beam, and white oak are common associates. Poorly drained areas support green ash, red maple, silver maple, American elm, balsam poplar, and black ash. Extensive areas of lowland deciduous forests occur south of the Jock River as it enters Ecodistrict 6E-11, north of the community of Carleton Place, and northeast of Cranberry Lake. Shagbark hickory, bitternut hickory, butternut, gray birch, rock elm, and slippery elm are limited across the landscape.

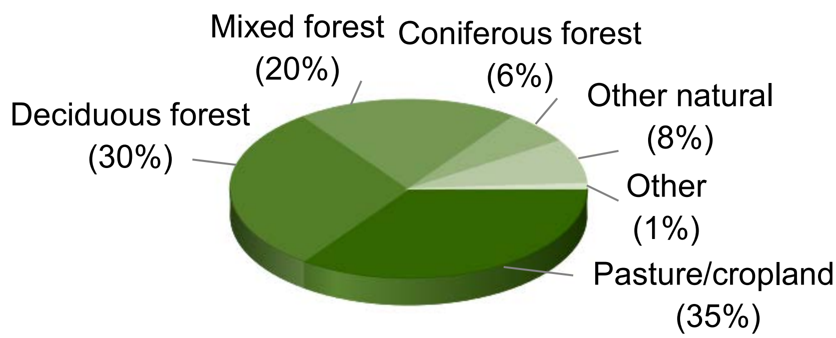


Figure 425. Land cover types in Ecodistrict 6E-11.

Conifers growing in mixed forests include eastern white pine and red pine on dry sites and eastern hemlock, white spruce, and balsam fir on moist to wet, typically cooler-than-normal sites. Coniferous forests occur in the northeast and comprise black spruce, American larch, and eastern white cedar in wet areas, and eastern white pine, red pine, and eastern white cedar on drier sites. Sites with very shallow substrates support eastern red cedar. Abandoned agricultural fields may contain white spruce and eastern white cedar. Marshes are generally associated with large river systems and lakes, including the Mississippi River and Lower Rideau Lake. Fen and bog complexes are limited, with the former occurring along streams and lake shores, and the latter in shallow depressions. Sparse treed systems occur on exposed bedrock to very shallow substrates where trees are typically restricted to bedrock crevices. Bare bedrock to very shallow systems may also support alvar communities (Figure 426) growing Virginia saxifrage and balsam groundsel (Reschke et al. 1999). Flora near their northern limits in the Smiths Falls ecodistrict includes smooth arrowwood (White 1992), white aven, and large tick-trefoil. Species at their southern limits include gay-wing milkwort and hooked violet (Brunton 1986a).

Figure 426. Burnt Lands Alvar. Wasyl Bakowsky, MNRF.

Land use

Settlement and associated infrastructure, including the communities of Brockville, Carleton Place, Smiths Falls, and Perth, occupy less than 1% of the area (Figure 427). Agriculture, business and industry, aggregate extraction, hydroelectric generation, and services associated with resource-based activities occur throughout the ecodistrict. Protected areas encompass less than 1% of the ecodistrict.

Ecodistrict boundary delineation

Two adjustments have been made to the original site district boundaries as proposed by Hills (1959). The western boundary with Ecodistrict 5E-11 has been refined to follow revisions made to the 5E/6E ecoregional boundary (Jalava et al. 1997) and a portion of 6E-10 has been added to 6E-11 to better reflect the transition from Precambrian to Paleozoic bedrock.

The eastern and northern boundaries with 6E-12 and 6E-16 are defined by the transition from shallow, typically morainal material in 6E-11 to deeper glaciolacustrine deposits. The southeastern boundary occurs at the Ontario-United States border. The transition from Paleozoic bedrock in 6E-11 to Precambrian bedrock in 6E-10 defines the southern boundary. The western boundary reflects ecoregional climatic differences, with 6E representing a warmer and drier climate than 5E.

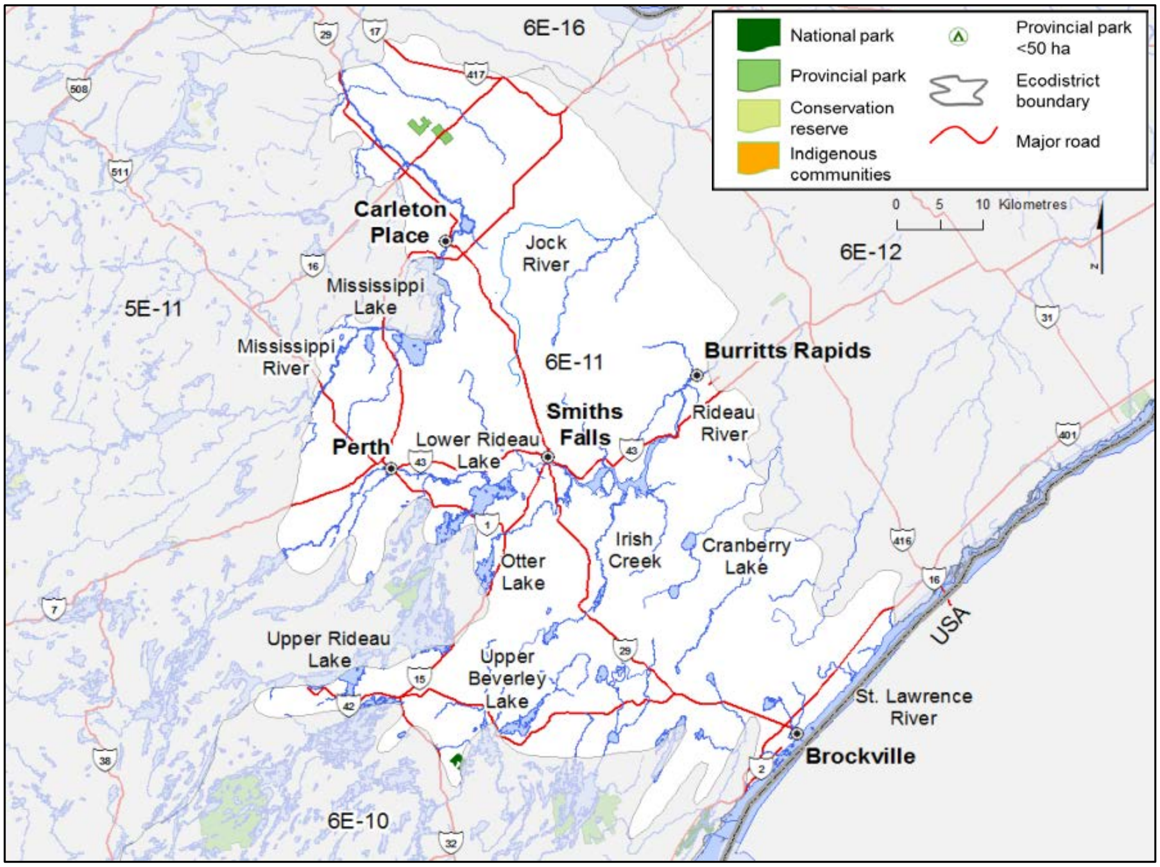


Figure 427. Select communities, natural heritage areas, major roads, lakes, and waterways in Ecodistrict 6E-11.

Burnt Lands Alvar

Alvars are notable communities occurring on level limestone or dolostone with a discontinuous layer of very shallow mineral material (Reschke et al. 1999). The communities are characterized by a distinct group of flora and fauna that are maintained by seasonal drought and, in some areas, by seasonal flooding. Typically a mosaic of alvar vegetation types occurs in an area. Ecosystems dominated by bare rock, may coexist with grass, sedge, or shrub dominated communities. Tree cover may be absent, sparse, or open but total cover is less than 60% (Alvar Working Group 1995, Reschke et al. 1999). Almost all of the alvars in North American occur in the Great Lakes basin. The global conservation status or ranking for alvar communities is critically imperiled (G1) to vulnerable (G3) (Reschke et al. 1999).

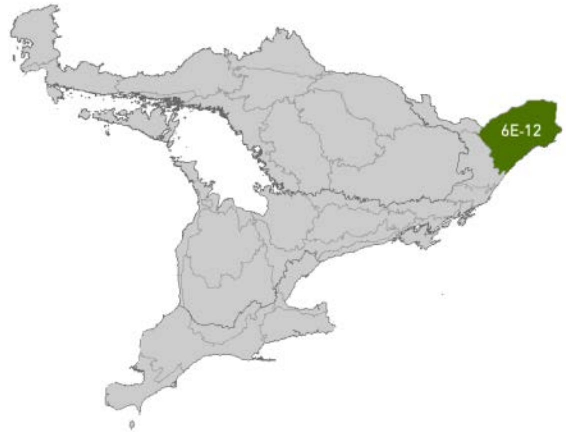
Figure 428. Great Plains ladies`-tresses. Wasyl Bakowsky, MNRF.

The Burnt Lands Alvar is the most eastern alvar in Ontario (Brunton 1986a) and the only extensive alvar in Ecodistrict 6E-11 (Ontario Parks 2001a). It is one of the five most diverse alvars in the Great Lakes basin (Brdar 2000) and supports several notable species including Great Plains ladies`-tresses (Figure 428) and prairie dropseed (Reddoch et al. 2015).

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 6E-12

Kemptville Ecodistrict



Encompassing 774,847 ha (12.3% of the ecoregion, 0.8% of the province), the Kemptville Ecodistrict is bound by the Québec border to the north, east, and southeast. The southwestern boundary is delineated by the Canada-United States border, and the western boundary occurs near the community of Stittsville. The elevation in this gently rolling landscape ranges from 36 m above sea level along the Ottawa River to 136 m above sea level northwest of the community of Stittsville.

Figure 429. Cropland and forests of the Ottawa Valley. Lezumbalaberenjena.

Key features

- Cropland and pasture occupy more than half of the ecodistrict (Figure 429).
- Area characterized by glaciolacustrine deposits.
- Leda clays present.
- Largely influenced by the Champlain Sea.

Geology and substrates

In the Kemptville Ecodistrict, the Champlain Sea and isostatic rebound influenced the gently rolling modern landscape. Approximately 11,500 years ago (Dyke 2004), the glaciers had retreated from the area, lake levels in glacial Lake Iroquois dropped while the land was isostatically depressed, allowing a large portion of the ecodistrict to be inundated with marine water, forming the Champlain Sea (Barnett 1992). Morainal and glaciofluvial sediment transported and deposited by the glaciers and their meltwaters, were reworked by the marine water and deposited as fine-textured glaciomarine mineral material, referred to as Leda clays.

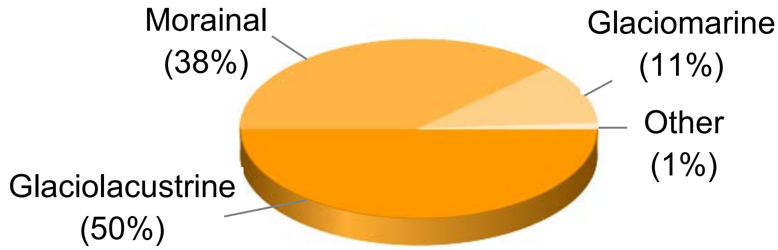


Figure 430. Modes of deposition in Ecodistrict 6E-12.

As the glaciers continued to retreat and the land rebounded from the weight of the ice, significant quantities of fresh water flowed through the Ottawa River valley forming a large delta and depositing calcareous, glaciolacustrine mineral material often underlain by glaciomarine deposits over half of the ecodistrict (Figure 430; Marshall et al. 1979). Following the formation of the delta, the Ottawa River cut several large channels (two approximately east-west and three approximately north-south) through the glaciolacustrine material to the glaciomarine material below. The location of these channels was influenced by a series of faults (Gadd 1976). Terraces, bluffs, and abandoned channels in the north mark the path of these channels today.

Morainal material containing a stony mixture of calcareous Paleozoic and acidic Precambrian material is common, particularly in the south, where the inundation by marine water was minimal (Chapman and Putnam 1984). Morainal deposits (e.g., drumlins) occur in the central and southern portions of the ecodistrict. The North Gower Drumlin Field south of the community of Nepean, consists of a series of scattered drumlins typically surrounded by material from the Champlain Sea (Chapman and Putnam 1984). In addition to the drumlins, the gently rolling, typically calcareous, landscape is broken by a number of faults that run through the ecodistrict. The Gloucester Fault extends from the community of Ottawa to the southeast and the Hazeldean Fault can be found south of the community of Nepean. The eastern extent of the Ottawa-Bonnechere Graben, a large rift valley formed between the Mattawa and Petawawa faults, also occurs here. Karst topography (e.g., solution caves) is found in the northeast (Gadd 1976).

A small portion of glaciomarine deposits remain at the surface. Fine-textured mineral material associated with the Champlain Sea occurs in the southeast adjacent to the St. Lawrence River and east of the community of Kemptville. As the marine waters receded, the Champlain Sea also created relict shorelines. Composed of gravels, coarse sands, and cobbles, the beaches often contain fossils (Marshall et al. 1979). Organic materials have accumulated in areas of poor drainage. Three larger organic deposits occur: one southeast of the community of Gloucester, a second south of Highway 7 near South Nation River, and a third at the convergence of Highways 417 and 138. Small pockets of organic material are also associated with river and creek systems. Glaciofluvial deposits and bedrock are limited. Esker ridges occur south and east of the communities of Nepean and Gloucester, respectively. Large areas of very shallow substrates and exposed bedrock can be found east of the community of Kanata and north of the community of Metcalfe. Typically Paleozoic, two small pockets of Precambrian bedrock occur along the eastern boundary with Québec. Alluvial material may occur adjacent to rivers including the Ottawa River.

Gleysols have typically developed in fine-textured mineral material in low-lying areas, including areas along the Rideau, South Nation, Castor, and Jock rivers (Figure 431). In areas with more relief, Melanic Brunisols occur in coarse-textured, well drained mineral material. Humo-Ferric Podzols have developed in acidic mineral material adjacent to the Ottawa River, extending to Bear Brook and the northern portion of the South Nation River. Mesisols have developed in poorly drained areas where organic material has been able to accumulate. Significant organic accumulations occupy landscape depressions created by the Ottawa River as it cut large channels through the valley. Sombric Brunisols and Gray Brown Luvisols are limited, with the former developing in acidic mineral material east of the community of Ottawa and the latter in calcareous mineral material southeast of the community of Ottawa.

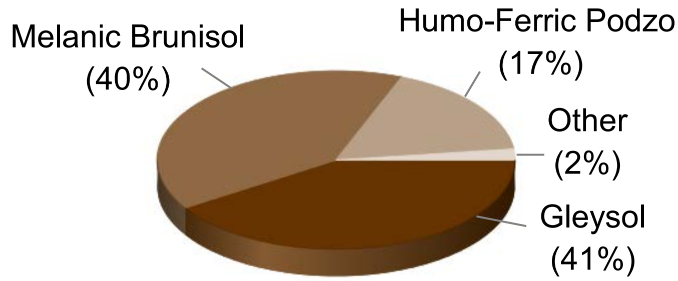


Figure 431. Substrate types in Ecodistrict 6E-12.

Land cover and vegetation

The Kemptville Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Type (Baldwin et al. 2018) and the Upper St. Lawrence Region (L.2) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Over half of the ecodistrict has been converted to pasture and cropland (Figure 432). Forested areas are predominantly deciduous. Upland deciduous forests are dominated by sugar maple and American beech. Lowland, moister sites support American elm, red maple, black ash, large-toothed aspen, silver maple, green ash, and bur oak. Common associates include American basswood, yellow birch, trembling aspen, white ash, bitternut hickory, butternut, eastern hop-hornbeam, northern red oak, balsam poplar, black cherry, and paper birch. White oak, eastern cottonwood, common hackberry, blue-beech, swamp white oak, rock elm, slippery elm, shagbark hickory, gray birch, and black maple may also occur. Mixed forests are scattered throughout the ecodistrict. Conifer species growing in mixed forest associations include eastern white pine and occasionally red pine on dry sites and white spruce, balsam fir, eastern white cedar, and eastern hemlock on moist to wet, typically cooler-than-normal conditions. Coniferous forests are limited. On cooler-than-normal wet sites black spruce, eastern white cedar, balsam fir, and American larch dominate

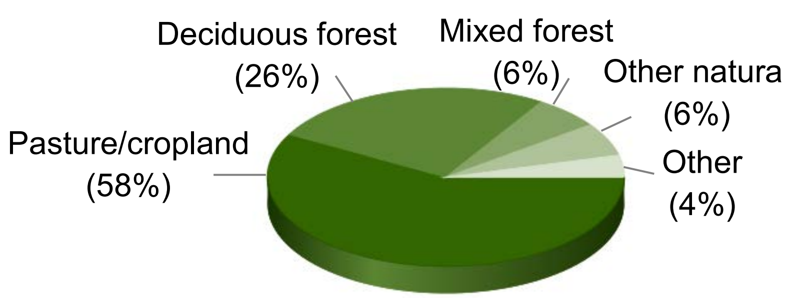


Figure 432. Land cover types in Ecodistrict 6E-12.

(Brunton 1992). Balsam fir, eastern white cedar, and spruce forests occur on regenerated land and pine forests are generally restricted to areas of deep sandy substrates (Marshall et al. 1979).

Two of Ontario's largest wetland complexes south of the Canadian Shield occur in Ecodistrict 6E-12. Mer Bleue and Alfred bogs (Figure 433; Brunton 1992) are dominated by bog and fen complexes with some conifer swamp and marsh areas. Species more common in southern Ontario that also occur in 6E-12 include stout woodreed, Canada moonseed, and cut-leaved coneflower, and the easternmost record for common hackberry in Ontario is along the Ottawa River. Northern species, typical of wet acidic sites (e.g., balsam willow and kidney-leaved white violet) also occur (Brunton 1992). The incursion of marine water has influenced some plant communities in this ecodistrict. Salt-rich springs occur near the edges of major Champlain Sea drainage channels supporting communities of halophytic plants, including spreading alkaligrass, cursed buttercup, and American golden dock (Brunton 1992).

Figure 433. Fen complex in Alfred Bog. Mike Oldham, MNRF.

Land use

Approximately 3% of the area has been converted into settlement and associated infrastructure. Communities include Ottawa, Nepean, Gloucester, Kanata, and Cornwall (Figure 433). A significant portion of the land base has been converted for agriculture. Business and industry, aggregate extraction, hydroelectric and wind power generation, and services associated with resource-based activities also occur. Less than 1% of the ecodistrict compises protected areas.

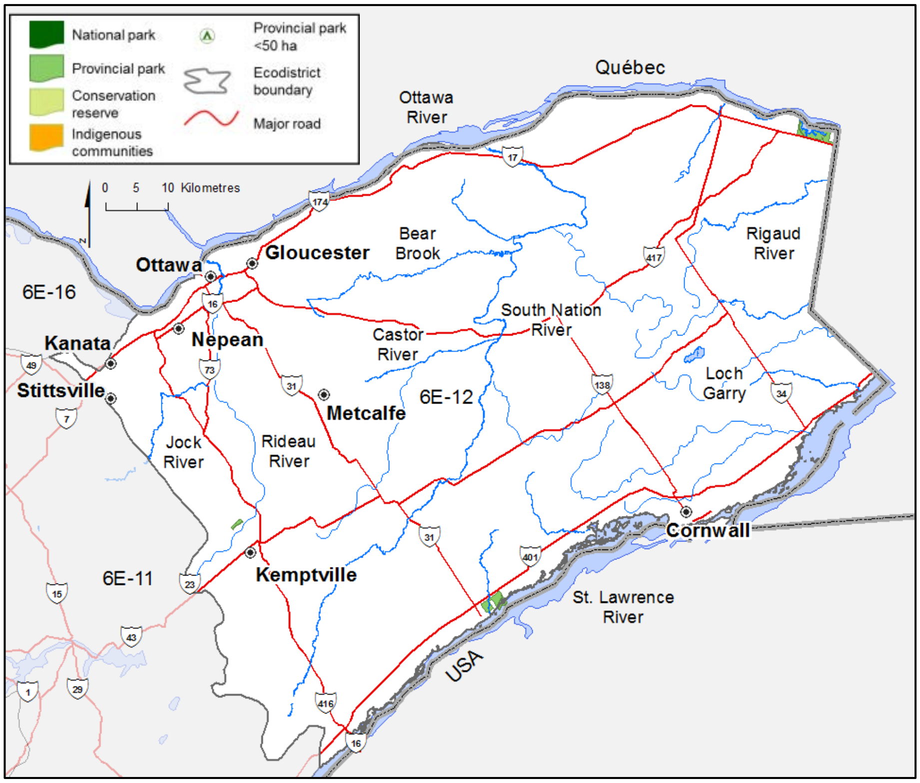


Figure 433. Select communities, natural heritage areas, major roads, and waterways in Ecodistrict 6E-12.

Ecodistrict boundary delineation

The Kemptville Ecodistrict is bound in the north, east, and southeast by the province of Québec and in the southwest by the United States. The western boundary with Ecodistrict 6E-11 is defined by a transition from deep glaciolacustrine deposits in 6E-12 to shallow, morainal material. In the northwest corner, a portion originally described by Hills (1959) as part of Site District 6E-12, has been allocated to 6E-16 to better represent the underlying bedrock topography. The transition from Ecodistrict 6E-12 to 6E-16 reflects the change from Paleozoic bedrock in 6E-12 to Precambrian bedrock in 6E-16.

Leda clays

Leda clays or quick clays are deep water glaciomarine deposits. They typically have two distinct layers. The upper portion is non-calcareous, with no fossils, and was deposited during the late stages of the Champlain Sea in the presence of fresh water. The lower portion is slightly calcareous, contains fossils, and was deposited in salt to brackish water during the early stages of the Champlain Sea (Schut and Wilson 1987). Bound by sodium, the clay particles become unstable when rainfall and snowmelt penetrate the substrate, saturating the clay and washing away the sodium. Earthquakes or abnormal rainfall can liquefy the clay, causing landslides. In 1989, the community of Lemieux, along South Nation River, was relocated after Leda clay was discovered under the town. Several years later, a 17 ha landslide swallowed the town's former main street (Figure 435; McIntyre 2005).

Figure 435. Lemieux landslide, 1993. Photo 1993-296 by S.G. Evans, Natural Resources Canada 2014, Geological Survey of Canada.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26,

Ecodistrict 6E-13

Oshawa-Cobourg Ecodistrict

The Oshawa-Cobourg Ecodistrict comprises a long narrow band along the north shore of Lake Ontario, encompassing 98,614 ha (1.6% of the ecoregion, 0.1% of the province). The ecodistrict extends from the community of Pickering, in the west, to the community of Carrying Place, in the east. The northern extent is 3 to 12 km north of Lake Ontario. The elevation in this gently rolling landscape ranges from 73 m above sea level along Lake Ontario to 239 m above sea level east of Proctors Creek.

Figure 436. Cropland and marsh near the community of Whitby. Lou Wise.

Key features

- More than half of the landscape has been converted to cropland and pasture (Figure 436).
- Gently rolling landscape is dominated by glaciolacustrine deposits overlying Paleozoic bedrock.
- Includes relict shorelines of glacial Lake Iroquois.

Geology and substrates

Stretched along the north shore of Lake Ontario, the substrates of the Oshawa-Cobourg Ecodistrict were modified and shaped by glacial Lake Iroquois, the precursor to present day Lake Ontario. Approximately 12,000 years ago (Dyke 2004), as the ice margin retreated, low-lying areas bordering Lake Ontario were inundated by water (Barnett 1992) forming glacial Lake Iroquois. Water levels in this glacial lake were approximately 40 m higher than present day Lake Ontario (Coakley and Karrow 1994). Wave action and fluctuating lake levels modified existing morainal material. As a result, calcareous, fine-textured glaciolacustrine material was deposited over half of the ecodistrict (Figure 437). Glacial retreat and the opening of the outlet in the lower St. Lawrence valley, led to successive lower lake levels and the creation of shoreline features (e.g., cliffs, bars, beaches, boulder pavement; Barnett 1992) many of which are visible today. Minimum lake levels are estimated to be approximately 100 m below the present shoreline (Coakley and Karrow 1994). At this time, rivers and creeks including the Ganaraska River and Gage and Oshawa creeks, cut deep valleys through lake bed sediment. With isostatic rebound, water in Lake Ontario has risen to present day levels (Coakley and Karrow 1994) flooding portions of the valleys.

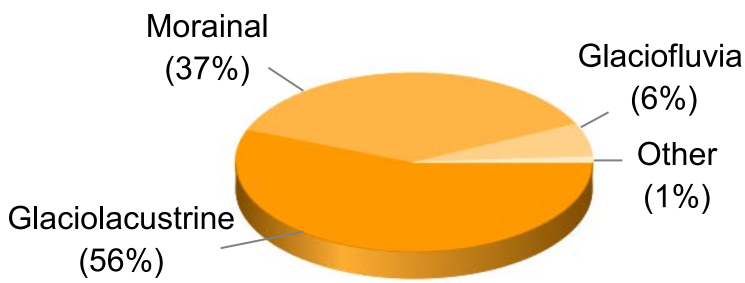


Figure 437. Modes of deposition in Ecodistrict 6E-13.

Morainal deposits occur on upland sites unaffected by glacial water. Deposits include a series of drumlins and a moraine east of the community of Colborne (Chapman and Putnam 1984). Formerly islands in glacial Lake Iroquois, waves have cut steep slopes into the ends of many of the exposed drumlins (Kor et al. 2013a). Minimal glaciofluvial deposits occur east of the community of Cobourg. Limited organic deposits occur in low-lying flat areas associated with Lake Ontario or inland rivers. Lacustrine and aeolian materials are associated with Lake Ontario and alluvial deposits can be found along river systems.

Calcareous mineral material and the warming effect of Lake Ontario create ideal conditions for the development of Gray Brown Luvisols that blanket the landscape (Figure 438). Limited pockets of Melanic Brunisols have developed in coarse-textured mineral material north of the community of Oshawa. Poorly drained sites with organic material accumulations typically support Mesisols. Regosols occur adjacent to lakes and rivers where lacustrine, aeolian, and alluvial materials are found.

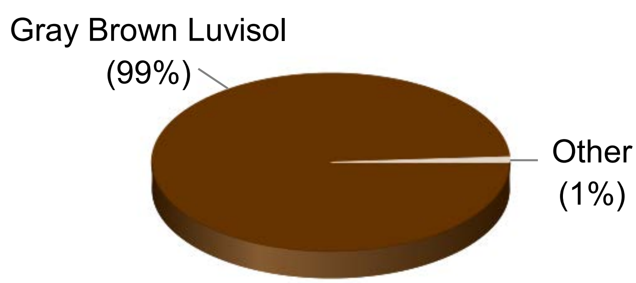


Figure 438. Substrate types in Ecodistrict 6E-13.

Land cover and vegetation

Nearly three-quarters of the natural cover in the Oshawa-Cobourg Ecodistrict has been converted into pasture and cropland or settlement and other developed land (Figure 439). Associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Region (D.1) of the Deciduous Forest Region (Rowe 1972), natural communities are dominantly deciduous forests. On dry to fresh sites sugar maple with American beech and northern red oak may occur. Associates include American basswood, yellow birch, red maple, white ash, eastern hop-hornbeam, black cherry, white oak, and bur oak. Younger forests are composed of white birch, trembling aspen, and large-toothed aspen. Tree species on moister sites include silver maple, American elm, balsam poplar, black ash, and green ash. Conifer species that occur in mixed and coniferous dominated forests include eastern hemlock on cooler-than-normal, humid slopes, and occasionally eastern white pine on dry sites. Wetter sites may include eastern white cedar, and on cooler-than-normal sites black spruce, balsam fir, and American larch. White spruce and eastern white cedar can be found in abandoned agricultural fields.

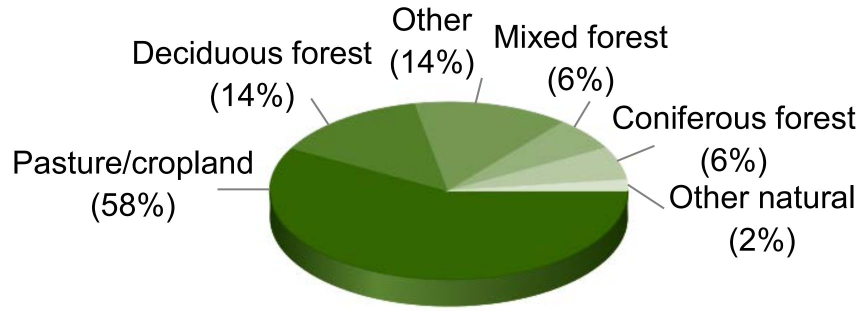


Figure 439. Land cover types in Ecodistrict 6E-13.

Relict shorelines from glacial Lake Iroquois form bluffs along the shores of Lake Ontario. The nearly vertical bluffs are interspersed with numerous Great Lakes marshes (Hanna 1984b). Ecodistrict 6E-13 supports the largest number of Great Lakes marshes in the western part of Lake Ontario (Varga 2018, MNRF, pers. comm.). Marshes are also found along the shoreline in quiet bays, sheltered river mouths, or behind barrier beaches (Figure 440). Plant species adapted to active aeolian materials (e.g., American beachgrass) occur along the shoreline of Lake Ontario.

The modifying effects of Lake Ontario result in high rates of precipitation, cooler-than-normal summers, and warmer-than-normal winters. These conditions support plant species more common farther south, including common hackberry, American witch-hazel, bitternut hickory, and blue-beech (Farrar 1995). Plant species near their southern limits include striped maple (Soper and Heimburger 1982) and mountain sweet cicely (Henson and Brodribb 2005). Shoreline species (e.g., American sea rocket and seaside spurge) are more common in the east (Henson and Brodribb 2005).

Figure 440. Wetlands at Darlington Provincial Park. Ontario Parks.

Land use

Settlement and associated infrastructure account for approximately 13% of the area, including the communities of Oshawa, Pickering, Whitby, Ajax, and Clarington (Figure 441). In addition to agriculture, which occurs over half of the area, other activities include business and industry, aggregate extraction, and hydroelectric and wind power generation. Protected areas encompass less than 1% of the ecodistrict.

Ecodistrict boundary delineation

Ecodistrict 6E-13 was originally designated as part of Site District 7E-4 (Hills 1959); this was later modified when the eastern portion was deemed to lack the vegetation characteristics typical of Ecoregion 7E. Climatic and elevational differences also distinguish 6E-13 from 7E-4 where 6E-13 is cooler, typically wetter, and lower in elevation. The northern boundary with Ecodistrict 6E-7 has been modified to better reflect the transition from glaciolacustrine deposits in 6E-13 to morainal deposits in 6E-7 (Jalava et al. 1997). The eastern boundary with 6E-15 follows the change from deep typically coarse-textured mineral material in 6E-13 to shallower, fine-textured material in 6E-15. The southern boundary of the Oshawa-Cobourg Ecodistrict occurs along the north shore of Lake Ontario extending to the border with the United States.

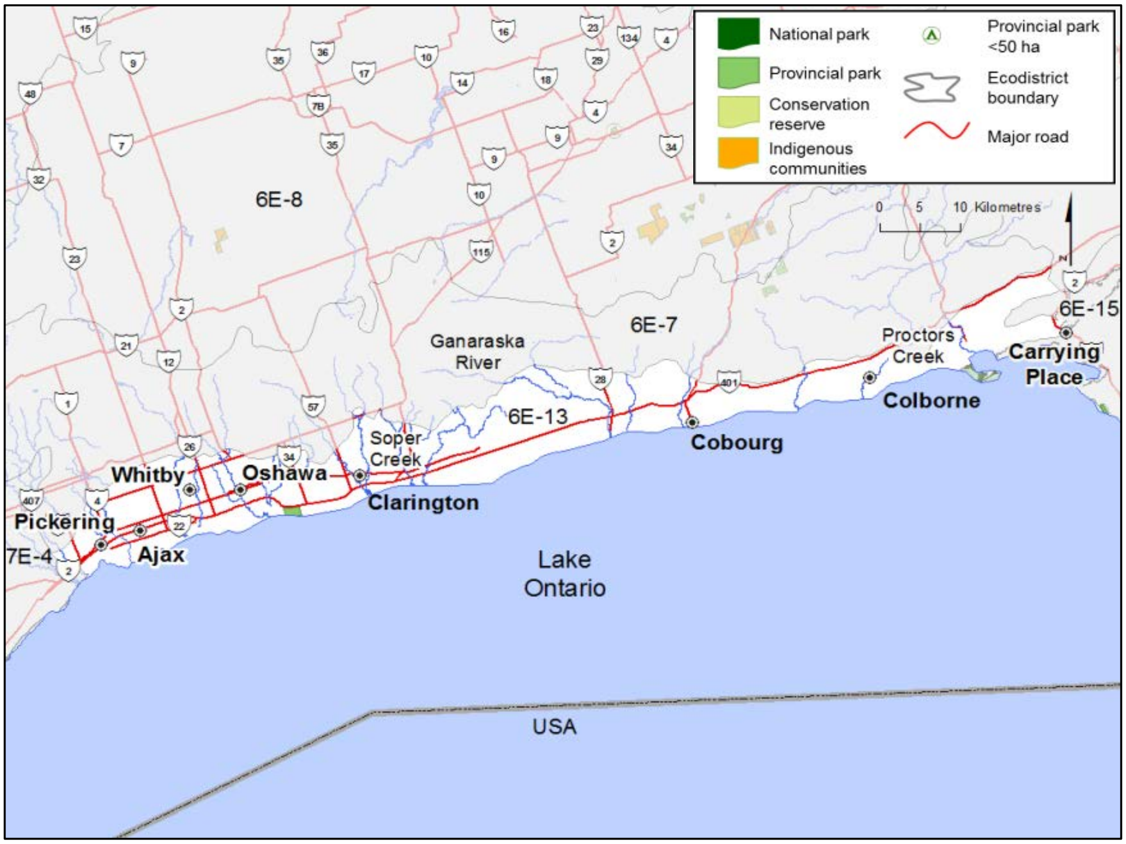


Figure 441. Select communities, natural heritage areas, major roads, and waterways in Ecodistrict 6E-13.

Shoreline wetlands on Lake Ontario

Shoreline wetlands are habitats that occur in the transition zone between upland areas and the deeper water of a lake or river. In Lake Ontario, shoreline wetlands develop in sheltered areas including river mouths, embayments, and behind bars and barrier beaches (Figure 442; Environment Canada and OMNR 2003). In Ecodistrict 6E-13, marshes and swamps occur along the Lake Ontario shoreline providing important migratory stopover and breeding habitats for numerous bird species (Figure 443) and spawning and nursery environments for fish species living in the lake (Environment Canada 2011).

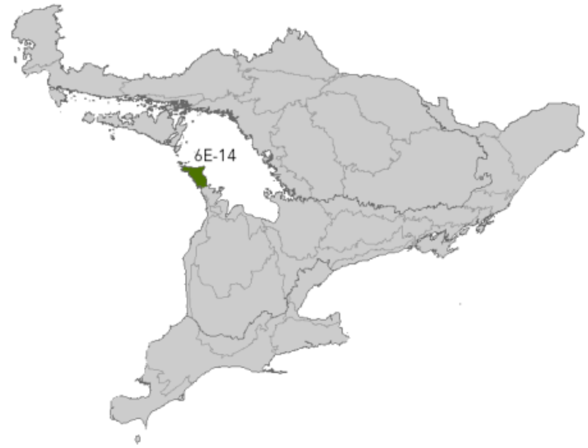
Figure 442. Lynde Shores Conservation Area near the community of Whitby. Lou Wise.

Figure 443. Migrating whimbrels along Lake Ontario. Denby Sadler.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26

Ecodistrict 6E-14

Tobermory Ecodistrict



Situated at the northern end of the Bruce Peninsula, the Tobermory Ecodistrict is bound on three sides by Lake Huron. The southern extent occurs south of the community of Stokes Bay and includes Lyal Island. Northern islands include Cove, Flowerpot, and Bears Rump. The smallest ecodistrict in Ecoregion 6E, it encompasses 62,347 ha (1.0% of the ecoregion, 0.1% of the province). The elevation ranges from 172 m above sea level along the western shore of Lake Huron to 283 m above sea level north of Gillies Lake.

Figure 444. Forests of the Tobermory Ecodistrict. Rebecca Lidster, MNRF.

Key features

- Dominated by coniferous, mixed, and deciduous forests (Figure 444).
- Deposits are very shallow to shallow morainal over Paleozoic bedrock.
- Characterized by the Niagara Escarpment and Georgian Bay cliffs.

Geology and substrates

Approximately 11,000 years ago (Dyke 2004), glacial ice receded from the Tobermory Ecodistrict and the landscape was submerged by glacial Lake Algonquin. As deglaciation continued, the area was exposed. The western shoreline and islands were subsequently inundated by the Nipissing Great Lakes. High glacial lake levels and previous flooding by glacial meltwater under the ice created a gently rolling landscape with a discontinuous layer of very shallow to shallow, calcareous, morainal material (Figure 445). Deeper deposits occur north of Miller Lake (Cowan and Sharpe 2007). A prominent feature in Ecodistrict 6E-14 is the Niagara Escarpment, a large ridge formed by the differential erosion of the underlying Paleozoic bedrock. Shaped over millions of years by water, ice, and wind, the escarpment comprises a series of cliffs, bluffs, and shore caves in the east adjacent to Georgian Bay. In the west, the ecodistrict gently descends into Lake Huron. The underlying Paleozoic bedrock shows evidence of karst topography with a series of fissures and solution holes (Riley et al. 1996).

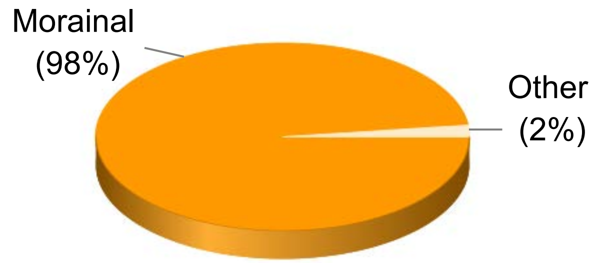


Figure 445. Modes of deposition in Ecodistrict 6E-14.

Glaciolacustrine features are limited. Materials deposited in deep water, most likely in glacial Lake Nipissing (Cowan and Sharpe 2007), occur at the southern boundary with 6E-4, along portions of the Stokes River and Chin Creek, and south of the community of Tobermory. Relict beaches are common; however, they are fragmented and small due to the shoreline terrain (Cowan and Sharpe 2007). The discontinuous, thin nature of the mineral material in Ecodistrict 6E-14, results in small patches of bedrock occurring throughout.

Post-glacial deposits include organic, aeolian, lacustrine, and colluvial materials. Organic deposits are infrequent and small, occurring in shallow depressions in the bedrock or overlying glaciolacustrine material with poor drainage. Aeolian and lacustrine fine-textured materials are generally limited to the western shore (Cowan and Sharpe 2007). Diverse shoreline bedrock and coarse fragment features including shingle and cobble beaches are common in the east, an area influenced by strong northerly winds and waves (Cowan and Sharpe 2007). Colluvial deposits (i.e., talus) may occur at the base of cliffs, including the prominent cliffs north and south of the community of Dyer’s Bay (Riley et al. 1996).

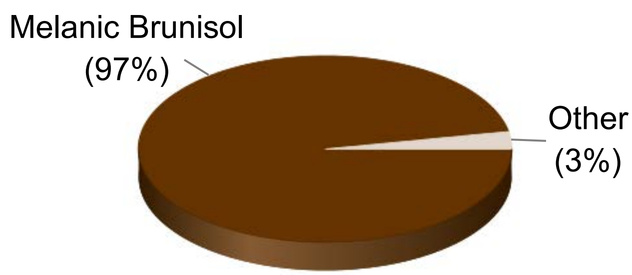


Figure 446. Substrates types in Ecodistrict 6E-14.

Melanic Brunisols are common throughout the ecodistrict (Figure 446), having developed in well drained, calcareous, and coarse-textured morainal material. Gleysols are restricted to low lying areas, typically in glaciolacustrine material. Mesisols have developed throughout the ecodistrict where organic materials have accumulated. Larger deposits occur south of Miller Lake and the community of

Tobermory. Due to the very shallow mineral material, bare bedrock can occur throughout the ecodistrict, typically as patches in vegetated areas. Bedrock shorelines including the one at Gillies Lake and bedrock shelves adjacent to Georgian Bay can also be found (Figure 447; Riley et al. 1996). Regosols are associated with lacustrine and aeolian deposits.

Figure 447. Bedrock shelves and shoreline at Flower Pot Island. Mike McMurtry, MNRF.

Land cover and vegetation

The Tobermory Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Coniferous forests dominate the area (Figure 448). Eastern white cedar is a common species and is often accompanied by balsam fir and white spruce. Old growth eastern white cedar forests grow on undisturbed islands in the north and along the escarpment as stunted trees (Riley et al. 1996). Eastern white pine, jack pine, and red pine are limited, occurring on dry sites. Eastern red cedar and jack pine may occur on rocky ridges. Mixed forests comprise eastern white cedar, paper birch, and trembling aspen. Associates may include balsam fir, large-toothed aspen, and white spruce. Eastern hemlock is uncommon, typically occurring on cooler-than-normal, humid sites with eastern white cedar and deciduous tree species. Upland deciduous forests are dominated by sugar maple. American beech, American basswood, yellow birch, eastern hop-hornbeam, and

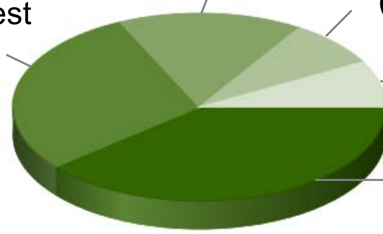


Figure 448. Land cover types in Ecodistrict 6E-14.

white ash may also occur. Paper birch and trembling aspen are common on disturbed sites. Northern red oak forests are limited, occurring on dry substrates including sandy areas near Cameron Lake. Lowland deciduous forest species include silver maple, red maple, green ash, black ash, American elm, and occasionally balsam poplar (Riley et al. 1996). Fire has significantly affected the ecodistrict, increasing the area of trembling aspen and white birch and decreasing the occurrence of eastern hemlock.

In areas with deeper substrates, the land has been converted to pasture and cropland. Marshes and fen complexes often occur near lakes and along the shore in sheltered embayments. Alvar communities occur on bare to very shallow covered bedrock in areas with specialized environmental conditions that support the growth of a unique assemblage of plant species including lakeside daisy, little bluestem, and false pennyroyal (Riley et al. 1996). Sparse forests are generally associated with dry, bedrock conditions where vegetation is limited to cracks with organic or mineral material accumulations.

Ecodistrict 6E-14 is bound on three sides by Lake Huron resulting in a lake modified climate. The moderating effects are more apparent on the northern islands. Cooler-than-normal summers help sustain boreal and subarctic plant species (e.g., alpine bluegrass, naked mitrewort). Some southern species (e.g., black raspberry, skunk cabbage) reach their northern limits due to the warmer-than-normal winters (Riley et al. 1996). Local climate is influenced by the Niagara Escapement. North facing escarpment slopes are cooler and moister, compared with southern slopes where warmer and drier conditions result in greater seasonal and daily temperature fluctuations (Riley et al. 1996). Species with western affinities also occur in Ecodistrict 6E-14, including male and northern holly ferns (Ontario Parks 1997).

Land use

Less than 1% of the total area has been converted to settlement and associated infrastructure including the communities of Tobermory, Miller Lake, and Stokes Bay (Figure 449). Services associated with resource-based activities, agriculture, aggregate extraction, and business and industry occur throughout the ecodistrict. Approximately 28% of the ecodistrict is designated as protected areas. An additional 9,829 ha of water are protected within Fathom Five National Marine Park.

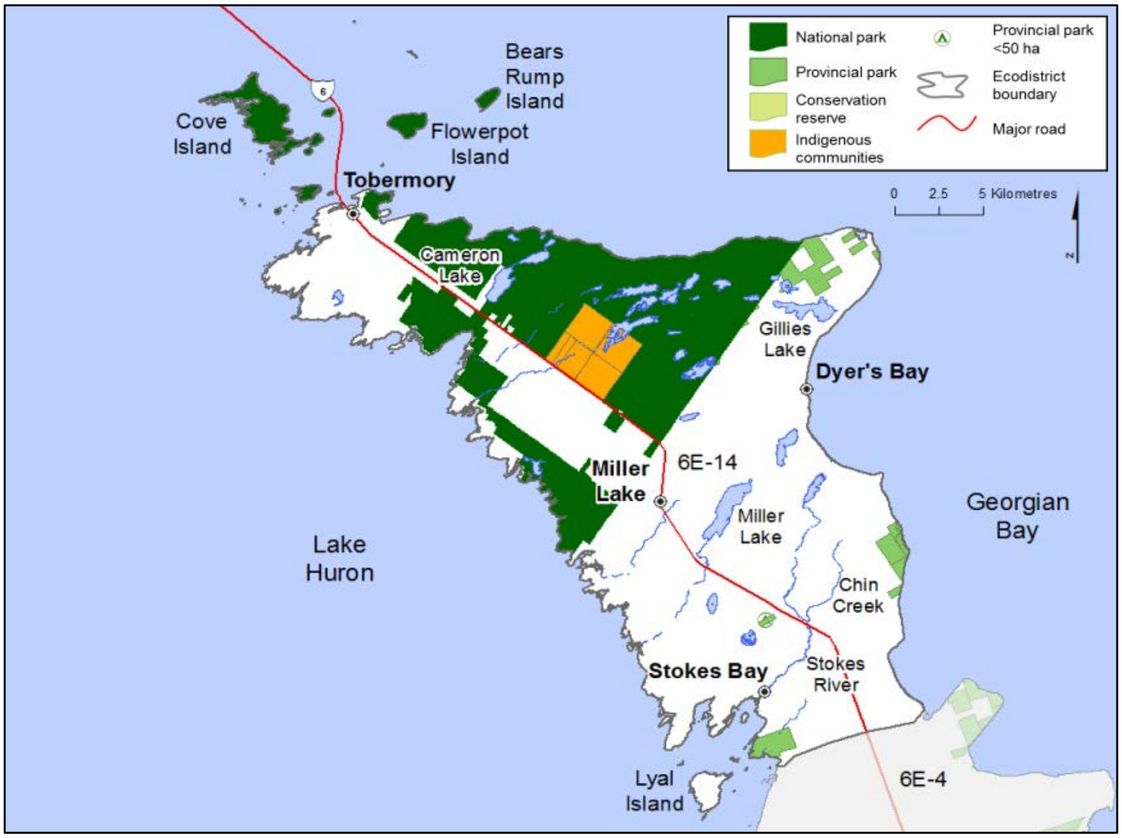


Figure 449. Select communities, natural heritage areas, major roads, lakes, and waterways in Ecodistrict 6E-14.

Ecodistrict boundary delineation

Ecodistrict 6E-14 is a portion of the previously described Site District 5E-2 (Hills 1959). The Paleozoic bedrock and climate regime is more consistent with Ecoregion 6E. The original southern boundary was moved to the north to exclude deeper glaciolacustrine deposits (Jalava et al. 1997). The Tobermory Ecodistrict is bound on three sides (north, east, and west) by Lake Huron. To the north across Lake Huron, Ecodistrict 6E-17 represents a cooler climate. The southern boundary reflects the transition from very shallow morainal deposits in 6E-14 to the deeper glaciolacustrine and morainal deposits in 6E-4.

Ecodistrict 6E-15

Picton Ecodistrict

The Picton Ecodistrict is located along the northeastern shore of Lake Ontario. Encompassing 237,971 ha (3.8% of the ecoregion, 0.2% of the province), it extends from the community of Napanee in the north to the shore of Lake Ontario. The western limit occurs near the community of Presqu'ile Point and extends east to include Amherst, Wolfe, and Howe islands. The gently rolling landscape varies in elevation from 71 m above sea level along the shore of Lake Ontario to 158 m above sea level northeast of the community of Picton.

Figure 450. Agricultural field in Ecodistrict 6E-15. David Bree, Ontario Parks.

Key features

- Landscape dominated by pasture and cropland (Figure 450).
- Shallow morainal deposits on Paleozoic bedrock cover approximately half of the area.
- Includes two large fresh water baymouth barriers and a tombolo bar (Ontario Parks 2009b, d).

Geology and substrates

Glaciation, glacial lakes, and post-glacial processes have shaped the Picton Ecodistrict leaving behind a variety of landscape features. Glaciation deposited a layer of calcareous morainal material of variable depth throughout the area. As the glaciers began to retreat nearly 12,000 years ago (Dyke 2004), glacial Lake Iroquois inundated the ecodistrict (Whitcombe et al. 1973). High water levels modified the morainal material, depositing glaciolacustrine sediments over nearly half of the area (Figure 451), particularly in the north and east. The morainal material unaffected by glacial Lake Iroquois is generally shallow and occurs in the southern half of the ecodistrict. Morainal deposits (e.g., drumlins) have formed south and west of the communities of Picton and Napanee. Many of the drumlins were transformed by glacial Lake Iroquois into flattened elongated hills. As the ice retreated, an outlet for glacial Lake Iroquois opened in the lower St. Lawrence Valley, dropping the lake levels 100 m below the present level of Lake Ontario (Coakley and Karrow 1994). This drop in lake levels and the isostatic rebound of the land resulted in the deposition of a series of shorelines (e.g., sand beaches and gravel bars).

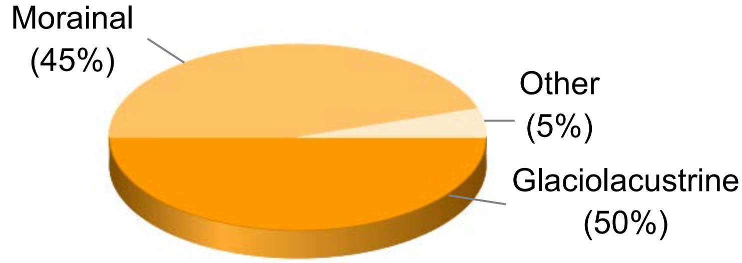


Figure 451. Modes of deposition in Ecodistrict 6E-15.

Limited glaciofluvial deposits occur across the land base. Southwest of the community of Picton to West Lake, an esker and outwash deposits can be found. Similar to the morainal deposits, the glaciofluvial features have been highly modified by glacial Lake Iroquois (Macdonald 1987). Limited bare bedrock, typically Paleozoic, occurs throughout the ecodistrict and areas of Precambrian bedrock occur northeast of the communities of Ameliasburg and Belleville (Leyland 1982) and in the northeast adjacent to the border with Ecodistrict 6E-10. Across the ecodistrict faults add relief to the gently rolling topography. Notable faults include the Picton, Salmon River, and Hamilton-Presqu'ile (McFall 1993). The escarpments on the northern and eastern shores of the islands and the southern peninsula accentuate the gentle southwesterly gradient of the Picton Ecodistrict towards the shore of Lake Ontario.

Organic deposits occur in poorly drained bedrock depressions and in sheltered bays along the Great Lakes shoreline. Larger deposits occur west of the community of Picton and east of the community of Ameliasburg. Although alluvial deposits are scattered throughout the ecodistrict, extensive deposits have formed along the Salmon River. Lacustrine features include baymouth barriers, which separate West and East lakes from Lake Ontario (Leyland 1982, Ontario Parks 2009d); a tombolo bar near the community of Presqu'ile Point; beaches; and limestone shore cliffs maintained by wave action (Figure 452). In the southwest adjacent to Lake Ontario, aeolian deposits consist of vegetated sand ridges and unvegetated dunes (Ontario Parks 2009d). Most of the dune systems on Lake Ontario are found in Ecodistrict 6E-

15 (Bakowsky and Henson 2014a). Aeolian processes have further modified the baymouth barrier and tombolo bar.

Figure 452. Limestone cliff on the shore of Lake Ontario. Peter Uhlig, MNRF.

Melanic Brunisols occur over approximately one-third of the land base (Figure 453). Common in well drained, calcareous, and coarse-textured morainal material, they occur in the southwest and south of the community of Napanee. Gleysols have developed in fine-textured mineral material with poor drainage along the shore from the community of Belleville to Kingston and on Amherst Island. Gray Brown and Gray Luvisols occur in glaciofluvial and glaciolacustrine materials. Gray Brown Luvisols are more common under deciduous or mixed forest canopies with calcareous mineral material, while Gray Luvisols occur in neutral to mildly acidic sites with a mixed or coniferous overstory. Limited pockets of Humo-Ferric Podzols can be found in acidic, coarse-textured mineral materials. Organic materials are typically Mesisols and vary from small, isolated accumulations to extensive, interconnected systems (Macdonald 1987). Regosols are associated with lacustrine, alluvial, and active aeolian materials. Paleozoic and Precambrian bedrock exposures are limited in the ecodistrict. In cases where the Paleozoic bedrock has been exposed to water, karst topography may occur including fissures that divide the surface into sections. Karst features are found along the Salmon and Napanee rivers (Brunton and Dodge 2008).

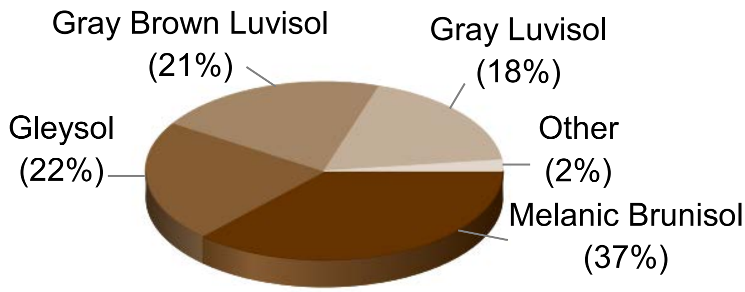


Figure 453. Substrate types in Ecodistrict 6E-15.

Land cover and vegetation

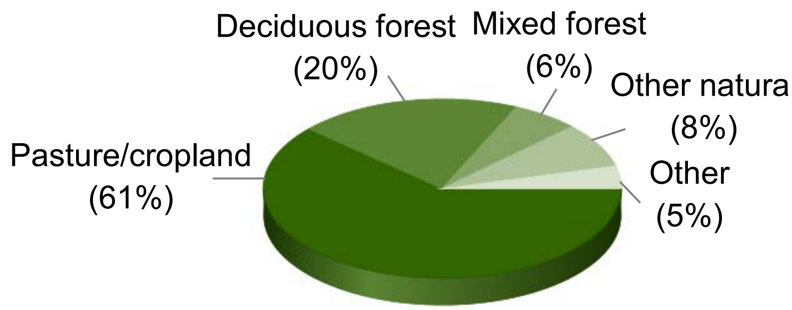


Figure 454. Land cover types in Ecodistrict 6E-15.

The Picton Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018). Rowe (1972) allocated most of the area to the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region. A small portion in the northwest including the communities of Presqu'ile Point, Belleville, and Ameliasburg, south to Consecon Lake occur in the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Cropland and pasture have been established on nearly two-thirds of the land base (Figure 454). Deciduous forests of sugar maple and American beech are the most common forest type on upland sites. Associates include red oak, paper birch, white ash, American basswood, white oak, bur oak, butternut, trembling aspen, and large-toothed aspen. Silver maple, green ash, American elm, red maple, black ash, and yellow birch are more common on wetter sites. Mixed forests comprise deciduous tree species with eastern white pine on dry sites and white spruce, eastern hemlock, balsam fir, and eastern white cedar in areas with cooler-than-normal conditions. American larch, eastern white cedar, and black spruce form wet coniferous forests. Eastern red cedar is common on dry, shallow sites. White spruce and eastern white cedar may be found on abandoned agricultural fields. Marshes occur adjacent to rivers and lakes including the Great Lakes shoreline. Between dune ridges, wind scoured areas close to the water table may occur. These wet depressions are influenced by fluctuating water levels and alkaline substrates and typically support meadow marshes. Small areas of exposed bedrock occur across the landscape, often associated with sparse treed systems where mineral or organic material has accumulated. Fen complexes are generally found in the southwest between the communities of Picton and Ameliasburg.

The modifying climatic effects of Lake Ontario influence the distribution of vegetation in the ecodistrict. The close proximity to Lake Ontario increases humidity and precipitation resulting in a cooler spring, milder winter, and an extended summer growing season. Vegetation with southern affinities are typical throughout the area and include chinquapin oak, shagbark hickory, and black oak. Plants that are near the limits of their northern range include narrow-leaved glade fern, green arrow arum, and American witch-hazel. Northern species (e.g., blue bead-lily, common wood-sorrel) occur on cooler sites often associated with wetlands and areas of Precambrian bedrock. Great Lakes shoreline species (e.g., Kalm's St. John's-wort, Garber's sedge) grow adjacent to Lake Ontario and western species including spreading cinquefoil and beach pea are associated with dry beach habitats. Specialized environmental conditions support alvar communities. These systems, when they occur, are generally small in area, support a unique assemblage of plants and animals, and are located between the communities of Napanee and Belleville.

Land use

Settlement and associated infrastructure occur over approximately 3% of the total area including the communities of Kingston, Belleville, Picton, and Napanee (Figure 455). Agriculture with a significant area dedicated to growing grapes, business and industry, aggregate extraction, wind power and hydroelectric generation, and services associated with resource-based activities occur throughout the ecodistrict. Less than 1% of the ecodistrict is designated as protected areas.

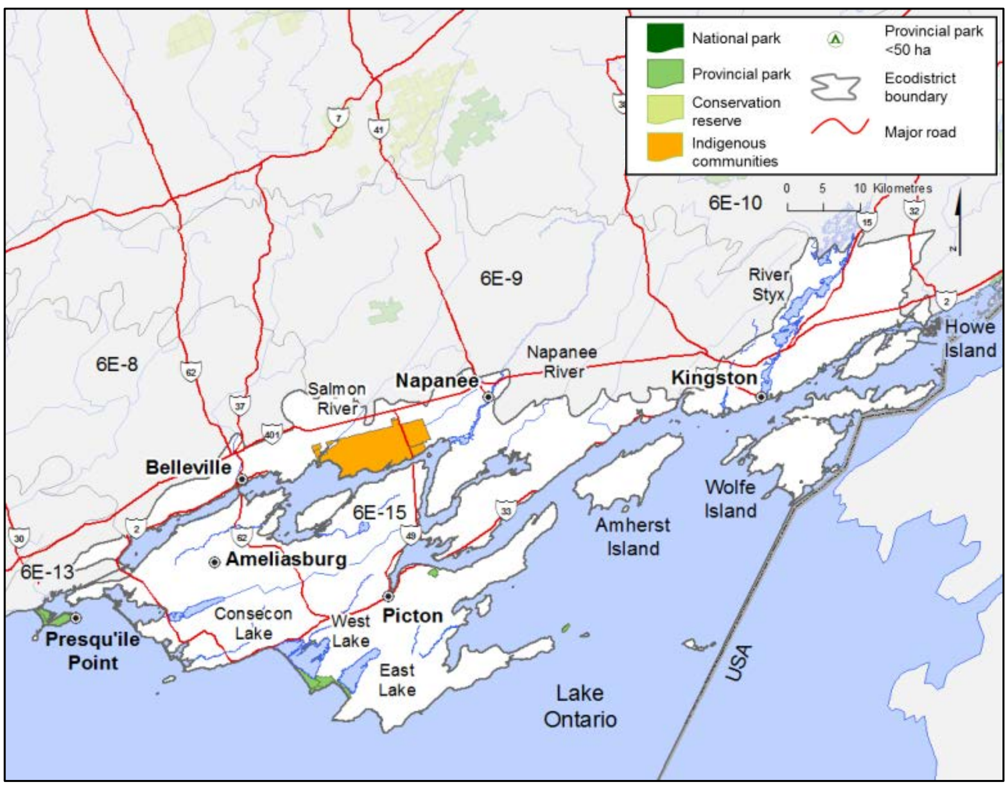


Figure 455. Select communities, natural heritage areas, major roads, and lakes in Ecodistrict 6E-15.

Ecodistrict boundary delineation

Ecodistrict 6E-15 was previously described as Site District 7E-5 (Hills 1959). This was later modified when research showed that it lacked the vegetation characteristics typical of Ecoregion 7E. Proposed boundary changes by Jalava et al. (1997) that better reflect the transitions from one ecodistrict to another have been adopted.

In the west, the boundary with 6E-13 follows the change from shallow, fine-textured material in 6E-15 to the deep, typically coarse-textured mineral material in 6E-13. The northwestern boundary with 6E-8 reflects the transition from morainal deposits with little to no relief in 6E-15 to morainal deposits with relief (e.g., drumlins) in 6E-8. The northeastern boundary follows the change from deep, glaciolacustrine mineral materials in 6E-15 to very shallow, morainal deposits in 6E-9. The eastern boundary with 6E-10 reflects the transition from Paleozoic bedrock in 6E-15 to Precambrian bedrock in 6E-10. The southern boundary of the Picton Ecodistrict is defined by the Ontario-United States border.

Tombolo and wetlands

Notable features in Ecodistrict 6E-15 include a tombolo (Figure 456) and wetlands that have formed between dune ridges. A tombolo, a peninsula created as the result of sand deposition between mainland and a former island, occurs near Presqu'ile Point. The barrier beach that connects the island with the mainland is a unique system of sand beaches, dunes, and multiple beach bars supporting a diverse array of vegetation communities (Ontario Parks 2011). Lying between the dune ridges, extensive wet sand flats support wetland communities of twig rush and small-flowered purple false foxglove (Figure 457), and variegated horsetail (Macdonald 1987) can be found.

Figure 456. Tombolo at Presqu'ile Provincial Park. Google Earth.

Figure 457. Small-flowered purple false foxglove. Wasyl Bakowsky, MNRF.

Ecodistrict 6E-16

Pembroke Ecodistrict

Extending from the community of Pembroke in the west, east along the Ottawa River to Watts Creek, the Pembroke Ecodistrict encompasses 196,374 ha (3.1% of the ecoregion, 0.2% of the province). The northern boundary extends from the Ottawa River south to the community of Pakenham. The gently rolling landscape varies in elevation from 55 m above sea level southeast of the community of Constance Bay to 225 m above sea level northwest of the community of Renfrew.

Figure 458. Agricultural fields and mixed forests near the community of Renfrew. Monique Wester, MNRF.

Key features

- Over half of the ecodistrict has been converted to pasture and cropland (Figure 458).
- Area is dominated by fine-textured glaciolacustrine deposits.
- Underlain by a mix of Precambrian and Paleozoic bedrock.

Geology and substrates

The Pembroke Ecodistrict represents the western most extent of the Champlain Sea. Approximately 11,500 years ago (Dyke 2004), as the glaciers retreated, the isostatically depressed landscape was inundated by marine water, forming the Champlain Sea (Barnett 1992). The sea reworked morainal and glaciofluvial material deposited by the glaciers and their meltwaters, laying down a layer of fine-textured glaciomarine material. With continued isostatic rebound and an influx of fresh water, the extent of the Champlain Sea was reduced and the sea evolved into a fresh water to brackish delta. Large volumes of glacial meltwater flowing down the Ottawa Valley brought mineral material, predominately from the Canadian Shield, into the delta. The sediment was deposited into the delta forming the glaciolacustrine dominated landscape seen today (Figure 459; Marshall et al. 1979).

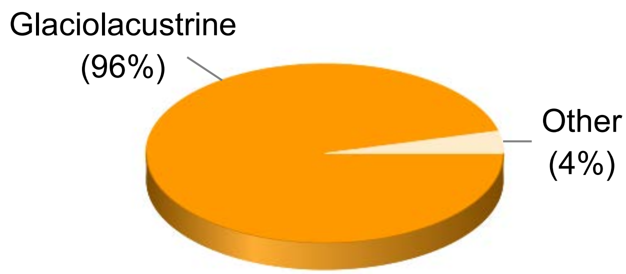


Figure 459. Modes of deposition in Ecodistrict 6E-16.

The underlying bedrock is a mix of Paleozoic and Precambrian bedrock. Bedrock patterning and the origin of the surficial material (i.e., a large quantity of mineral material originated on the Canadian Shield) have resulted in a mix of neutral to mildly acidic mineral material across the landscape. Substrates are generally more calcareous in the east. Prominent rock ridges and escarpments interrupt the gently rolling landscape. The Ottawa-Bonnechere Graben, a rift valley that formed between the Mattawa and Petawawa faults is a prominent feature in the ecodistrict. Other notable faults include the northwest to southeast trending Muskrat Lake Fault that runs along Muskrat Lake towards the Ottawa River and the northwest to southeast trending Lake Doré Fault north of the community of Renfrew and south of the community of Arnprior (Chapman 1975). Several fault zones occur near the interface of Precambrian and Paleozoic bedrock (Gillespie et al. 1964). Bedrock ridges, which were islands in the Champlain Sea, are typically Precambrian, bare, or covered by a shallow layer of morainal material. Thicker morainal deposits occur west of Muskrat Lake and northwest of the Bonnechere River. Karst landforms, including sinkholes and underwater caves, occur in Paleozoic bedrock near the community of Westmeath (Brunton and Dodge 2008). Numerous sinkholes and some of the longest, flooded karst caves known in Canada occur along the Ottawa River (Brunton and Dodge 2008).

Limited glaciomarine deposits include relict shorelines, particularly near the communities of Cobden and Westmeath; landslide sediment that has re-exposed glaciomarine material (Barnett and Clarke 1980); and areas where faster moving meltwater has cut small channels through the glaciolacustrine material. Organic deposits can be found throughout the ecodistrict. Large accumulations occur east of the community of Constance Bay and north and west of Muskrat Lake. Glaciofluvial deposits were extensively reworked by the Champlain Sea, leaving few recognizable features. Examples include terraces along the Bonnechere and Ottawa rivers and small glaciofluvial deposits near the community of Westmeath. Alluvial deposits occur along the Bonnechere and Ottawa rivers (Barnett and Clarke 1980). Aeolian material can be found near the community of Westmeath (Simpson 1977, Bakowsky and Henson 2014a).

Gray Luvisols have formed in approximately half of the ecodistrict, typically in neutral to acidic, fine-textured mineral material (Figure 460). Where the mineral material is calcareous and well drained, Melanic Brunisols have developed. Humo-Ferric Podzols occur in deep, acidic, typically morainal material. Sombric Brunisols have formed in acidic mineral material under deciduous forest canopies. To a limited extent Gray Brown Luvisols have developed in calcareous material. Small organic deposits, typically Mesisols, can be found in poorly drained areas associated with discontinuous very shallow mineral material over bedrock (Simpson 1977). Larger accumulations commonly occur in depressions overlying fine-textured material (Barnett and Clarke 1980). Exposed Precambrian bedrock occurs on rock ridges near Muskrat Lake and the Carp River and Paleozoic outcrops can be found in the vicinity of the community of Westmeath. Small, isolated wetlands and escarpments are common components of the rugged areas of Precambrian bedrock (Brunton 1992). Regosols are associated with alluvial and active aeolian deposits adjacent to rivers and streams.

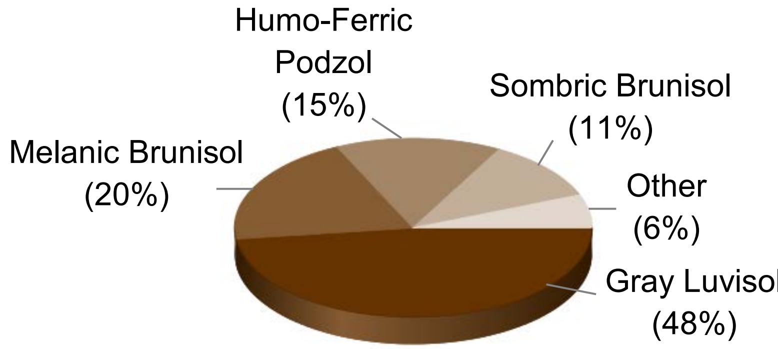


Figure 460. Substrate types in Ecodistrict 6E-16.

Land cover and vegetation

Ecodistrict 6E-16 is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Upper St. Lawrence Section (L.2) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Approximately half of the ecodistrict has been converted to cropland and pasture (Figure 461). Forests are typically mixed or deciduous. Mixed forest are scattered around the ecodistrict including large areas east and south of Muskrat Lake and near the community of Westmeath. Sugar maple, American beech, white spruce, balsam fir, and eastern white pine are common associates. On fresh sites eastern hemlock and yellow birch may occur, and on dry conditions mixed forests may include eastern white pine, red pine, red oak, and occasionally large-toothed aspen. Lowland mixed forests consist of eastern white cedar, black ash, and green ash. Deciduous forests dominate on deeper, fine-

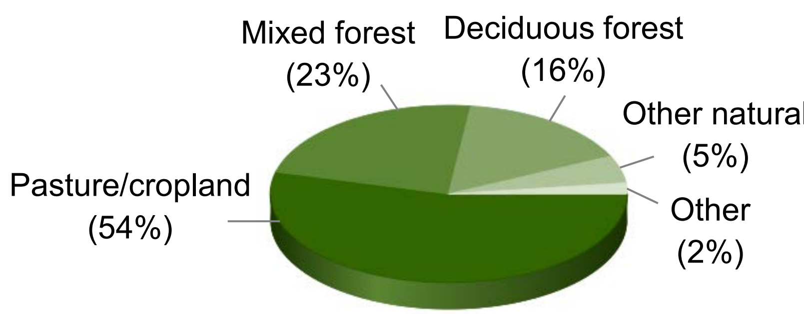


Figure 461. Land cover types in Ecodistrict 6E-16.

textured mineral material (Noble 1984). Prior to European settlement, the deciduous forests were dominated by sugar maple and American beech. Currently, deciduous forests grow trembling aspen, large-toothed aspen, and paper birch (Noble 1984) as land that was initially cleared for agriculture becomes reforested. Associated tree species include red maple, yellow birch, balsam poplar, eastern hop-hornbeam, black cherry, American basswood, white ash, red oak, and bur oak. On wetter sites, silver maple, black ash, green ash, American elm, and slippery elm can occur. Species near their northern limits in Ontario that can be found in the ecodistrict include white oak, gray birch, blue-beech, shagbark hickory, bitternut hickory, rock elm, and butternut.

Coniferous forests are limited. On dry, coarse-textured sites, eastern white pine and red pine grow, while on wetter sites black spruce and eastern white cedar are more common. Additional conifer species include American larch, eastern hemlock, white spruce, and balsam fir. In the east, eastern red cedar occurs on dry, very shallow substrates over Paleozoic bedrock. Marsh complexes have formed in quiet bays along the Ottawa River as well as along smaller rivers and lakes. Bog and fen complexes are limited, typically occurring as small, isolated vegetation communities in bedrock depressions. A large fen complex has formed south of the community of Constance Bay. Ecodistrict 6E-16 includes active aeolian deposits, more commonly associated with the shores of the Great Lakes and larger lakes. Found along the Ottawa River near the community of Westmeath, the environment supports vegetation species (e.g., woolly beach-heath, beach pea, and tall wormwood; Figure 462) that are adapted to active mineral material (Bakowsky and Henson 2014a, Noble 1984).

Figure 462. Tall wormwood along the beach at Westmeath Provincial Park. Lauren Trute, Ontario Parks.

The Pembroke Ecodistrict contains a mix of species reaching their eastern, western, northern, and southern limits. More common to the west, common hackberry is near its eastern extent (Brunton 1992), while gray birch is near its western extent. Northern species growing in the ecodistrict include three-toothed cinquefoil. Species more common in southern Ontario include rough cocklebur, pale dogwood, and slender flatsedge (Noble 1984). Southeast of the community of Pembroke, the specialized environment of a small alvar community supporting a unique assemblage of plants and animals can be found.

Land use

Settlement and associated infrastructure including the communities of Pembroke, Renfrew, and Arnprior occupy approximately 1% of the total area (Figure 463). Agriculture, business and industry, aggregate extraction, hydroelectric generation, and services associated with resource-based activities occur throughout the ecodistrict. Less than 1% of the ecodistrict comprises protected areas.

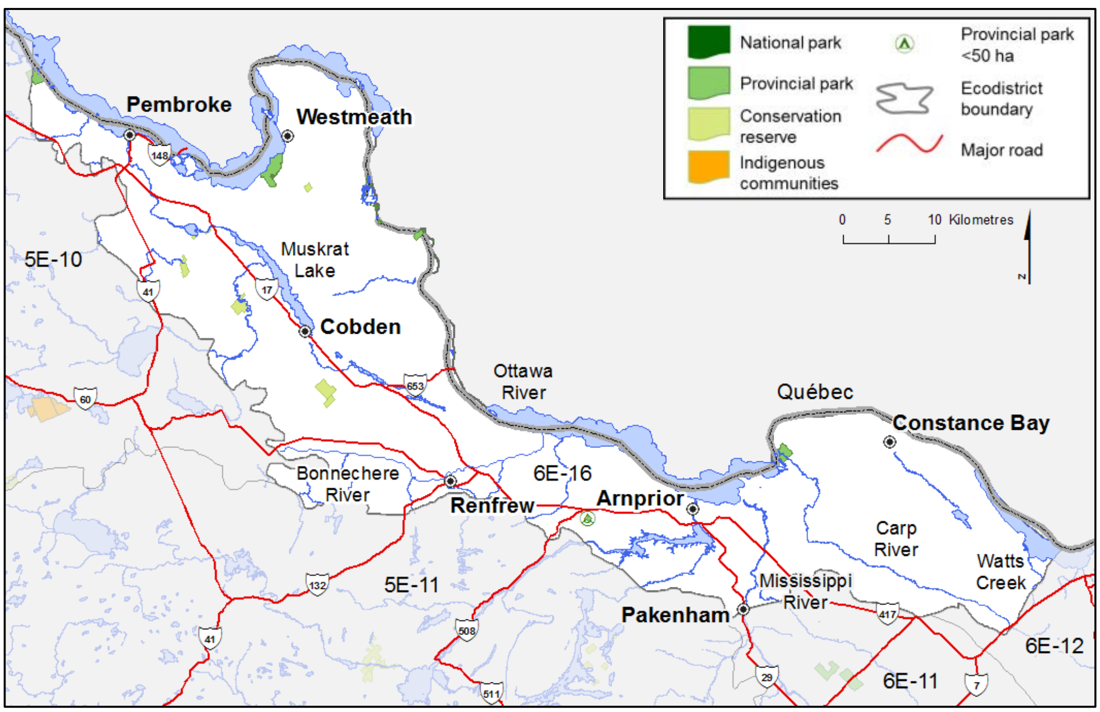


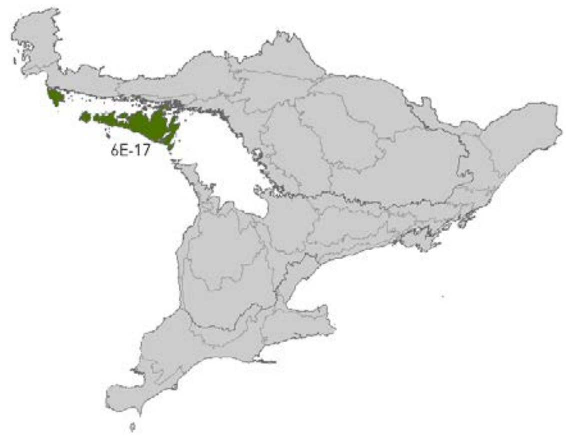
Figure 463. Select communities, natural heritage areas, major roads, and rivers in Ecodistrict 6E-16.

Ecodistrict boundary delineation

Hills (1959) previously described Ecodistrict 6E-16 as Site District 5E-12. Research in the area showed that the climatic conditions were advantageous for the growth of southern vegetation more characteristic of Ecoregion 6E (Jalava et al. 1997). The northern boundary of the Pembroke Ecodistrict occurs at the Ontario-Québec provincial border. The eastern boundary as originally proposed by Hills (1959) has been expanded east to include the western corner of Ecodistrict 6E-12, to better represent the underlying bedrock topography transition from Precambrian bedrock in 6E-16 to Paleozoic bedrock in 6E-12. The southeastern boundary with 6E-11 is defined by the transition from deep glaciolacustrine deposits in 6E-16 to shallow, typically morainal material in 6E-11. The southwestern and western boundaries with Ecoregion 5E reflect temperature and precipitation differences (e.g., Ecoregion 6E is warmer and drier) as well as a change in mineral material depth with deep mineral material in 6E-16 compared to very shallow to shallow substrates in Ecodistrict 5E-10 and 5E-11.

Ecodistrict 6E-17

Manitoulin Ecodistrict



The Manitoulin Ecodistrict consists of several islands located in northern Lake Huron, encompassing 369,042 ha (5.9% of the ecoregion, 0.4% of the province). Larger islands from west to east include St. Joseph, Cockburn, Manitoulin, and Fitzwilliam. The north-south extent of Ecodistrict 6E-17 includes Great La Cloche Island, north of Manitoulin Island and Great Duck Island to the south. The undulating topography ranges in elevation from 170 m above sea level along the southwestern shore of St. Joseph Island to 353 m above sea level west of Manitou Lake.

Figure 464. Deciduous forests and pasture on Manitoulin Island. Anna Sheppard, Ontario Parks.

Key features

- Deciduous and mixed forests occur over half of the ecodistrict (Figure 464).
- Approximately three-quarters of the landscape is overlain by morainal material of variable depth.
- Area is underlain by Paleozoic bedrock with Precambrian outliers at the northern edge.
-

Geology and substrates

The Manitoulin Ecodistrict is the northernmost extent the Niagara Escarpment. Cliffs and associated talus, particularly on the north shore of Manitoulin Island, give way to more gently sloping bedrock that gradually dips underwater along the Lake Huron shoreline (Noble 1995c). The Paleozoic bedrock is typically covered by calcareous morainal material of variable depth (Figure 465). Deeper morainal deposits that occur on St. Joseph and Cockburn islands and in small drumlin fields on Manitoulin Island are generally acidic derived from Precambrian material transported from areas farther north. Approximately 11,000 years ago (Dyke 2004), a series of glacial lakes including glacial Lake Algonquin inundated the area (Barnett 1992). Wave action from these lakes washed morainal material from large areas, leaving behind Paleozoic bedrock with a discontinuous layer of very shallow mineral sediment. Nearly 6,000 years later (Barnett 1992) the Nipissing Great Lakes submerged the southern shore of Manitoulin Island and most of St. Joseph and Cockburn islands.

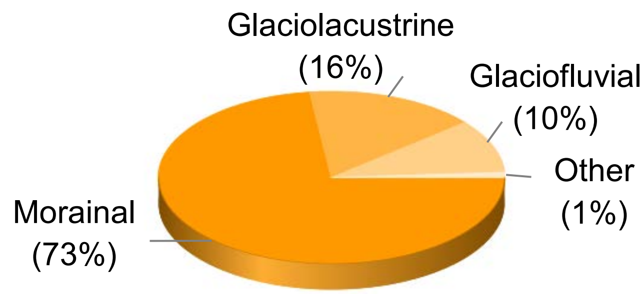


Figure 465. Modes of deposition in Ecodistrict 6E-17.

Glaciolacustrine features (e.g., relict shorelines, gravel bars, bluffs) were created as the glacial lakes receded. Large lake bed remnants consisting of fine-textured materials occur in the northwest, and north and south of Mindemoya and Kagawong lakes (Chapman and Putnam 1984). Pockets of glaciofluvial deposits are found near the community of Richard's Landing (Karrow 1991), northeast of Mindemoya Lake, parts of the southern shore of Manitoulin Island, and surrounding the community of Sheshegwaning (Hoffman et al. 1959). Precambrian outcrops occur in some areas along the northern shore of Great La Cloche Island and south of the community of Little Current (Liberty 1972). Large areas of Paleozoic bedrock can be found along the southern shore of Manitoulin Island, particularly on sites influenced by the wave action of the Nipissing Great Lakes. In some areas where limestone is at the surface or covered by a thin layer of mineral material, the bedrock has been dissolved by water creating karst features (e.g., sinkholes, crevice caves, disappearing streams) (Brunton and Dodge 2008). Organic deposits may occur in low-lying areas associated with lake and streams deposits. Aeolian and lacustrine deposits are typically restricted to the southern shore. Cobble beaches or bare bedrock are common adjacent to shorelines with high energy (i.e., wave or wind action).

Melanic Brunisols have developed in calcareous morainal material on two-thirds of the land base (Figure 466). Humo-Ferric Podzols have developed in acidic, coarse-textured glaciofluvial and morainal deposits with better drainage. Luvisolic substrates are more prevalent on St. Joseph and Cockburn islands where they have developed in upland forested sites underlain by fine-textured mineral material. Gray Brown Luvisols have developed in warm calcareous sites of glaciolacustrine origin, while Gray Luvisols are found in cooler calcareous sites derived from morainal deposits. Organic deposits, typically Mesisols and Humisols, occur in poorly drained areas, and Regosols are typically restricted to the southern shore associated with active aeolian and lacustrine deposits. Patches of bedrock occur along the southern shore of Manitoulin Island and wave-washed areas throughout the ecodistrict. Colluvial materials (i.e., talus) are associated with escarpment cliffs.

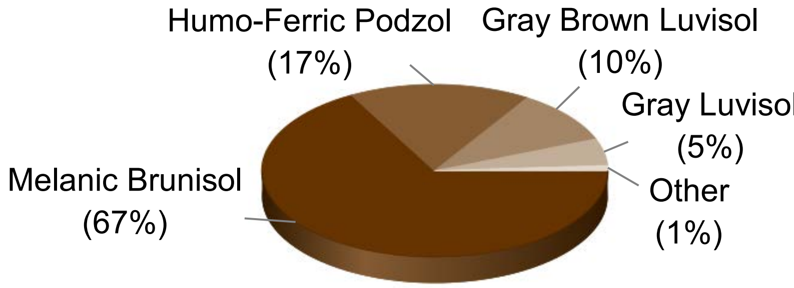


Figure 466. Substrate types in Ecodistrict 6E-17.

Land cover and vegetation

The Manitoulin Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Huron-Ontario Section (L.1) of the Great Lakes-St. Lawrence Forest Region (Rowe 1972). Deciduous forests occur over nearly one-third of the landscape and are more prevalent on St. Joseph and Cockburn islands (Figure 467). Sugar maple is common with a variety of associates including American beech, red maple, yellow birch, American basswood, red oak, white oak, eastern hop horn-beam, large-toothed aspen, white ash, and paper birch. Silver maple, green ash, black ash, and American elm may grow on moister sites.

Along the southern shoreline and in the east, mixed forests include eastern white pine, red pine, white spruce, jack pine, and balsam fir. Cropland and pasture frequently occur in the central portion of the ecodistrict and coniferous forests are scattered throughout. Sparse forests often occur on very shallow substrates and may include bur oak, eastern white cedar, and jack pine. Ecodistrict 6E-17 contains the largest total area of alvar ecosystems in Ontario (Figure 468). Primarily on Manitoulin Island, these communities have specialized environmental conditions that support a unique assemblage of plant and animal species including three-flowered avens and scarlet paintbrush (Catling 1995). Wetland communities (e.g., marsh, bogs and fen complexes) are limited to low-lying areas with poor drainage. The Manitoulin Ecodistrict contains several large dune systems (Bakowsky and Henson 2014a). Pitcher’s thistle and American beachgrass can be found in these unique habitats (Henson and Brodribb 2005).

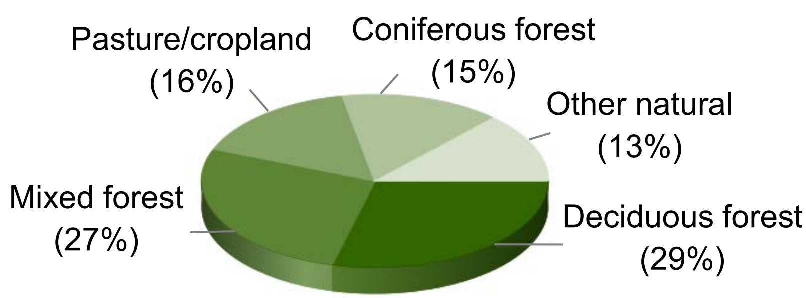


Figure 467. Land cover types in Ecodistrict 6E-17.

Figure 468. Treed and grass alvar communities, Manitoulin Island. Wasyl Bakowsky, MNRF.

The modifying local effects of Lake Huron influences temperature (e.g., warmer-than-normal winters and cooler-than-normal summers) and increases precipitation. Transitional species from the boreal and temperate forests, Great Lakes endemic species, and western disjuncts contribute to the vegetation diversity found here. Plant species at their southern limits include mountain sweet cicely and low spikemoss (Henson and Brodribb 2005). Endemic Great Lakes plants include sand-dune wildrye and Great Lakes sandreed. Small-flowered blue-eyed Mary, cut-leaved anemone, and Alaskan rein-orchid are more commonly found in the west (Henson and Brodribb 2005).

Land use

Settlement and associated infrastructure, including the communities of Little Current, Wikwemikong, Gore Bay, and Richard’s Landing encompass less than 1% of the land base (Figure 469). Throughout the ecodistrict agriculture, timber harvesting, wind power and hydroelectric generation, aggregate and petroleum extraction, hunting, fishing, and services associated with resource-based activities occur. Approximately 2.4% of the ecodistrict is designated as protected areas.

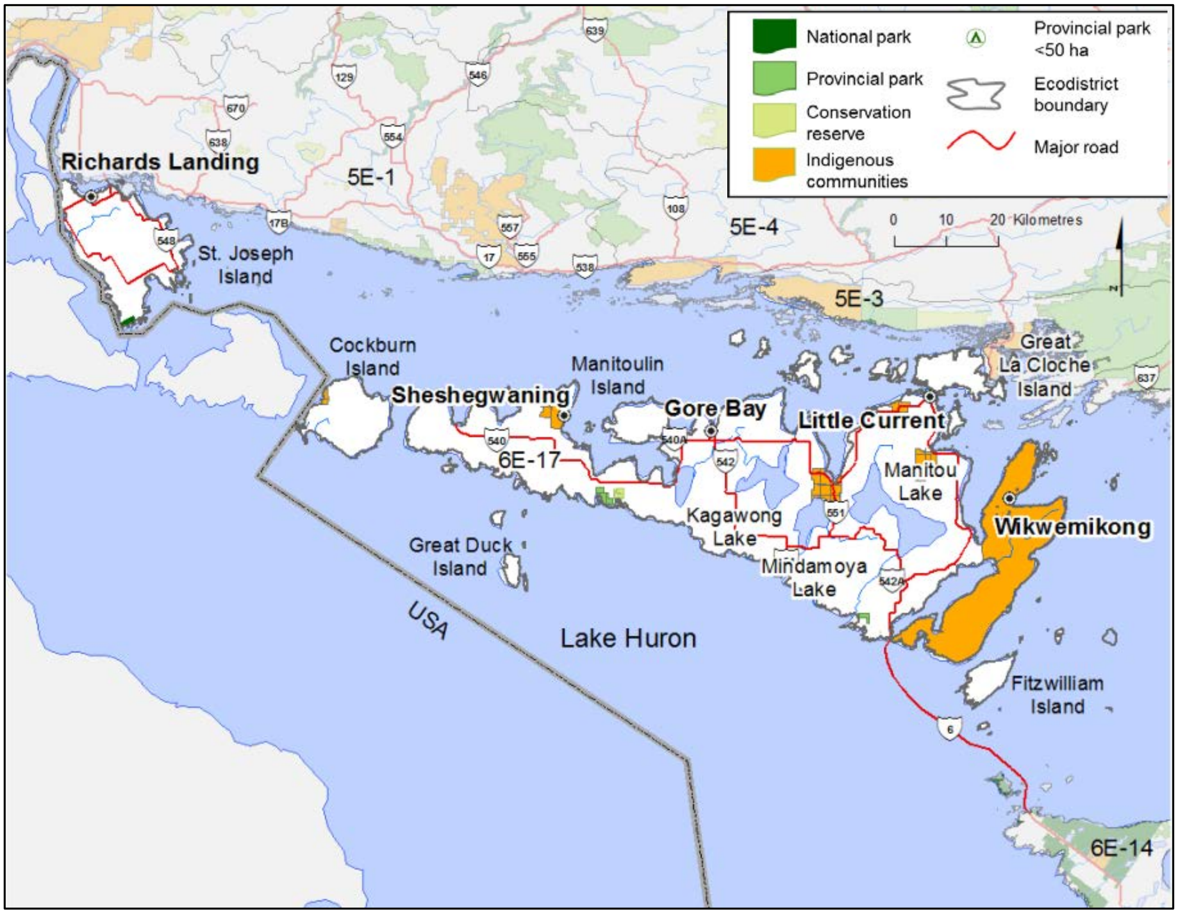


Figure 469. Select communities, natural heritage areas, major roads, and lakes in Ecodistrict 6E-17.

Ecodistrict boundary delineation

Originally described as Site District 5E-2 by Hills (1959), the Manitoulin Ecodistrict has since been included in Ecoregion 6E (Jalava et al. 1997). A comparison of bedrock and climatic regimes showed that the area is more consistent with Ecoregion 6E than 5E. The western and southern boundary of Ecodistrict 6E-17 is defined by the Ontario-United States border. The northern boundary is defined by ecoregional differences. The climate in Ecoregion 6E is warmer and the bedrock is Paleozoic, compared to the Precambrian bedrock of 5E. The eastern boundary with 6E-14 is defined by a cooler climate in 6E-17.

Thistles, daisies, and turtles

Bedrock geology, glacial events, and climate have produced a notable mosaic of floristic plant species with southern, northern, Atlantic maritime, western Cordillera, and grassland affinities, including some species that are endemic to the Great Lakes (Noble 1995c) and several species at risk. Three threatened species found on Manitoulin Island include Pitcher's thistle (Figure 470), Blanding's turtle (Figure 471), and lakeside daisy or *Manitoulin Gold* (Figure 472). Lakeside daisy and Pitcher's thistle are restricted to the Great Lakes Basin. Lakeside daisy occurs on limestone bedrock and Pitcher's thistle grows in windblown sandy habitats. Blanding's turtles can be found in wetland complexes throughout southern, central, and eastern Ontario.

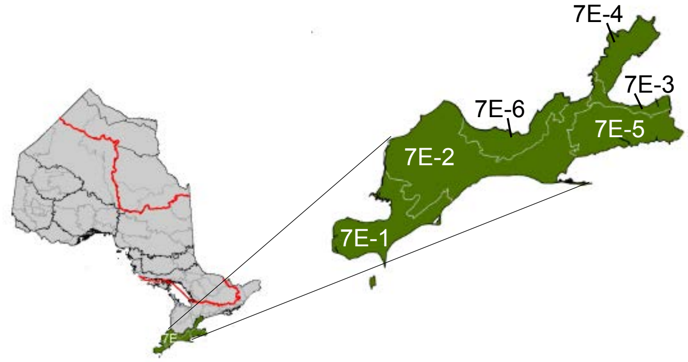
Figure 470. Pitcher's thistle. Sam Brinker, MNRF.

Figure 471. Blanding's turtle. Anna Sheppard, Ontario Parks.

Figure 472. Lakeside daisy. Monique Wester, MNRF.

Ecoregion 7E

Lake Erie-Lake Ontario



Ecoregion 7E is the most southern ecoregion in the province. Located in the Mixedwood Plains Ecozone on the shorelines of lakes Huron, Erie, and Ontario, it extends from the communities of Windsor and Sarnia east to the Niagara Peninsula and the city of Toronto. The Lake Erie-Lake Ontario Ecoregion encompasses 2,185,845 ha (2.2% of the province) and is divided into six ecodistricts (Table 12).

Table 12. Ecodistricts in Ecoregion 7E**.**

Ecodistrict	Ecodistrict name
7E-1	Essex
7E-2	St. Thomas
7E-3	Grimsby
7E-4	Toronto
7E-5	Niagara
7E-6	London

The typography is generally flat with deep calcareous, morainal material overlying Silurian and Devonian limestone bedrock. Glaciolacustrine deposits, remnants of glacial lakes, also occur. Drumlin fields and a portion of the Niagara Escarpment add relief. Gray Brown Luvisols and Gleysols dominate with a minor component of organic material.

Several large rivers, including the Grand, Thames, and Humber, have created valleys perpendicular to the shores of lakes Huron, Erie, and Ontario. A few small lakes are present and drainage is generally poor.

With the mildest climate in Canada, the Lake Erie-Lake Ontario Ecoregion has cool winters and long, hot, humid summers. Nearly three-quarters of the land base has been converted into cropland and pasture. Developed land and remnant forests (mainly deciduous) cover the rest of the area. Scattered throughout the ecoregion are Great Lakes shoreline marshes, deciduous and conifer forests, and fens.

The flora and fauna in Ecoregion 7E are the most diverse in Canada and include several provincially significant plants, animals, and vegetation communities (Figure 472). Sugar maple, American beech, and eastern white pine are widespread. Species with affinities to temperate forests in the United States including tulip tree, sassafras, and Kentucky coffee-tree also occur. Plant species associated with alvar and grassland communities are located here.

Figure 472. Remnant oak forest, Walpole Island. Sam Brinker, MNRF.

Characteristic bird and mammal species that inhabit the ecoregion include green heron, eastern kingbird, striped skunk, white-tailed deer, and Virginia opossum. Midland painted turtle, eastern gartersnake, yellow perch, and banded killifish also occur. Many of Ontario's species at risk can be found here.

The Lake Erie-Lake Ontario Ecoregion is the most heavily urbanized and industrialized area in Ontario and contains several of the province's largest cities, including Toronto, Hamilton, London, and Windsor.

Twenty-two types of natural heritage areas are found including Rondeau Provincial Park (Gray et al. 2009), Ontario's second oldest park (Dobbyn and Pasma 2012). The park is located on a major sand spit on the north shore of Lake Erie and is home to one of Canada's largest remaining treed areas in Ecoregion 7E (Klinkenberg 1984).

Ecoregion 7E is distinguished from 6E based on its warmer temperature and longer growing season, resulting in higher net primary productivity. Ecoregion 7E also has a lower elevation and a higher proportion of glaciolacustrine deposits compared with morainal material in 6E.

Ecodistrict 7E-1

Essex Ecodistrict

Ecodistrict 7E-1 is the most southerly ecodistrict in Ontario. The western boundary occurs near the community of Amherstburg and extends east to the community of Duart. Middle Island marks the southern limit, and in the north the boundary is near the community of Sombra. It encompasses 379,328 ha (17.4% of the ecoregion, 0.4% of the province). The level terrain changes in elevation from 165 m above sea level on Middle Island to 245 m above sea level southwest of the community of Duart.

Figure 473. Agricultural fields of Ecodistrict 7E-1. Rebecca Lidster, MNRF.

Key features

- The majority of the area has been converted to agricultural fields (Figure 473).
- Morainal deposits occur over most of the ecodistrict.
- The Lake Erie Archipelago, also referred to as the Western Lake Erie Islands (NCC 2015a), the southerly most islands in Canada, occur here.

Geology and substrates

The Essex Ecodistrict is a relatively flat landscape underlain by Paleozoic bedrock. Glaciers deposited calcareous fine-textured morainal material over much of the region (Figure 474).

The morainal deposits are generally deep, except for the Lake Erie Archipelago, and are typically covered by a thin layer of glaciolacustrine material (Chapman and Putnam 1984). Moraines that occur in the area include the Blenheim, Charing Cross, Leamington, and Essex (Barnett 1992). Glaciolacustrine material and features of glacial lakes (e.g., Maumee, Arkona, Whittlesey, Warren, Grassmere, and Lundy) that inundated the area starting nearly 13,500 years ago (Dyke 2004) occur throughout the landscape. Deeper deposits occur in the northwest, and in the northeast and southwest along the shore of Lake Erie. Relict shorelines, particularly adjacent to lakes Erie and St. Clair, and shore bluffs from the succession of glacial lakes can be found across the ecodistrict.

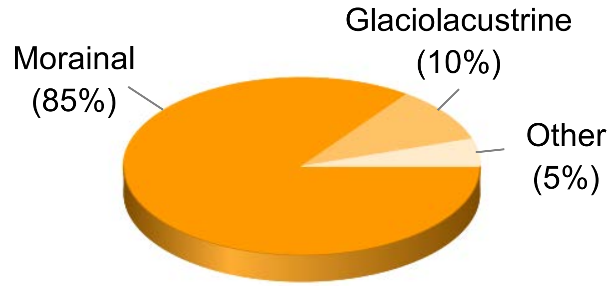


Figure 474. Modes of deposition in Ecodistrict 7E-1.

Organic deposits generally occur along the margins of lakes or rivers. Significant accumulations of organic material occur southeast of the communities of Amherstburg and Leamington, at the north end of Lake St. Clair as well as south of the communities of Wallaceburg and Shrewsbury. Larger river valleys (e.g., Thames and Sydenham rivers) contain glaciofluvial and alluvial deposits. Lacustrine and aeolian materials (i.e., sand spits, vegetated sand ridges, unvegetated dunes) are limited to the shorelines of larger lakes. Bedrock outcrops are found on the Lake Erie Archipelago.

The relatively flat topography of the Essex Ecodistrict results in poor drainage and the development of Gleysols, which dominate the area (Figure 475). Gray Brown Luvisols are generally found in better drained, mineral material. Organic deposits are typically Humisols, which accumulate adjacent to larger water bodies in marsh areas. Bare bedrock is limited, typically occurring on the southern Lake Erie islands. Regosols are associated with alluvial, lacustrine, and active aeolian mineral materials.

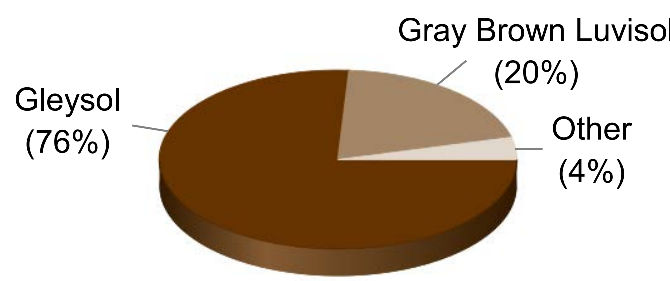


Figure 475. Substrate types in Ecodistrict 7E-1.

Land cover and vegetation

Ecodistrict 7E-1 is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). At the southern part of the Essex Ecodistrict, the Lake Erie Archipelago, which includes Pelee and Middle islands, are the southernmost islands in Canada, roughly parallel to the northernmost portions of California (Finkelstein 2015). The southern latitude and moderating effects of the Great Lakes contribute to the warmest climate in Ontario.

The majority of the land base has been converted to cropland and pasture (Figure 476). Deciduous forests, at 4%, represent the largest remaining total area of natural vegetation. Outside of protected lands, deciduous forests are mostly small and scattered. Tree species include sugar maple, American beech, northern red oak, white ash, pin cherry, white oak, American basswood, eastern hop-hornbeam, black cherry, bitternut hickory, trembling aspen, large-toothed aspen, butternut, yellow birch, and balsam poplar. Bur oak, silver maple, black ash, American elm, red maple, green ash, and Manitoba maple are more common on moist sites. Scattered throughout are trees with southern affinities, including black maple, black walnut, blue-beech, shagbark hickory, sycamore, black willow, rock elm, common hop-tree, American chestnut, eastern cottonwood, common hackberry, and slippery elm. The Essex Ecodistrict is part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep). Ecosystems in this zone may contain a highly diverse group of plants and animals typically found in the temperate portions of the United States. Unique tree species include tulip tree, sassafras, Kentucky coffee-tree, black gum, blue ash, chinquapin oak, black oak, honey-locust, swamp white oak, shellbark hickory, and pawpaw.

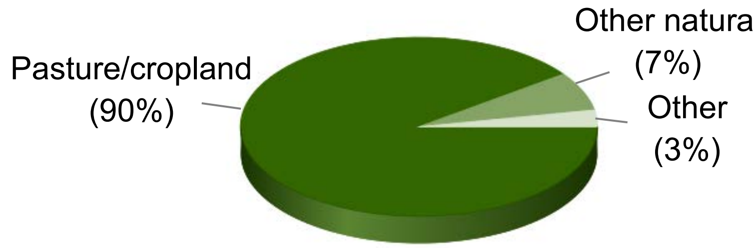


Figure 476. Land cover types in Ecodistrict 7E-1.

Marshes occur adjacent to rivers and lakes including the Great Lakes shoreline. Some of the most notable marshes (Figure 477) in southwestern Ontario occur in Ecodistrict 7E-1 (Klinkenberg 1984). Larger marsh complexes occur along the north end of Lake St. Clair, south of the community of Leamington, and east of the community of Shrewsbury. Species with southern affinities that occur in the marsh environment include American lotus (Klinkenberg 1984). Mixed and coniferous forests are very limited. Typically conifer trees include eastern white pine on dry sites and American larch on wetter conditions. Eastern red cedar may occur in scattered locations along the shore of Lake Erie on dry, very shallow substrates.

Ecosystems (e.g., meadows, woodlands) with grassland species more common in the central United States are generally small and occur throughout the ecodistrict. Two of the most extensive examples of these ecosystems occur at Walpole Island (Bkejwanong) First Nation at the north end of Lake Clair and Ojibway Prairie south of the community of Windsor (Oldham 2017). These sites are among the richest grasslands and botanical areas in Ontario (Jalava 2017, pers. comm.). Plant species found in these ecosystems include yellow wild indigo and prairie rosinweed (Bakowsky 1993). Alvar communities are located on Pelee Island; these communities have specialized environmental conditions that support a unique assemblage of plant and animal species, including nodding onion and large field chickweed (Kirk 1994).

Figure 477. Hillman Marsh east of the community of Leamington. Sam Brinker. MNRF.

The warm to hot summers and mild winters support a range of species not found elsewhere in Canada. The greatest concentrations of plant species with a limited range in Canada are found here (Jalava 2017, pers. comm.). Southern species at their northern range include large-seeded forget-me-not and Davis' sedge (Campbell and Reznicek 1977). Plant species with western affinities include two-flowered dwarf-dandelion, yellow stargrass, and stiff cowbane (Pratt 1983) and species that are more common in the east include seaside spurge and American sea rocket. The shorelines of lakes Erie and St. Clair support Great Lakes endemic species including Hill's thistle. Dune ecosystems can be found along Lake Erie (Bakowsky and Henson 2014a), supporting species that are adapted to active mineral material including golden puccoon and trailing wild bean (Dobbyn and Pasma 2012).

Land use

Agriculture is the primary land use in Ecodistrict 7E-1 accounting for 90% of the landscape. Business and industry, tourism, wind power generation, aggregate extraction, mining, petroleum extraction, and services associated with resource-based activities also occur throughout the area. Land devoted to settlement and associated infrastructure account for approximately 3% of the ecodistrict. Urban areas include the larger communities of Windsor, Chatham, Leamington, and Tecumseh (Figure 478). Less than 1% of the ecodistrict comprises protected areas.

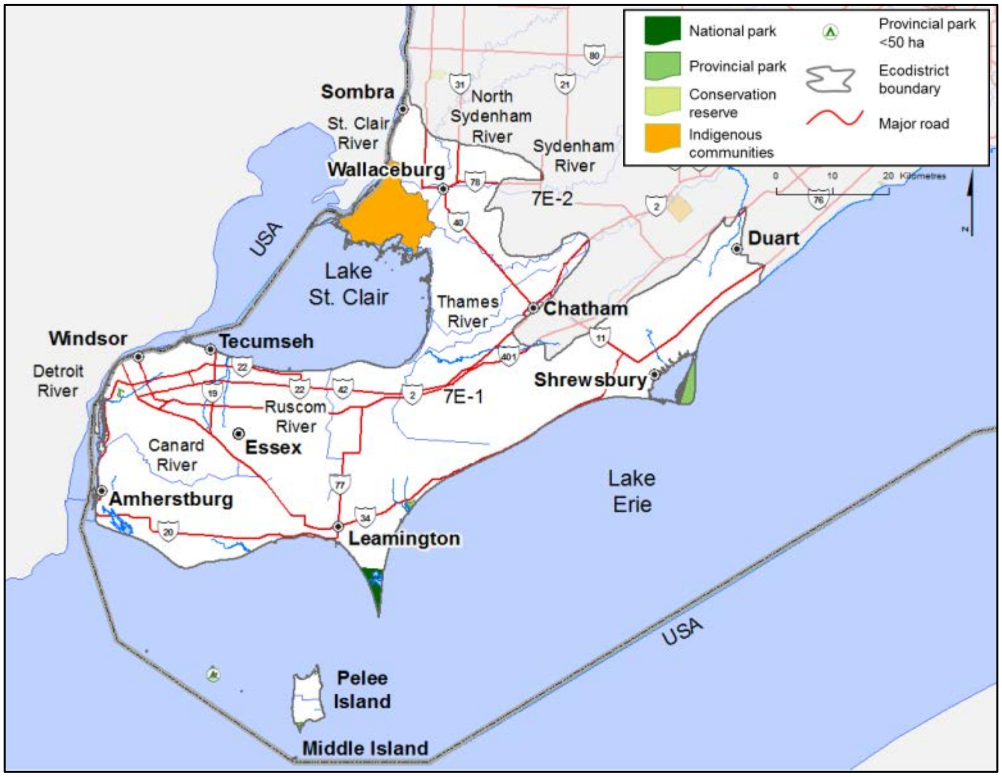


Figure 478. Select communities, natural heritage areas, major roads, lakes, and rivers in Ecodistrict 7E-1.

Ecodistrict boundary delineation

The Essex Ecodistrict is bound on two sides by lakes or rivers and the United States border. The southern boundary occurs in Lake Erie and includes the Lake Erie Archipelago (e.g., Pelee and Middle islands). The western boundary occurs along the shore of the Detroit River and Lake St. Clair. The northern and eastern boundaries with 7E-2 as proposed by Hills (1959) have been modified to better reflect the transition from fine-textured materials and minor morainal deposits in 7E-1 to coarse-textured typically morainal materials with greater relief in 7E-2 (Jalava et al. 1997).

The Warm Eastern Canadian Temperate Deciduous Forest

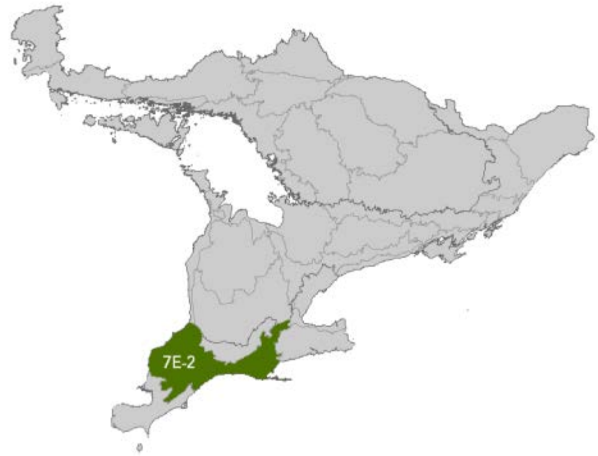
Extending north from the temperate portions of the United States, the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep) supports a large diversity of plants and animals. Home to 25% of Canada's species at risk, the area covers less than 1% of the country (NCC 2015b). In Ontario, the zone roughly corresponds to Ecoregion 7E. Due to the moderating effects of the Great Lakes, substrate conditions, and the southern location, a variety of species more commonly found in the temperate portions of the United States can occur including tulip tree, pawpaw (Figure 479), and spotted beebalm (Figure 480).

Figure 479. Pawpaw. Wasyl Bakowsky, MNRF.

Figure 480. Spotted beebalm. Wasyl Bakowsky, MNRF.

Ecodistrict 7E-2

St. Thomas Ecodistrict



The St. Thomas Ecodistrict stretches east from the community of Sarnia to the community of West Flamborough. The northern extent occurs near the community of Grand Bend, and the southern boundary follows the Lake Erie shoreline. The largest ecodistrict in Ecoregion 7E, it encompasses 944,493 ha (43.2% of the ecoregion, 1.0% of the province). The elevation changes from 170 m above sea level near the community of Long Point to 294 m above sea level east of the Thames River along the border with Ecodistrict 7E-6.

Figure 481. Agricultural fields and forested areas near the Thames River in Ecodistrict 7E-2. Thames Talbot Land Trust.

Key features

- The landscape is dominated by agricultural land (Figure 481).
- Approximately two-thirds of the ecodistrict is overlain with morainal deposits.
- Relict shorelines of glacial lakes Maumee, Arkona, Whittlesey, Warren, Grassmere, Lundy, Algonquin, and Algoma can be found in the ecodistrict.

Geology and substrates

The movement of glaciers and the influence of glacial lakes have shaped the geology and substrates of the St. Thomas Ecodistrict. The gently rolling landscape is dominated by morainal deposits overlying Paleozoic bedrock (Figure 482), particularly in the west, and

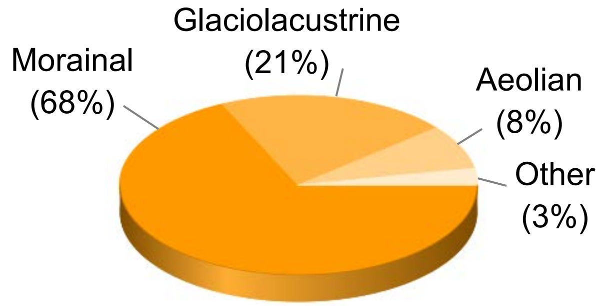


Figure 482. Modes of deposition in Ecodistrict 7E-2.

a series of moraines including portions of the Wyoming, Seaforth, St. Thomas, Sparta, Tillsonburg, Paris, and Galt (Barnett 1992). The morainal material is deep and calcareous, often covered with a thin layer of glaciolacustrine sediment (Chapman and Putnam 1984). Nearly 13,000 years ago (Dyke 2004), glacial Lake Whittlesey followed by glacial Lake Warren covered most of Ecodistrict 7E-2. Rather than depositing a thick layer of glaciolacustrine material, lake sediment settled in depressions, smoothing the landscape (Chapman and Putnam 1984). During the formation of the moraines, some were built into the waters of glacial Lake Whittlesey (e.g., Wyoming and Paris) while the St. Thomas Moraine was constructed by a submerged ice front (Chapman and Putnam 1984). Glaciolacustrine deposits associated with glacial lakes Whittlesey and Warren are well developed and included lake bed sediments and relict shorelines. Deeper glaciolacustrine deposits are common in the east. Shoreline features of glacial lakes Maumee, Arkona, Grassmere, Lundy, Algonquin, and Algoma also occur throughout the ecodistrict but are less developed (Fitzgerald et al. 1979).

Aeolian deposits, i.e., active dunes and vegetated sand ridges, are limited, occurring near the communities of Strathroy (Cooper et al. 1978) and Bothwell as well as inland from the shores of lakes Erie and Huron (Figure 483). Glaciofluvial and alluvial deposits are associated with larger river valleys including the Thames, Sydenham, and St. Clair rivers (Cooper and Baker 1978, Fitzgerald et al. 1979), as well as Big Otter and Big creeks (Barnett 1993). Organic material has accumulated in low-lying areas with poor drainage. Lacustrine deposits occur adjacent to lakes Erie and Huron.

Gray Brown Luvisols dominate the area occurring in well drained, typically fine-textured mineral material (Figure 484). Gleysols are common in mineral material found in depressions or low-lying areas with poor drainage. Melanic Brunisols are limited, developing in well drained, coarse-textured mineral material. Larger organic deposits, typically Mesisols, occur along the Lake Erie shoreline near the community of Long Point, south of the communities of Brantford and Grand Bend, and northeast of the community of Sarnia. Regosols are associated with alluvial, lacustrine, and active aeolian deposits including a large sandy promontory, the largest sand spit on the Great Lakes (Stenson 1996) east of the community of Long Point.

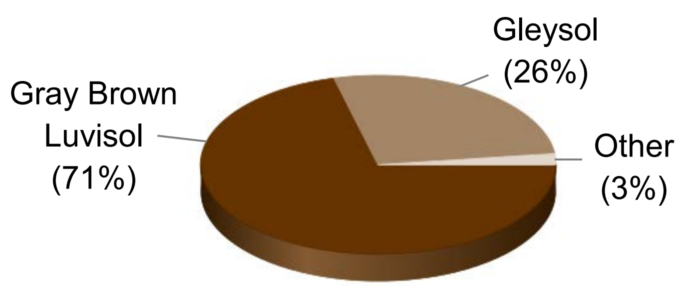


Figure 484. Substrate types in Ecodistrict 7E-2.

Figure 483. Herbaceous, shrub, and treed vegetation types on aeolian deposits, east of the community of Long Point. Sam Brinker. MNRF.

Land cover and vegetation

The St. Thomas Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Pasture and cropland occur over most of the landscape (Figure 485). Deciduous forests occur over small areas, typically associated with parks, natural heritage areas (i.e., Areas of Natural and Scientific Interest, Conservation Authority properties, provincially significant wetlands), or other stewardship lands (Henson and Brodribb 2005). Common trees on fresh to moist sites include sugar maple, American beech, white ash, silver maple, yellow birch, black ash, American elm, red maple, bur oak, American basswood, eastern hop-hornbeam, green ash, black cherry, bitternut hickory, trembling aspen, large-toothed aspen, balsam poplar, butternut, and Manitoba maple. Northern red oak and white oak occur more frequently on drier sites.

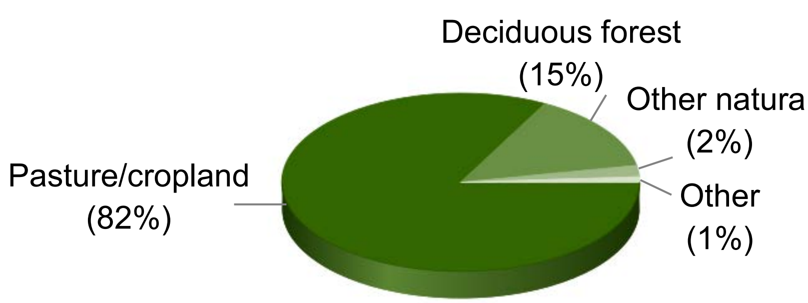


Figure 485. Land cover types in Ecodistrict 7E-2.

Mixed and coniferous forests are limited. American larch and eastern white cedar are common on wetter sites. Eastern white pine mixed with red pine occurs on dry conditions. Eastern red cedar can be found adjacent to the shorelines of lakes Erie and Huron. Marshes may develop adjacent to lake shores. When they occur, bog and fen complexes are typically small, occupying water filled depressions where organic material has accumulated. Close to half of the ecosystems (e.g., meadows, woodlands) in southern Ontario containing grassland species more commonly found in central United States occur in 7E-2. Plant species in these ecosystems include round-headed bush-clover and dense blazing-star (Bakowsky 1993).

Due to the proximity of the St. Thomas Ecodistrict to lakes Erie and Huron and its southern location, it has one of the most favourable climates for plants in Ontario (Lindsay 1984c). Long summers and mild winters with a moderate amount of precipitation support the growth of plant species with southern affinities including black maple, black walnut, blue-beech, shagbark hickory, black oak, sycamore, black willow, rock elm, honey-locust, common hop-tree, American chestnut, eastern cottonwood, common hackberry, and slippery elm. As part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep), tulip tree, blue ash, chinquapin oak, pawpaw, black gum, dwarf chinquapin oak, swamp white oak, shellbark hickory, sassafras, pignut hickory, and Kentucky coffee-tree, tree species more common in the temperate portions of the United States may also occur.

Several plant species with eastern and western affinities occur in Ecodistrict 7E-2. American sea rocket and northern bayberry (Henson and Brodribb 2005) are more common farther east. Western species found here may include northern pin oak (Bakowsky 1993) and Riddell’s goldenrod (Henson and Brodribb 2005). Species that have reached their southern range in the St. Thomas Ecodistrict include paper birch, black spruce, and twinflower, while dwarf hackberry, Shumard oak, and climbing prairie rose occur at their northern limits. Along the shores of lakes Erie and Huron, species endemic to the Great Lakes occur and Pitcher’s thistle, sand-dune wildrye, and American beachgrass can be found in specialized dune habitats provided by active aeolian material. The most extensive system of vegetated sand ridges and unvegetated dunes in Ontario occurs at Long Point (Bakowsky and Henson 2014a).

Land use

Approximately 1% of the area is devoted to settlement and associated infrastructure. Large communities include Brantford, Sarnia, St. Thomas, and Delhi (Figure 486). Land uses include agriculture, business and industry, tourism, aggregate extraction, wind power generation, petroleum extraction, and services associated with resource-based activities. Less than 1% of the ecodistrict is designated as protected areas.

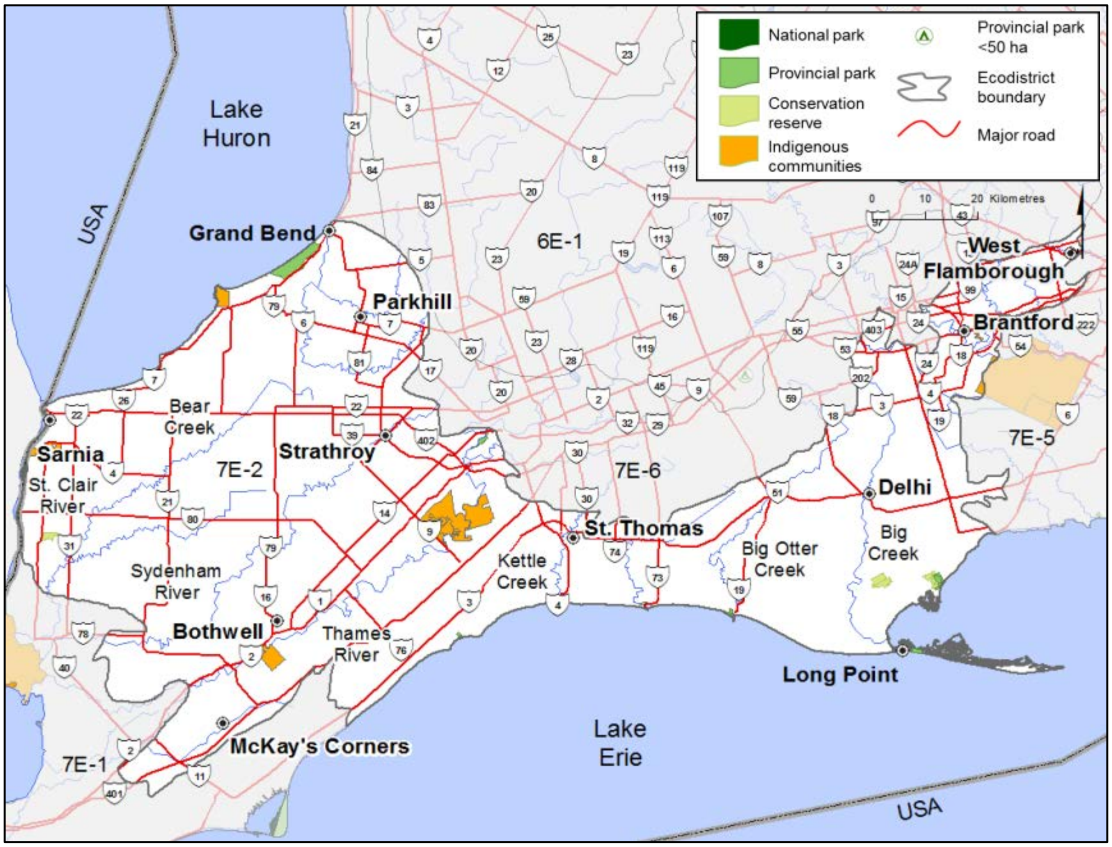


Figure 486. Select communities, major roads, natural heritage areas, and rivers in Ecodistrict 7E-2.

Ecodistrict boundary delineation

In Hills' (1959) original site district classification, Site District 7E-2 stretched from Lake Huron east to the Niagara River and the southwest shore of Lake Ontario. Observed differences in substrates between the western and eastern portions of Site District 7E-2 have led to the separation of the two areas (Jalava et al. 1997), with the western portion remaining as 7E-2 and the eastern part renamed 7E-5. This separation distinguishes the transition from coarse-textured mineral material in 7E-2 to fine-textured mineral material in 7E-5. The eastern boundary with 7E-3 has also been adjusted to better follow the glaciofluvial deposits in 7E-2 and the Niagara Escarpment in 7E-3 (Jalava et al. 1997). The southeastern boundary of the St. Thomas Ecodistrict occurs in the waters of Lake Erie, while the southwestern boundary with 7E-1 reflects the change from coarse-textured typically morainal materials with relief in 7E-2 to fine-textured materials with minor morainal deposits in 7E-1. The western boundary occurs at Lake Huron. The northwestern boundary with 6E-1 represents ecoregional differences (e.g., 7E is warmer, has a higher evapotranspiration rate and has a lower elevation; Crins et al. 2009). In addition, the northwestern boundary reflects deeper mineral material in Ecodistrict 7E-2 compared with 6E-1. The northern boundary with 7E-6 has been modified to better reflect the glaciolacustrine deposits in 7E-2 and the morainal and glaciofluvial deposits in 7E-6 (Jalava et al. 1997).

Glacial lakes of the lake Erie and Huron basins

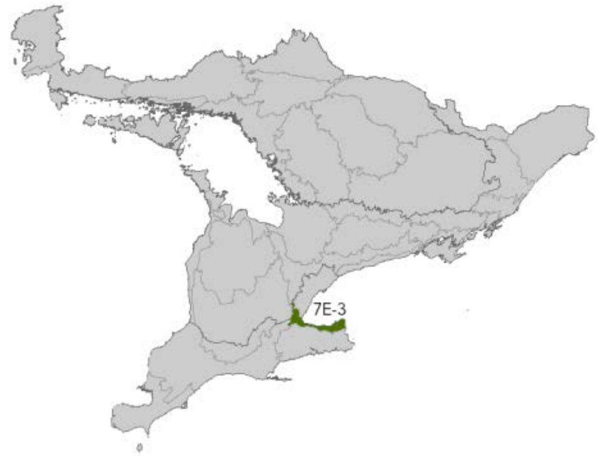
Approximately 14,000 years ago (Dyke 2004), all of Ontario was covered by ice. When the glaciers began to retreat, meltwater ponded at the receding edge. As the ice advanced and retreated, water levels in the glacial lakes rose and fell, producing a succession of lakes in the Lake Erie and Lake Huron basins (Table 13; Barnett 1992). Glacial lakes left behind a series of features (e.g., relict shorelines, bluffs) and lake bed sediment. Most of the area covered by deep glaciolacustrine deposits has been converted into agricultural land.

Table 13. A selection of ancestral lake phases in the lakes Erie and Huron basins (Barnett 1992).

Glacial lake	Years before present
Maumee	≈13,500
Arkona	≈13,250
Whittlesey	≈13,000
Warren	≈12,500
Grassmere	≈12,300
Lundy	≈12,250
Algonquin	≈12,000

Ecodistrict 7E-3

Grimsby Ecodistrict



The Grimsby Ecodistrict is the smallest ecodistrict in Ecoregion 7E encompassing 83,864 ha (3.8% of the ecoregion, 0.1% of the province). It extends from the community of Campbellville in the north, around the western tip of Lake Ontario to the community of Queenston and the United States border in the east. The undulating topography varies in elevation from 73 m above sea level along the shore of Lake Ontario to 345 m above sea level northeast of the community of Campbellville.

Figure 487. Agricultural fields and forested areas in Ecodistrict 7E-3. Rebecca Lidster, MNRF.

Key features

- Over half of the landscape has been converted to cropland and pasture (Figure 487).
- Morainal materials cover half of the ecodistrict.
- Features include relict shorelines of glacial Lake Iroquois and the southern section of the Niagara Escarpment.
- Is a major fruit, vegetable, and wine producing area.

Geology and substrates

The Grimsby Ecodistrict is characterized by the Niagara Escarpment, a series of moraines, lake bed sediment and relict shorelines from a series of glacial lakes, and glaciofluvial deposits. Within Ecodistrict 7E-3, the Niagara Escarpment stretches from the northern tip, to southwest of the community of Dundas and then east to the community of Queenston. The escarpment was formed by the differential erosion of Paleozoic bedrock. Through time, ice, water, and wind have eroded the softer layers of bedrock, cutting into the escarpment, and leaving behind the feature we see today (Varga et al. 1992). Predominantly characterized by exposed cliff faces with talus slopes, the escarpment also features broad terraces, waterfalls, and incised gorges carved out by river action including Spencer Gorge near the community of Dundas and the Niagara Gorge that starts in Ecodistrict 7E-5 and ends near the community of Queenston (Kor 1991). The escarpment is broken by several major re-entrant valleys including Bronte Creek Valley, Short Hills Valley near Twelve Mile Creek, and Dundas Valley near the community of Dundas (Riley et al. 1996). Morainal material can be found over approximately half of the landscape (Figure 488). Very shallow to shallow deposits occur on the escarpment and, at the edge, steep slopes of morainal material have been deposited (Riley et al*.* 1996). Deeper morainal deposits can be found in the Vinemount Moraine, which lies along the rim of the Niagara Escarpment near the ecodistrict's southern boundary, and in a series of concentric moraines, the Waterdown Moraines (Cowell et al. 2013), which occur west of the Niagara Escarpment at the western end of Lake Ontario. Deep deposits of morainal material may also occur in re-entrant valleys.

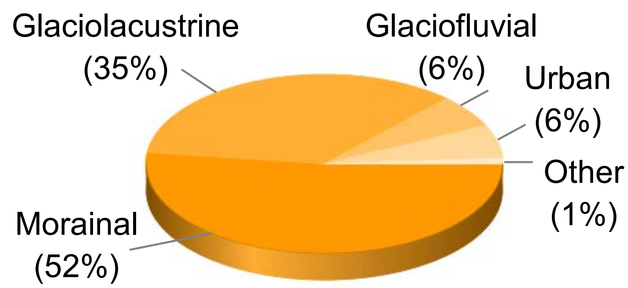


Figure 488. Modes of deposition in Ecodistrict 7E-3.

Glaciolacustrine features are a result of a series of glacial lakes that inundated the area including glacial lakes Whittlesey and Iroquois. Lake bed sediments of glacial Lake Whittlesey, a precursor to Lake Erie, were deposited approximately 13,000 years ago (Dyke 2004) as the glacial lake reached its most easterly extent near the community of Waterdown. Glaciolacustrine deposits can be observed between the ridges of the Waterdown Moraines. Approximately 1,000 years later as the ice continued to recede, glacial Lake Iroquois was formed (Barnett 1992). Low-lying areas bordering current day Lake Ontario were inundated by water with the Niagara Escarpment forming a natural barrier. As the ice further retreated, lake levels dropped exposing shorelines, bluffs, beach bars, and lake bed sediment. Several streams cut deep valleys through lake bed sediment deposited by glacial Lake Iroquois. Over time, the water levels in Lake Ontario have risen to modern levels, flooding portions of the valleys. Notable features include two large gravel bars between the communities of Aldershot and Hamilton (Karrow 1982) and several large flooded embayments along the Lake Ontario shoreline (Riley et al. 1996), including Cootes Paradise near the community of Dundas and Jordan Harbour north of the community of Vineland.

Glaciofluvial deposits are limited. Accumulations occur west of the community of Dundas. Glacial meltwater also deposited glaciofluvial sediment on top of the Niagara Escarpment and in valleys of post-glacial rivers through the Niagara Escarpment particularly in the north. Glaciofluvial and alluvial material can be found in larger river systems. Approximately 6% of the area, concentrated around urban centres, has been built-up or heavily modified. Organic accumulations are limited to low-lying wet areas and lacustrine deposits (e.g., beach, bars) occur along the shoreline of Lake Ontario. Bedrock exposures and colluvial materials (e.g., talus) occur along the Niagara Escarpment.

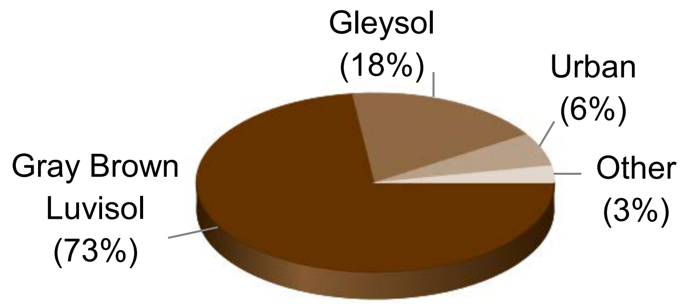


Figure 489. Substrate types in Ecodistrict 7E-3

Mineral materials in the Grimsby Ecodistrict are typically calcareous. The dominant substrate types are Gray Brown Luvisols, occurring in better drained, calcareous mineral material extending north from the community of Hamilton and east of Twenty Mile Creek along the Lake Ontario shoreline (Figure 489). Gleysols have developed in poorly drained mineral material east of Hamilton to Twenty Mile Creek. Significant changes to existing surficial deposits (i.e., excavation, alteration, covering) are localized around larger urban centres. Melanic Brunisols have developed in coarse-textured glaciofluvial deposits near the community of Campbellville and east of the community of Dundas. Organic accumulations, typically Mesisols, are restricted to poorly drained areas. Large organic deposits occur east of the community of Dundas at the head of Lake Ontario. Regosols are associated with alluvial and lacustrine deposits.

Land cover and vegetation

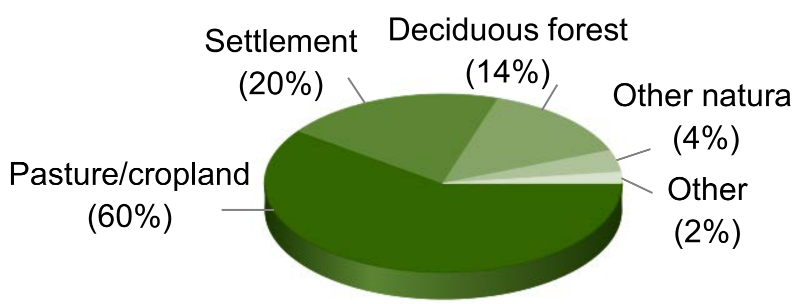


Figure 490. Land cover types in Ecodistrict 7E-3.

Associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972), a large portion of Ecodistrict 7E-3 has been converted to support agriculture, including orchards and vineyards, and settlement (Figure 490). Deciduous forests are typically restricted to river valleys, the Niagara Escarpment, and small scattered woodlots (Figure 491). Tree species commonly found include sugar maple, American beech, American basswood, and white ash on fresh sites and northern red oak and white oak on drier sites. Associates include bur oak, black cherry, eastern hop-hornbeam, balsam poplar, yellow birch, red maple, black walnut, large-toothed aspen, trembling aspen, paper birch, black oak, shagbark hickory, bitternut hickory, slippery elm, butternut, and blue-beech. On wetter sites, silver maple, green ash, black ash, eastern cottonwood, American elm, and Manitoba maple may occur. Mixed forests are limited supporting eastern white pine on drier sites and eastern hemlock in cooler-than-normal, humid areas. At a few sites, the Niagara Escarpment and talus slopes support eastern white cedar forests include old growth trees. Eastern white cedar and American larch, a species more commonly found in the north, occur in low-lying wetter areas. West of the community of St. Catherines, eastern red cedar grows along the rim of the escarpment and in successional valley forests (Riley et al*.* 1996). Tree species with southern affinities grow in the area including black maple, American chestnut, northern pin oak, sycamore, common hop tree, Shumard oak, and eastern flowering dogwood. Ecosystems within Ecodistrict 7E-3 are part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep). They contain a highly diverse group of plant and animal species more commonly associated with the temperate forests of the United States, including shellbark hickory, swamp white oak, black gum, chinquapin oak, pawpaw, black oak, sassafras, red mulberry, cucumber tree, pignut hickory, tulip tree, American bladdernut, common prickly-ash (Riley et al. 1996), eastern green-violet, and Carolina geranium (Cuddy et al. 1976).

Figure 491. Sugar maple forest on the Niagara Escarpment, north of the community of Waterdown. Dave Bradley, MNRF.

Shoreline and inland marshes are limited. Marshes along the shore of Lake Ontario often form in the mouths of river valleys (e.g., Cootes Paradise, east of the community of Dundas). Inland, marshes may be associated with seeps, low-lying areas particularly in bedrock controlled areas where water has been trapped between two pieces of higher ground, or along rivers and creeks.

Several factors combine to moderate the climate in the Grimsby Ecodistrict creating favourable environments for plant species with southern and northern affinities. The proximity to Lake Ontario increases humidity and precipitation with a cooler spring and an extended summer growing season. The escarpment confines the warmer air near the lake (Gardner et al. 2004) and shelters the area near Lake Ontario from the prevailing winter winds (Cuddy et al. 1976). Warmer-than-normal microclimates along the escarpment support species with southern affinities including fern-leaved yellow false foxglove (Cuddy et al. 1976) and cherry birch (Bakowsky 2018, MNRF, pers. comm.). Plant species with northern affinities occur on cooler-than-normal north-facing slopes, including eastern white cedar on the escarpment rim. Cooler-than-normal microclimates also occur in the deeply cut valleys and gorges (Riley et al. 1996). Species with western affinities (e.g., whorled loosestrife and sky-blue aster) typically occur on drier sites (Riley et al. 1996). Along Lake Ontario, American sea rocket, a species more common in the east (Henson and Brodribb 2005) can be found.

Land use

Settlement and associated infrastructure represent approximately 20% of the area. Communities include Hamilton, St. Catharines, Stoney Creek, Flamborough, and Dundas (Figure 492). Agriculture with a large area dedicated to growing fruit, business and industry, tourism, hydroelectric generation, aggregate extraction, petroleum extraction, and services associated with resource-based activities occur in the area. Less than 1% of the ecodistrict comprises protected areas.

Ecodistrict boundary delineation

Several ecodistrict boundary adjustments, as proposed by Jalava et al. (1997), have been made to the original site district outlined by Hills (1959). The northeastern boundary with 7E-4 has been adjusted to more closely follow the transition from the Niagara Escarpment in 7E-3 to morainal deposits in 7E-4. The southern boundary with 7E-5 better reflects the change from the Niagara Escarpment and shallow morainal material along the rim in 7E-3 to deeper morainal and glaciolacustrine material in 7E-5. Changes to the southwestern boundary with 7E-2 were made to follow the Niagara Escarpment features in 7E-3 and the glaciofluvial deposits in 7E-2. The western boundary adjustment more closely follows the transition from the Niagara Escarpment influenced moraines and glaciofluvial features in 7E-3 to very shallow to shallow morainal material in 6E-1. The final boundary change was made to follow the revised 6E/7E ecoregional boundaries, which reflect the warmer temperature and lower elevation of 7E compared with 6E (Crins et al. 2009). The eastern boundary of the Grimsby Ecodistrict occurs at the United States border and a significant portion of the northern boundary is defined by the shores of Lake Ontario.

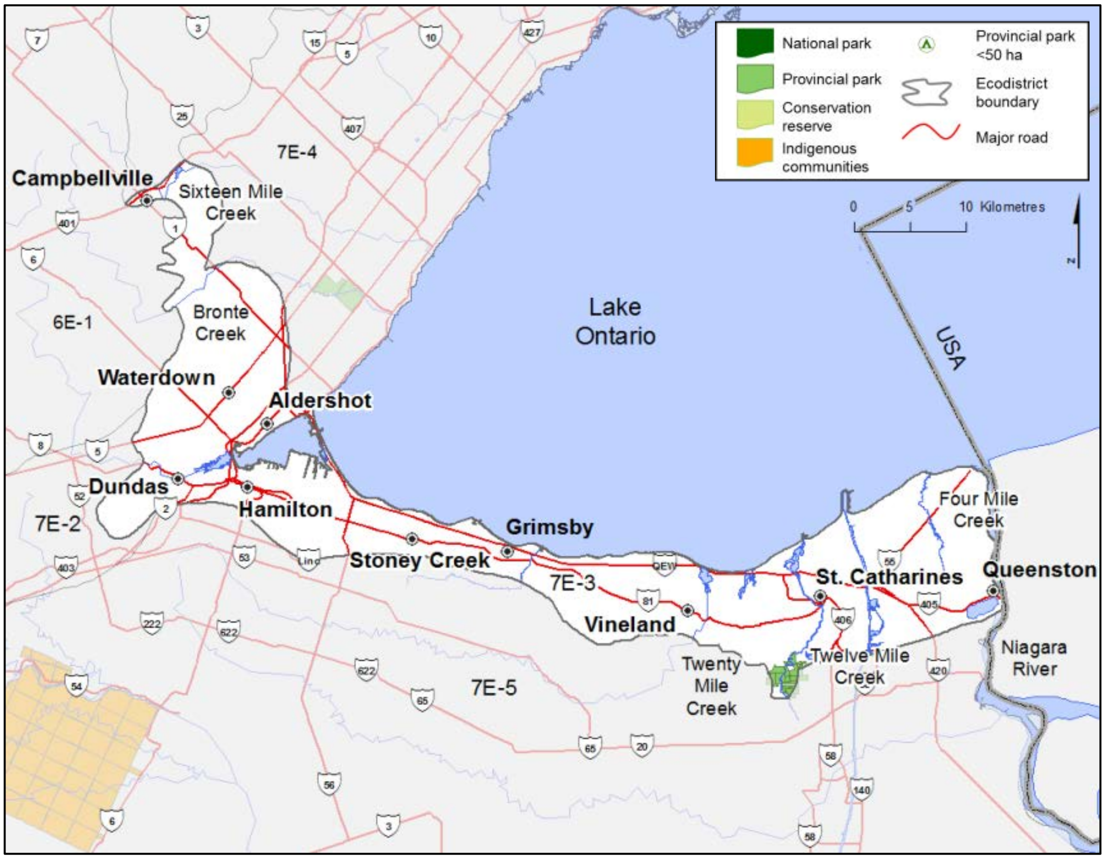


Figure 492. Select communities, major roads, natural heritage areas, and waterways in Ecodistrict 7E-3.

Cootes Paradise Drowned Valley

Located east of the community of Dundas, Cootes Paradise Drowned Valley occurs at the base of a large Niagara Escarpment valley that is nearly buried by glacial and post-glacial material. Rising Lake Ontario water levels flooded or *drowned* the lower part of the valley creating a shallow body of water.

Within the Niagara Escarpment World Biosphere Reserve, Cootes Paradise is home to the largest Provincially Significant Wetland Complex on western Lake Ontario (NEC 2015) and has the highest floristic diversity and greatest concentration of significant plant species (Riley et al. 1996). The area is also the second most important staging area for waterfowl on Lake Ontario (Gould 1989).

Figure 493. Open water marsh at Cootes Paradise. Barry Gray, Hamilton Spectator.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 7E-4

Toronto Ecodistrict

Located along the shore of Lake Ontario, the Toronto Ecodistrict extends from the Rouge River west to Bronte Creek. The community of Burlington marks the southern limit and the northern extent is near the community of Markham. The ecodistrict encompasses 191,193 ha (8.8% of the ecoregion, 0.2% of the province). The undulating topography varies in elevation from 73 m above sea level along the shore of Lake Ontario to 280 m above sea level northwest of the community of Markham.

Figure 494. The city of Toronto and the Toronto Islands. Rebecca Lidster, MNRF.

Key features

- Communities and associated infrastructure occupy over half of the landscape — the most in Ontario (Figure 494).
- Agriculture occurs over one-third of the area.
- Morainal materials dominate the landscape.
- Includes relict shorelines of glacial Lake Iroquois.

Geology and substrates

The geology and substrates of the Toronto Ecodistrict are characterized by glacial and modern deposits. The area is dominated by a variable depth of calcareous, fine-textured morainal material (Figure 495). Drumlins occur in the north and the Trafalgar Moraine runs parallel to the shore of Lake Ontario extending from the Niagara Escarpment at the western edge of the ecodistrict to the Credit River (Kor et al. 2012). Approximately one-third of the ecodistrict, generally the area closest to Lake Ontario, has been altered to support infrastructure associated with urban development. The modification includes excavation, alteration, or covering of existing morainal and glaciolacustrine deposits. In addition, fill has been added to the waterfront and the islands in Lake Ontario since 1910 (Sharpe 1980).

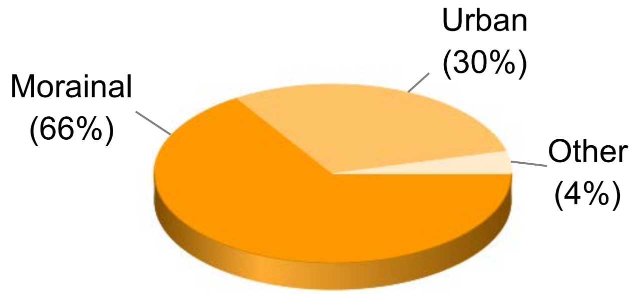


Figure 495. Modes of deposition in Ecodistrict 7E-4.

Glaciolacustrine deposits are limited. Near the shore of Lake Ontario, relict shorelines and bluffs occur, remnants of glacial Lake Iroquois, which inundated the adjacent shoreline approximately 12,000 years ago (Dyke 2004). A series of bluffs can be found between the communities of Mississauga and Burlington, approximately 2 km inland from Lake Ontario. Northeast of the community of Toronto, prominent bluffs (e.g., the Scarborough Bluffs) lie close to the current Lake Ontario shoreline. Glacial meltwater held between the Oak Ridges Moraine, the Niagara Escarpment, and an ice sheet to the south deposited glaciolacustrine materials to the north of the Trafalgar Moraine.

The undulating landscape is broken by deep river valleys including the Credit, Humber, Don, and Rouge rivers (Chapman and Putnam 1984). Glacial lake levels dropped as the ice retreated exposing bluffs, shorelines, and lake bed sediment. Meltwater cut deep valleys through lake bed sediment and as the level of Lake Ontario rose to modern levels, portions of the valleys have been flooded. Glaciofluvial and alluvial materials are limited to these valleys and to the river mouths along Lake Ontario. Waves and currents associated with Lake Ontario affect remnant portions of natural shoreline, depositing lacustrine material in the form of beaches and bars. Lacustrine and aeolian deposits have also created portions of Toronto Island (Chapman and Putnam 1984). Organic deposits are limited, often occurring in quiet embayments along the shore of Lake Ontario.

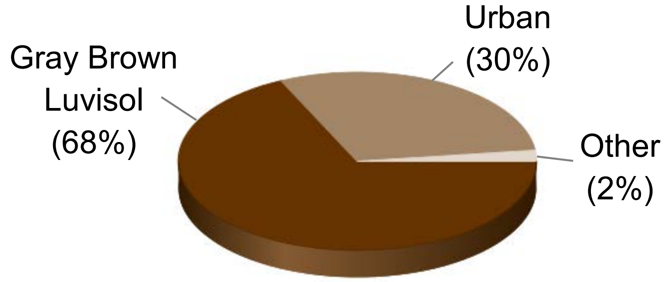


Figure 496. Substrate types in Ecodistrict 7E-4.

Gray Brown Luvisols occur over two-thirds of the ecodistrict, having developed in calcareous, fine-textured substrates (Figure 496). Approximately one-third of the area has been heavily modified or built-up. Melanic Brunisols are limited but have developed in coarse-textured material in the northeast. Organic accumulations, typically Mesisols, are restricted to poorly drained areas. Regosols are associated with alluvial, active aeolian, and lacustrine materials.

Land cover and vegetation

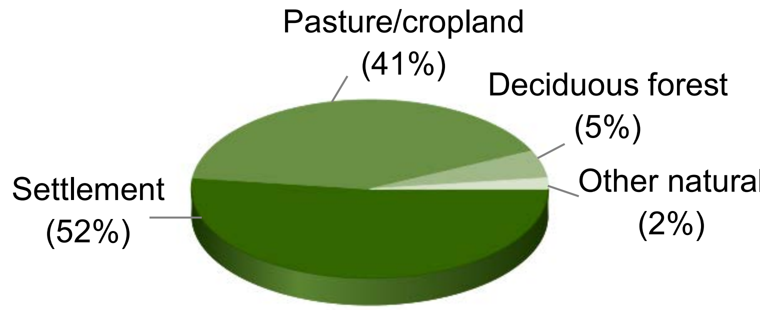


Figure 497. Land cover types in Ecodistrict 7E-4.

Ecodistrict 7E-4 is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Approximately 7% of the ecodistrict supports relatively natural cover (Figure 497). Common natural features include upland treed areas, shoreline bluffs, river valley systems, and river/lakefront marshes (Hanna 1984c). Deciduous forest, primarily consisting of American beech and sugar maple, typically occur along rivers (e.g., Credit, Bronte, Sixteen Mile, and Rouge rivers; Figure 498) or as remnant forests. Common associates on drier sites include northern red oak and white oak and on fresh sites American basswood, red maple, trembling aspen, white ash, eastern hop-hornbeam, balsam poplar, large-toothed aspen, paper birch, yellow birch, black cherry, and butternut. Minor components of bitternut hickory, black maple, shagbark hickory, eastern cottonwood, sycamore, black walnut may also be found. Green ash, silver maple, black ash, American elm, and bur oak typically grow on moist conditions. Manitoba maple may also occur. The Toronto Ecodistrict is part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep). Within this zone, highly diverse ecosystems more commonly found in the temperate forests of the United States have extended north, typically a result of substrate conditions and the moderating effects of Lake Ontario. Tree species that may grow in these areas include black oak, swamp white oak, and sassafras.

Mixed and coniferous forests may include eastern hemlock on cooler-than-normal, humid slopes and eastern white pine on drier sites. Eastern white cedar with balsam fir and American larch can be found on wet conditions. Marshes occur along the lake shore and larger river systems in quiet embayments and in small depressions on the Trafalgar Moraine (OMNR 2014a). Great Lakes shoreline marshes can be found at the mouth of the Credit, Humber, and Rouge rivers (Environment Canada and OMNR 2003; Varga et al. 1991) and on the Toronto Islands (Varga 1987). Ecosystems (e.g., meadows, woodlands) with grassland affiliates are very limited occurring in isolated pockets. Plant species growing in these ecosystems include big bluestem, little bluestem, sundial lupine, and New Jersey tea (Goodban 1999; Varga 1989, 1999). Along the shore of Lake Ontario, active aeolian deposits (Bakowsky and Henson 2014a) support American sea rocket and seaside spurge (Henson and Brodribb 2005) species more common to the east, and spreading cinquefoil (Henson and

Brodribb 2005), which reaches its eastern limit in Ecodistrict 7E-4. Plant species at their northern limits include sweet crabapple and eastern flowering dogwood (Soper and Heimburger 1982), while balsam fir is near its southern limit.

Figure 498. Deciduous forest, Bronte Creek Provincial Park. Bronte Creek Provincial Park.

Land use

Approximately 52% of the ecodistrict, the highest proportion for Ontario, has been altered to support settlement and associated infrastructure. Communities include Toronto, Mississauga, Brampton, Markham, and Burlington (Figure 499). Activities that occur in the ecodistrict include business and industry, agriculture, tourism, aggregate and petroleum extraction, wind power generation, and services associated with resource-based activities. Less than 1% of the area has been designated as protected areas.

Ecodistrict boundary delineation

The eastern portion of Site District 7E-4 as proposed by Hills (1959) was truncated east of the Rouge River to better represent differences in vegetation characteristics between Ecoregions 6E and 7E (Hills 1966). The southern boundary of the Toronto Ecodistrict occurs in Lake Ontario. The southwestern boundary with 7E-3 has been adjusted to more closely follow the transition from the Niagara Escarpment to morainal deposits in 7E-4 (Jalava et al. 1997).

Adjustments have also been made to the northern and western boundary with 6E-7 to better reflect the transition from morainal deposits without relief in 7E-4 to morainal deposits with relief in 6E-7 (Jalava et al. 1997). The boundary with Ecoregion 6E is also defined by climatic and elevational differences. Ecoregion 7E is warmer with a higher evapotranspiration rate and has a lower elevation than 6E (Crins et al. 2009).

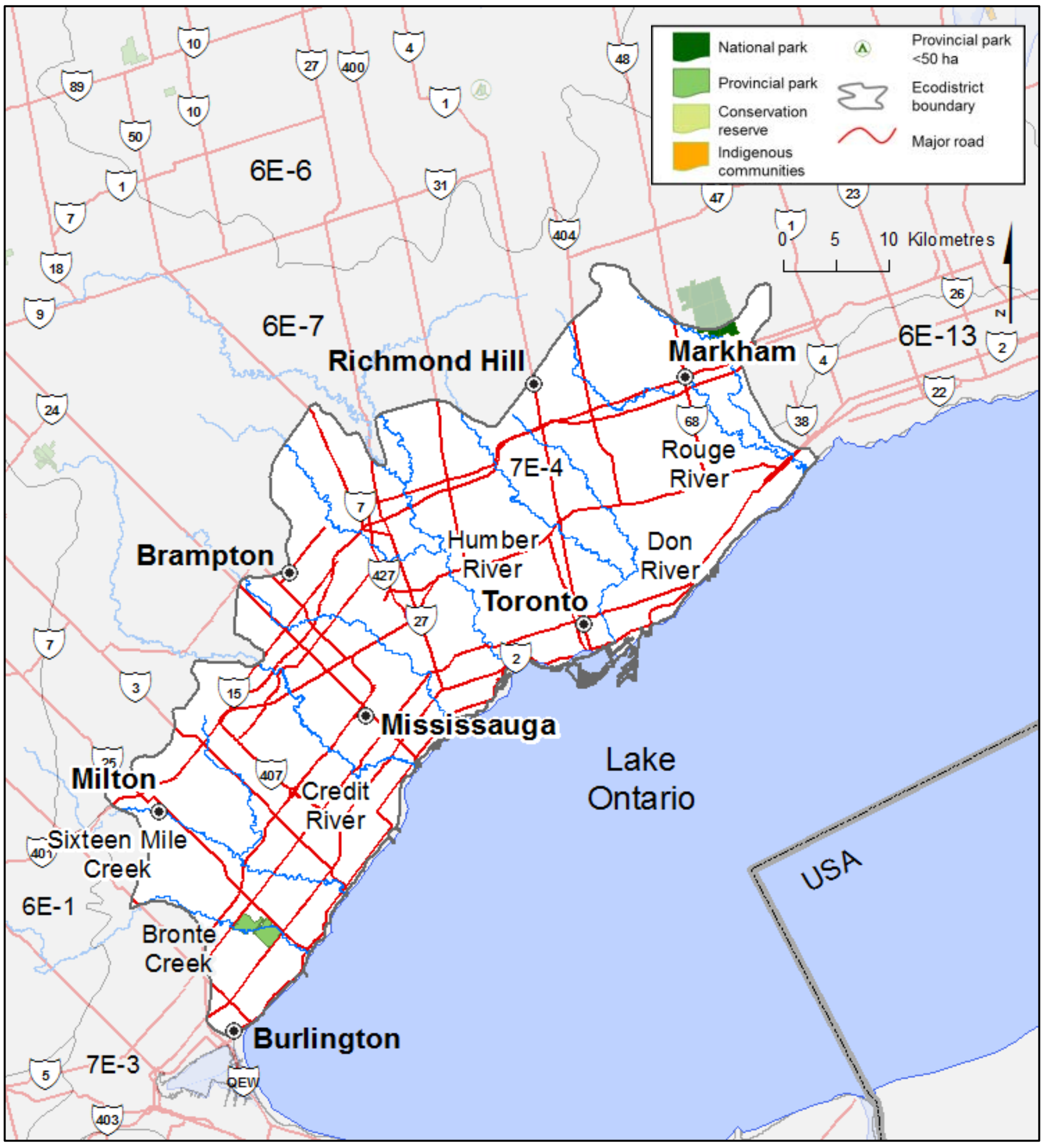


Figure 499. Select communities, major roads, natural heritage areas, and waterways in Ecodistrict 7E-4.

Geological history in the Toronto Ecodistrict

Over 200,000 years of glacial history can be observed at sites near the community of Toronto. Well preserved fossil rich deposits and glacial deposits were exposed during the industrial excavation of the Don Valley Brick Works. In the quarry walls, six geological periods can be seen, three main glacial and three non-glacial. Fossils indicating warmer-than-normal and cooler-than-normal climates can also be observed (Sharpe 1980).

Figure 500. Quarry wall of the Don Valley Brick Works, 1908. City of Toronto Archives.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 7E-5

Niagara Ecodistrict

The Niagara Ecodistrict extends from the community of Jarvis in the west to the Niagara River in the east. The northern boundary occurs near the community of Ancaster and extends south to Lake Erie. The ecodistrict encompasses 361,785 ha (16.6% of the ecoregion, 0.4% of the province). The elevation ranges from 130 m above sea level north of the community of Fonthill to 264 m above sea level southeast of the community of Ancaster.

Figure 501. Agricultural fields and deciduous forests of the Niagara Ecodistrict. Rebecca Lidster, MNRF.

Key features

- Three-quarters of the ecodistrict has been converted to agriculture (Figure 501).
- Glaciolacustrine materials from glacial Lake Warren dominate the landscape.
- The province's largest post-glacial incised valley, the Niagara Gorge, occurs here.

Geology and substrates

The Niagara Ecodistrict follows the Niagara Escarpment in the north and the shore of Lake Erie in the south. The gently rolling landscape is dominated by fine-textured, calcareous, glaciolacustrine deposits (Figure 502), representing lake bed sediment from a series of glacial lakes that inundated the area approximately 12,000 years ago (Dyke 2004). Glacial Lake

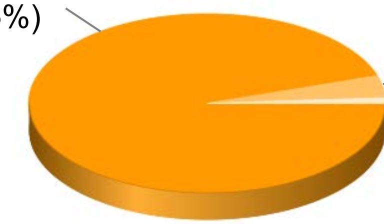


Figure 502. Modes of deposition in Ecodistrict 7E-5.

Warren, reaching an elevation 200 m above sea level, covered much of the landscape including higher land in the south along the Onondaga Escarpment (NPCA 2010). Changes in the position of the glacier created a succession of glacial lakes that affected the area, including glacial lakes Whittlesey, Warren, Grassmere, and Lundy (Chapman and Putnam 1984). In addition to deep glaciolacustrine deposits, the series of glacial lakes left behind shorelines and bluffs, most notably near the communities of Fonthill and Fort Erie (Barnett 1992, Chapman and Putnam 1984).

Morainal materials are limited. The low ridges of the Niagara Falls and Fort Erie moraines occur in the north. Formed underwater at the edge of the glacier, the moraines have a subdued topography. A series of drumlins partially buried in glaciolacustrine material can be found in the west near the community of Caledonia (Chapman and Putnam 1984).

Glaciofluvial deposits include the Fonthill Kame-Delta near the community of Fonthill, where subglacial meltwater left behind material at the edge of the melting glacier (Kor and Webster 2013), and sediment northwest of the community of Port Colborne where the Grand River deposited material into glacial Lake Lundy (NPCA 2010). Exposures of the underlying Paleozoic bedrock occur in the southeast, along the Lake Erie shoreline, in larger rivers and along the Onondaga Escarpment (Macdonald 1980). The only known representation of Oriskany Sandstone in Ontario occurs south of the community of Caledonia (Macdonald 1989). Karst features can also be found in the area (Brunton and Dodge 2008). Modern deposits include the accumulation of organic material in areas with poor drainage, alluvial deposits along larger river systems including the Grand River, and lacustrine deposits along the shore of Lake Erie.

The Niagara Ecodistrict is home to the province’s largest post-glacial incised valley. Carved by the Niagara River over the last 12,000 years, the Niagara Gorge (Figure 503) is 11 km long and 90 m deep (Riley et al. 1996). In addition to the Niagara Gorge, significant areas of relief in the gently rolling landscape occur along larger river and stream valleys, including the Grand River where a large valley has been cut into the underlying glaciolacustrine material (Chapman and Putnam 1984).

Figure 503. The Niagara Gorge. Sam Brinker, MNRF.

Fine-textured soils and poor drainage have led to the development of Gleysols in over two-thirds of the ecodistrict (Figure 504). Gray Brown Luvisols occur in better drained soils near the community of Fonthill and in the west. Organic deposits have accumulated in low-lying areas. Larger deposits occur north of the community of Port Colborne where water from glacial Lake Warren was trapped in front of and north of the Onondaga Escarpment (NPCA 2010). Alluvial and lacustrine materials are typically Regosols.

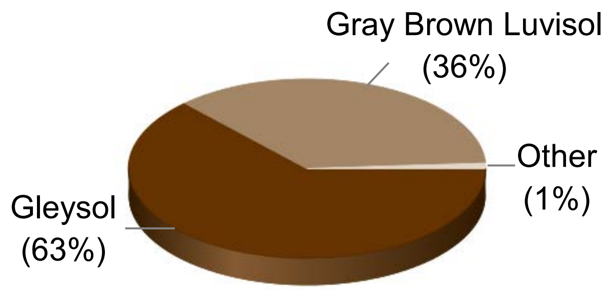


Figure 504. Substrate types in Ecodistrict 7E-5.

Land cover and vegetation

The Niagara Ecodistrict forms part of the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region (Rowe 1972). Approximately three-quarters of the area has been converted to pasture and cropland (Figure 505). Deciduous forests are scattered throughout the landscape. Trees species commonly associated with these forests include sugar maple, American beech, northern red oak, red maple, white ash, American basswood, eastern hop-hornbeam, white oak, balsam poplar, yellow birch, large-toothed aspen, black cherry, butternut, blue-beech, trembling aspen, and paper birch. Shagbark hickory, northern pin oak, eastern cottonwood, bitternut hickory, black walnut, American chestnut, sycamore, black willow, rock elm, slippery elm, and black maple may also occur. Wetter conditions may grow green ash, black ash, silver maple, American elm, and bur oak as well as Manitoba maple. Ecodistrict 7E-5 is part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep). Diverse ecosystems more common to the temperate forests of the United States reach their northern limits here due in part to the warmer climate caused by the moderating effects of Lake Erie. These ecosystems may include black gum, swamp white oak, chinquapin oak, shellbark hickory, tulip tree, sassafras, cucumber tree, Carolina rose, and yellow mandarin (Macdonald 1989).

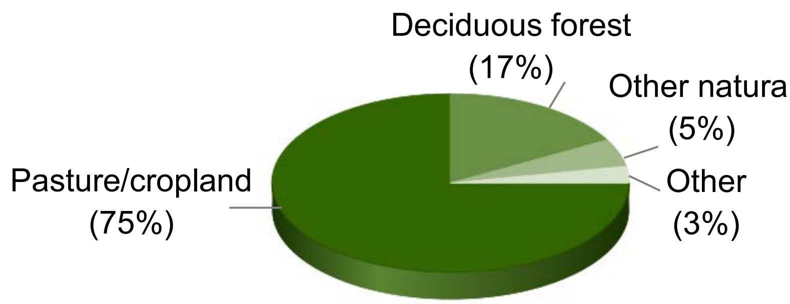


Figure 505. Land cover types in Ecodistrict 7E-5.

Mixed and coniferous forests, growing eastern hemlock on cooler-than-normal, humid sites, eastern white pine on drier conditions, and American larch and eastern white cedar on moist to wet sites are limited. Eastern red cedar occurs on very shallow mineral material over bedrock, south of the community of Caledonia (Macdonald 1989). Marshes occur along the Lake Erie shore and inland associated with larger river systems. Bog and fen complexes occur in poorly drained areas where water has accumulated including an extensive bog, the Wainfleet bog, near the community of Port Colborne (Riley 1988). Species with northern affinities (e.g., northern pitcher plant, leatherleaf) occur in the cooler-than-normal microclimates found in bog complexes (Macdonald 1989). A second cooler-than-normal microclimate is provided by the Niagara Gorge which is home to paper birch and eastern white cedar, species more commonly found farther north. Ecodistrict 7E-5 also supports plants with southern affinities (e.g., palmate-leaved violet, clasping-leaved Venus' looking glass; Macdonald 1980) and plants with western affinities including northern pin oak and prairie buttercup (Macdonald 1989). Some of these species are found on Oriskany Sandstone, a light to white sandstone characterized by an abundance of fossils south of the community of Caledonia (Macdonald 1989).

Land use

Settlement and associated infrastructure, including the communities of Niagara Falls, Welland, Fort Erie, Ancaster, and Port Colborne, account for approximately 3% of the ecodistrict (Figure 506). Agriculture, tourism, business and industry, wind power and hydroelectric generation, mining, aggregate and petroleum extraction, and services associated with resource-based activities occur across the landscape. Less than 1% of the ecodistrict comprises protected areas.

Ecodistrict boundary delineation

Hills (1959) originally included Ecodistrict 7E-5 in Site District 7E-2; however, differences in substrates between the western and eastern portions of Site District 7E-2 have led to the separation of the two areas (Jalava et al. 1997). The Niagara Ecodistrict is bound in the east by the Niagara River and the border with the United States. The southern boundary occurs in Lake Erie. The western boundary with 7E-2 distinguishes the transition from fine-textured mineral material in 7E-5 to coarse-textured mineral material in 7E-2. The northern boundary with 7E-3 has been modified to better reflect the change from deeper morainal and glaciolacustrine material in 7E-5 to the Niagara Escarpment and shallow morainal material along the rim in 7E-3 (Jalava et al. 1997).

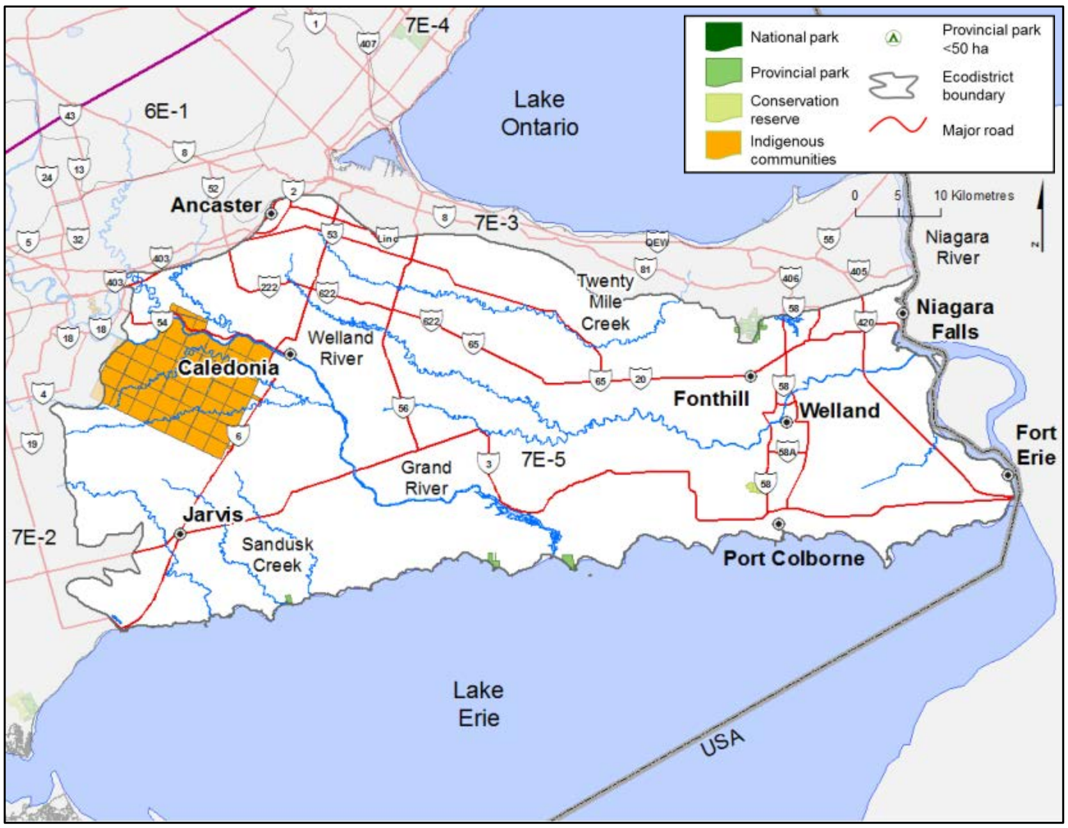


Figure 506. Select communities, major roads, natural heritage areas, rivers, and lakes in Ecodistrict 7E-5.

Natural features of the Niagara Ecodistrict

Found within Ecodistrict 7E-5 are several areas of natural and scientific interest (ANSI) including the Fonthill Kame-Delta and one of the few bogs left in southern Ontario. One of the most dominant features of the ecodistrict is the Fonthill Kame-Delta. It consists of a large complex dome of glacial and post-glacial sediments. Beach ridges, bluffs, and terraces show that the kame-delta was once an island in the sequence of glacial lakes that covered the area (Figure 507; Kor and Webster 2013).

Formed in a shallow depression (Macdonald 1992), northeast of the community of Port Colborne, the Wainfleet Bog (Figure 508) is the largest bog in Ecoregion 7E (Riley 1988). Parts of the bog have been disturbed by peat harvesting, drainage ditches, and agriculture (Macdonald 1992). The ANSI portion of the bog is home to a range of notable flora including species with northern affinities, distinctive southern and temperate plants (Macdonald 1992), and vegetation that is able to withstand acidic and low nutrient environments.

Figure 507. Relict beach ridges, Fonthill Kame-Delta. David Webster, MNRF.

Figure 508. Wainfleet Bog. Mark Browning, MNRF.

Excerpted from: Wester et al. 2018. The Ecosystems of Ontario, Part 2: Ecodistricts. Ontario Ministry of Natural Resources and Forestry, Science and Research Branch, Peterborough, ON. Science and Research Technical Report TR-26.

Ecodistrict 7E-6

London Ecodistrict

Ecodistrict 7E-6 forms a narrow band from the community of Coldstream in the west to the community of St. George in the east. The northern extent occurs near the community of Ayr and stretches southward to the community of Mapleton. The ecodistrict encompasses 225,181 ha (10.3% of the ecoregion, 0.2% of the province). The gently rolling landscape changes in elevation from 213 m above sea level south of the community of Paris to 371 m above sea level northeast of the community of Ayr.

Key features

- Most of the area has been converted into agricultural land (Figure 509).
- Morainal deposits dominate the landscape.
- Ecodistrict includes parts of eight different moraines.

Figure 509. Agriculture dominated landscape of Ecodistrict 7E-6. Scott Gillingwater, Upper Thames River Conservation Authority.

Geology and substrates

The geology and substrates of Ecodistrict 7E-6 were influenced by several ice lobes that retreated, temporarily readvanced, and stood still laying down a complex network of morainal deposits that dominate the landscape (Figure 510). The morainal material is deep and calcareous, consisting of a succession of ridges separated by areas of level deposits. Nearly 14,000 years ago (Dyke 2004), as several ice lobes split, the first land in Ontario — *Ontario Island* — was exposed to the north. As the ice lobes melted and readvanced, parts of at least eight moraines were deposited in the area. The Seaforth, Lucan, and Arva moraines occur in the east. Trending north-south, the moraines form a concentric pattern mimicking the shape of the Lake Huron shoreline (Dillon Consulting Limited 2004). The Ingersoll and Westminster moraines, south of the community of London are oriented in an east-west direction. Northeast-southwest trending moraines, including the St. Thomas and Norwich, occur in the western portion of the ecodistrict. The Ingersoll, Westminster, St. Thomas, and Norwich moraines represent minor readvances or standstills of the ice margin (Barnett 1992). The Dorchester Moraine, east of the community of London, is the oldest of the glacial deposits in the area (Sado 1978). Subsequent ice sheet readvances have subdued many of the features associated with this moraine (OGS 1982).

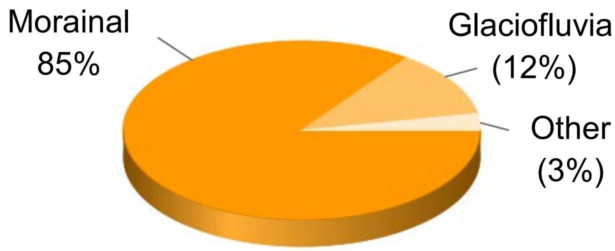


Figure 510. Modes of deposition in Ecodistrict 7E-6.

Coarse-textured glaciofluvial deposits are restricted to former meltwater channels adjacent to moraines. Large amounts of meltwater flowed through the channels carving terraces and bluffs. The valleys of larger channels are now occupied by the North Thames, Thames, Nith, and Grand rivers. Glaciolacustrine materials found east of London are a result of the deposition of sediment by meltwater that flowed down the Thames River valley into a delta of glacial Lake Maumee (Barnett 1992). Relict beaches of glacial Lake Maumee occur southwest of the community of London (Chapman and Putnam 1984). Organic deposits are limited, occurring in areas with poor drainage particularly associated with local kettle depressions (Sado 1978). Two larger organic deposits occur east of the community of London and southwest of the community of Paris. Alluvial materials occur along current river systems.

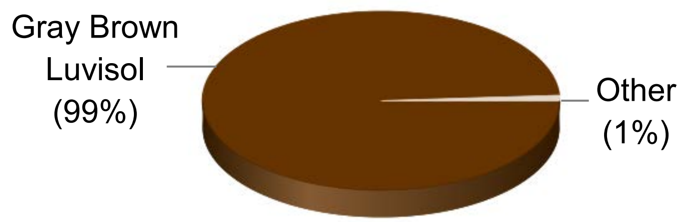


Figure 511. Substrate types in Ecodistrict 7E-6.

The London Ecodistrict is dominated by Gray Brown Luvisols, which occur in well drained mineral material (Figure 511). Gleysols have developed in mineral material in low-lying areas with poor drainage. In wet areas where organic material has accumulated, Mesisols are common. Regosols are associated with alluvial deposits.

Land cover and vegetation

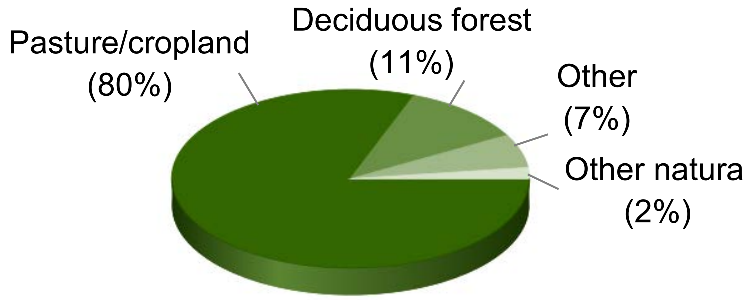


Figure 512. Land cover types in Ecodistrict 7E-6.

The London Ecodistrict is associated with the Eastern Temperate Deciduous Forest Vegetation Zone (Baldwin et al. 2018) and the Niagara Section (D.1) of the Deciduous Forest Region. A small band along the northeastern boundary occurs in the Huron-Ontario Section (L.1) of the Great Lakes Forest Region (Rowe 1972). Much of the ecodistrict has been converted to pasture and cropland (Figure 512). Large areas of deciduous forests grow in river valleys (Figure 513). Tree species commonly found in these forests include sugar maple, American beech, white ash, yellow birch, red maple, northern red oak, pin cherry, white oak, bur oak, American basswood, eastern hop-hornbeam, black cherry, bitternut hickory, paper birch, trembling aspen, large-toothed aspen, balsam poplar, and butternut. On moist sites, silver maple, black ash, green ash, American elm, and occasionally Manitoba maple may occur.

Mixed forests dominate in the northeast and small areas of coniferous forests can be found throughout the area. A few larger coniferous forests can be found on poorly drained, wet substrates east of the community of London. Coniferous tree species typical of the ecodistrict include eastern white pine on dry sites, eastern hemlock on cooler-than-normal, humid conditions and on wet sites American larch and eastern white cedar. Eastern red cedar occurs along the Grand River (Hanna 1984d). Marshes are limited, occurring adjacent to rivers or associated with kettle depressions including sites north of the Grand River and west of the Nith River. Small areas of bog and fen complexes occur in poorly drained areas. Bog complexes are typically cooler-than-normal sites that support species with northern affinities (e.g., black spruce, large cranberry).

Part of the Warm Eastern Canadian Temperate Deciduous Forest (Uhlig et al. in prep), Ecodistrict 7E-6 has long summers, mild winters, and moderate amounts of rainfall (Eagles and Beechey 1985), conditions that support the growth of species with southern affinities, including those more commonly found in the temperate forests of the United States. Tree species include blue ash, black maple, black walnut, blue-beech, shagbark hickory, black oak, sycamore, tulip tree, sassafras, chinquapin oak, black willow, rock elm, American chestnut, eastern cottonwood, common hackberry, and slippery elm. Eastern species that may occur include crooked-stem aster and eastern false rue-anemone (Henson and Brodribb 2005) and disjunct species more commonly found in the west include northern pin oak (Ball 1981) and edible valerian (Henson and Brodribb 2005).

Figure 513. Open black walnut forest west of the community of London. Peter Uhlig, MNRF.

Land use

Approximately 5% of the area is devoted to settlement and associated infrastructure. Communities include London, Paris, and Ayr (Figure 514). Land uses include agriculture, business and industry, aggregate and petroleum extraction, wind power and hydroelectric generation, tourism, and services associated with resource-based activities. No protected areas occur in Ecodistrict 7E-6.

Ecodistrict boundary delineation

Ecodistrict 7E-6 was originally associated with Site District 6E-1 (Hills 1959). Additional vegetation analysis identified that the southern part of 6E-1 was more characteristic of 7E than 6E (Jalava et al. 1997). Further modifications to the boundary occurred in the northeast to more closely follow the transition between morainal material with no drumlins in Ecodistrict 7E-6 and morainal material with drumlins in 6E-1. In the east, the boundary was adjusted to better reflect the change from deeper morainal material in 7E-6 to very shallow to shallow morainal material in 6E-1 (Jalava et al. 1997).

The boundary with Ecoregion 6E is defined by climatic variables (e.g., 7E is warmer and has a higher evapotranspiration rate) and a lower elevation in 7E (Crins et al. 2009). The western and southern boundary with 7E-2 has been modified to better reflect the morainal and glaciofluvial deposits in 7E-6 and glaciolacustrine deposits in 7E-2 (Jalava et al. 1997).

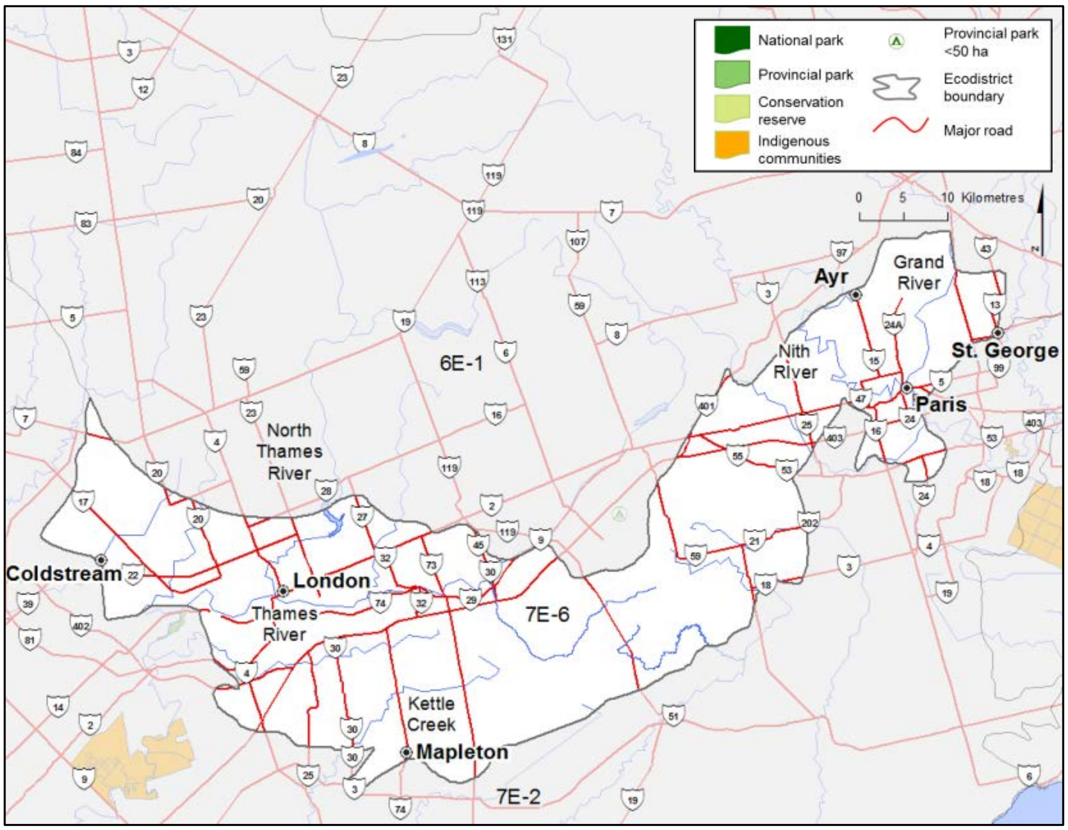


Figure 514. Select communities, major roads, natural heritage areas, and rivers in Ecodistrict 7E-6.

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Appendix 1. Glossary

Acidic bedrock — a descriptive term applied to igneous rocks that contain more than 66% silicone dioxide (SiO_2).

Active — sites not vegetated due to natural energy (wind, water, or gravity) or human influence.

Aeolian — pertaining to the wind; especially referring to such deposits as loess and dune sand or erosion and deposition caused by wind.

Alluvial (fluvial) — mineral material deposited by a stream or running water.

Basalt (basaltic) — dark igneous rock, commonly extrusive, composed primarily of calcic plagioclase and pyroxene.

Alvar — naturally open areas of thin soil over essentially flat limestone or marble rock with trees absent or not forming a continuous canopy.

Arctic — a climatic and ecological zone north of the latitudinal tree line.

Base-rich (basic) bedrock — a loosely defined term used in lithology to describe igneous or metamorphic rocks containing comparatively low amounts of silica and rich in metallic bases (magnesium, potassium, calcium, sodium) such as amphiboles, pyroxenes, biotite, and olivine.

Basophile — plants that grow well in alkali soils (pH range 7.4 to 8.5).

Boreal — a climatic and ecological zone that occurs south of the subarctic but north of the temperate forests of eastern North America.

Bog — ombrotrophic peatlands generally unaffected by nutrient-rich groundwater that are acidic (typically pH <4.8; National Wetlands Working Group 1997), often dominated by ericaceous shrubs and *Sphagnum* mosses, and may include open-growing, stunted trees.

Brunisol — soil of the Brunisolic order in the Canadian System of Soil Classification, consisting of soils that have sufficient development to be excluded from the Regosolic order, but lack the degree or kind of horizon development specified for soils of other orders.

Burns — Provincial Land Classification class (Spectranalysis 2004); burned forest estimated as less than 10 years of age.

Calciphile — plants that are typically restricted to calcium-rich substrates with a neutral pH.

Colluvial (Colluvium) — unconsolidated material deposited by gravity, often occurring at the base of a slope (e.g., talus, scree).

Coniferous — a tree belonging to the order Coniferae, usually evergreen with cones, needle-shaped leaves and producing wood known commercially as ‘softwood’.

Coniferous forest — Provincial Land Classification class (Spectranalysis 2004); largely continuous forest canopy composed primarily of coniferous species; includes swamps.

Cooler-than-normal — sites or landscape segments with locally modified climate resulting in cooler conditions relative to surrounding dominant conditions; typically the result of higher elevation or northerly aspects (adapted from Hills 1959).

Cropland — Provincial Land Classification class (Spectranalysis 2004); areas of row crops and fallow fields.

Cryosol — soil of the Cryosolic order in the Canadian System of Soil Classification that has permafrost within 1 m of the ground surface or shows strong evidence of cryoturbation within 2 m; can include organic and mineral substrates.

Cuestas — an asymmetrical ridge, with a long gentle slope on one side and a steep or cliff-like face on the other side.

Deciduous — a woody plant that drops all its leaves sometime during the year.

Deciduous forest — Provincial Land Classification class (Spectranalysis 2004); largely continuous forest canopy composed primarily of deciduous species; includes swamps.

Deep — mineral or organic depth class with the depth of unconsolidated mineral material greater than 120 cm over rock or bedrock or organic materials greater than 40 cm over mineral material, rock, or bedrock as defined by ELC and substrate description standards.

DeGeer moraine — discrete, narrow ridges trending parallel to former ice front; ridges may be up to 300 m apart and rarely greater than 15 m in height, comprising a till core, capped by a layer of partly rounded stones and boulders. This landscape feature is understood to have been formed beneath the grounded part of an ice sheet that extended into the waters of a lake or sea.

Devonian — a period of the Paleozoic era, after the Silurian and before the Mississippian periods, between 400 and 345 million years before present.

Diabase — dark igneous rock of intermediate texture and basic composition.

Dike — (dyke) a tabular body of igneous rock that cuts across the structure of adjacent rocks or cuts massive rocks.

Dike swarm — a set of parallel dikes.

Dolomite (dolostone) — a common rock-forming mineral consisting primarily of calcium magnesium carbonate.

Dune — low hill or ridge of unvegetated sand that has been sorted and deposited by the wind.

Eastern Boreal Forest Vegetation Zone — a geographical area with common ecological characteristics. In Ontario, this zone corresponds to ecoregions 2E, 3E, 3W, and ecodistricts 4S-1, 4S-2, 4S-3, and 4S-4.

Eastern Temperate Deciduous Forest Vegetation Zone — a geographical area with common ecological characteristics. In Ontario, this zone corresponds to ecoregions 6E and 7E.

Eastern Temperate Mixed Forest Vegetation Zone — a geographical area with common ecological characteristics. In Ontario, this zone corresponds to ecoregions 4E, 4W, 5E, 5S and ecodistricts 4S-5, 4S-6.

Ericaceous — a term describing plants of the heath family (Ericaceae), which are mostly shrubby, dicotyledonous, and often evergreen plants that thrive on open, barren substrates that are usually acidic.

Esker — serpentine ridge of roughly stratified gravel and sand that was deposited by a stream flowing in or beneath the ice of a stagnant or retreating glacier and was left behind when the ice melted.

Evapotranspiration — the loss of water through plant transpiration and ground surface evaporation.

Felsic — magma that is relatively rich in silica, sodium, aluminum, and potassium; solidifies to form rocks relatively rich in silica, sodium, aluminum, and potassium.

Fen — wetland with a peat substrate, nutrient-rich waters, and primarily vegetated by shrubs and graminoids.

Fibrisol — organic substrates that have formed in relatively undecomposed organic materials and have a dominantly fibric middle tier.

Fissure — an extensive crack, break, or fracture in the rocks.

Folisolic (folisol) — organic substrates that are formed primarily in upland organic (folic) materials, generally of forest origin, and rarely saturated with water.

Forest — a relatively large assemblage of tree-dominated stands.

Glaciofluvial — pertaining to meltwater streams flowing from glaciers, or to the deposits made by such streams. Typically coarse-textured mineral materials composed of sand. Rounded coarse fragments are common.

Glaciolacustrine — pertaining to, derived from, or deposited in glacial lakes. Typically fine-textured mineral materials composed of sands, silts, and clay.

Glaciomarine — pertaining to, derived from, or deposited in glacial seas. Typically fine-textured mineral materials composed of sands, silts, and clay.

Gleysol — soil of the Gleysolic order of the Canadian System of Soil Classification, a soil that develops in water-saturated depressions or where water is near the ground surface for a significant period of time during the year. Gleysolic soils are characterized by prominent mottles within 50 cm of the mineral surface.

Gneiss (gnessic) — foliated rock formed by regional metamorphosis, in which bands or lenticles of granular minerals alternate with bands or lenticles of minerals with flaky or elongate prismatic habit; generally, less than 50% of the minerals show preferred parallel orientation.

Graminoid — a plant that is grass-like; the term refers to grasses and plants that look like grasses, i.e., only narrow-leaved herbs; in the strictest sense, it includes plants belonging only to the family Graminaceae.

Granite (granitic) — holocrystalline quartz-bearing plutonic rock.

Grasslands — a climatic and ecological zone that primarily occurs in the central portions of the North American continent characterized by dry climate and a dominance of grassland and open, semi-treed vegetation. In Canada, extends from the eastern portions of the Canadian cordillera, across the southern portions of Alberta, Saskatchewan, and Manitoba to the margins of the boreal and temperate forests in Ontario.

Greenstone — compact, dark-green, altered or metamorphosed, basic igneous rock.

Halophytic — salt tolerant; a plant that naturally grows in salty water or saline substrates.

Heath — uncultivated land generally dominated by shrubs; ericaceous shrubs are common.

Humisol — organic substrates formed in organic materials that are at an advanced stage of decomposition and with a humic middle tier.

Igneous — a type of rock that forms from the solidification of magma.

Intolerant hardwood — deciduous trees unable to survive or grow satisfactorily under specific conditions; commonly used with respect to their sensitivity to shade.

Kame — a conical hill or irregular ridge of sand and gravel that was deposited in contact with glacial ice.

Karst — a terrane generally underlain by limestone or dolomite in which the topography is chiefly formed by the dissolving of rock and which may be characterized by sinkholes, caves, and subterranean drainage.

Kettle — a depression created by the melting of glacial ice.

Lacustrine — pertaining to, produced by, or inhabiting a lake.

Limestone — a sedimentary rock consisting chiefly of the mineral calcite (calcium carbonate).

Low treed — vegetation cover class condition consisting of trees with a height ≤10 m.

Lowland — extended plains or land that occurs below a significant elevated area.

Luvisol — soil of the Luvisolic order in the Canadian System of Soil Classification. A soil characterized by eluvial horizons and having B horizons in which silicate clay has accumulated.

Mafic — igneous rock composed chiefly of dark, ferromagnesian minerals.

Marine — pertaining to, derived from, or deposited by a sea or ocean.

Marsh — A wetland with a mineral or peat substrate inundated by nutrient-rich water and characterized by emergent graminoid vegetation.

Meadow — an area usually dominated by grasses or forbs.

Mesa — a tableland; a flat-topped mountain or other elevation bounded on at least one side by a steep cliff.

Mesisol — organic substrates formed in organic materials that are at intermediate stage of decomposition and have a dominantly mesic middle tier.

Mesoproterozoic — an era of the Proterozoic eon, 1600 to 1000 million years before present.

Metamorphic — a type of rock formed from pre-existent rock after undergoing natural geological processes such as heat or pressure; differs from the original rock in its physical, chemical, or mineral properties.

Metasedimentary — sedimentary rock that shows evidence of metamorphism.

Metavolcanic — volcanic rock that shows evidence of metamorphism.

Migmatitic — a body of rock altered to granitic texture and composition.

Mineral material — material containing ≤17% organic carbon (≤30% organic matter) by weight. Material composed of particle sizes ≤2 mm occupying >90% of the substrate.

Mixed forest — Provincial Land Classification class (Spectranalysis 2004); largely continuous forest canopy composed of both deciduous and coniferous species.

Mixedwood — forests composed of conifers and angiosperms each representing between 25 and 75% of the canopy cover.

Moderate — mineral depth class with the depth of unconsolidated mineral material >30 to ≤60 cm over rock or bedrock.

Moderately deep — mineral depth class with the depth of unconsolidated mineral material >60 cm to ≤120 cm over rock or bedrock.

Mode of deposition — classes of physical geological processes responsible for the transport and deposition of soil parent materials on a given site. May include a variety of physical processes including glacial deposition, water and wind transport, as well as mass wasting and colluvial processes.

Morainal — pertaining to, derived from, or deposited by glaciers; also referred to as till. Typically coarse loamy material with angular coarse fragments.

Moraine — mound or ridge of unstratified glacial drift, chiefly till, deposited by direct action of glacier ice.

Northern Boreal Woodland Vegetation Zone — a geographical area with common ecological characteristics. In Ontario, the zone corresponds to Ecoregion 1E.

Organic material — material containing >17% organic carbon (>30% organic matter) by weight. Can be derived from peat or folic material.

Outwash — materials washed from a glacier by flowing water and laid down as stratified sorted beds; generally composed of stratified sand and gravel.

Paleoproterozoic — one of the eras of geological time of the Proterozoic eon between about 2500 and 1600 million years before present.

Paleozoic — one of the eras of geological time of the Phanerozoic eon between about 540 million to 250 million years before present.

Palsa — cryogenic mounds, several to tens of metres in size, occurring mainly in the continuous permafrost zone (peat plateau, thermokarst lake system).

Pasture — Provincial Land Classification class (Spectranalysis 2004); open meadows with sparse shrubs in rural land; may include abandoned fields.

Peatland — a general term for peat covered terrain.

Permafrost — land that has a permanently frozen subsoil.

Podzol — soil of the Podzolic order in the Canadian System of Soil Classification that is characterized by the accumulation of iron, aluminum, and/or organic carbon in the B horizon.

Pothole — a single shaft, or an entire cave system that is dominantly vertical; also used to describe a single erosional bowl or moulin, rounded mainly by the swirling current in a stream bed.

Precambrian — one of the eons of geological time that preceded the Phanerozoic eon. Occurred more than 540 million years ago.

Regenerating depletion — Provincial Land Classification class (Spectranalysis 2004); represents older, very sparsely regenerated northern burns. Vegetation cover can be described as ‘barren and scattered’ even if specific evidence of fire is not available.

Regosols — soil of the Regosolic order in the Canadian System of Soil Classification characterized by minimal profile differentiation due to the youthfulness of the site or cold climate.

Sandstone — a type of sedimentary rock composed of grains of sand sized particles, usually consisting of quartz, set in a matrix of silt or clay and more or less firmly united by a cementing material.

Scarp — a bluff or very steep slope in bedrock due to faulting or differential erosion.

Settlement — Provincial Land Classification class (Spectranalysis 2004); clearings for human settlement and economic activity, including major transportation routes.

Shale — a fine-grained detrital sedimentary rock, formed by the compaction of clay, silt, or mud.

Shallow — mineral or organic depth class with the depth of unconsolidated mineral material >15 to 30 cm over rock or bedrock; depth of folic material >10 cm to ≤40 cm and the thickness of organic:mineral material is 2:1 over rock, bedrock, or mineral material; or depth of peat material >10 cm to ≤40 cm over bedrock, rock, or ≤30 cm mineral material.

Siltstone — indurated silt with the texture and composition of shale but lacking its fine lamination.

Silurian — a period of the Paleozoic era, after the Ordovician and before the Devonian periods, between 440 and 400 million years before present.

Sinkhole (doline) — karst feature; a basin- or funnel-shaped hollow in limestone, ranging from a few metres up to a kilometre in diameter and from a few to several hundred metres deep that was formed by solution widening.

Solution cave — karst feature; a natural hole in the ground, large enough for human entry, developed by dissolution.

Sparse forest — Provincial Land Classification class (Spectranalysis 2004); a patchy or sparse forest canopy composed of coniferous and deciduous species or a combination of the two.

Stunted — trees where growth is stopped, reduced, or hindered due to significant environmental limitations (i.e., excessive water, wind, nutrient limitations, ice, drought). Trees are often old and low treed, widely spaced, deformed, and chlorotic.

Subarctic — a zone immediately south of the Arctic characterized by stunted, open-growing spruce vegetation.

Subarctic Woodland-Tundra Vegetation Zone – a geographical area with common ecological characteristics. In Ontario, this zone corresponds to Ecoregions 0E.

Substrate — any mineral, bedrock, coarse fragment or organic materials normally above water or standing water less than 2 m deep that can support the establishment and succession of plant communities.

Swamp — a mineral-rich wetland characterized by a dense cover of deciduous or coniferous trees or shrubs.

Temperate — a climatic and ecological zone that occurs in the central part of the North American continent characterized by deciduous and mixed forests. In Ontario, the temperate zone includes ecoregions 4E, 5E, 6E and 7E.

Tombolo — a peninsula between the mainland and a former island created by sand deposition.

Tundra — a level to undulating, tree-less plain characteristic of Arctic or alpine regions. For most of the year, the mean monthly temperature is below the freezing point.

Tundra heath — Provincial Land Classification class (Spectranalysis 2004); low tundra vegetation growing on slightly raised beach deposits and strand lines along the Hudson Bay coast.

Ultramafic — igneous rock composed chiefly of mafic minerals.

Upland — a general term for an area that is elevationally higher than the surrounding area, but not a plateau. An area that is not a wetland and not imperfectly or poorly drained.

Vegetation zone — geographic areas with distinctive vegetation responses to regional macroclimate. Within zones, vegetation composition, structure, and dynamics are similar on comparable soils, landforms, and topographic positions across the landscape.

Very shallow — mineral depth class with the depth of unconsolidated mineral material >5 cm to ≤15 cm over rock or bedrock.

Warmer-than-normal — sites or landscape segments with locally modified climate resulting in warmer and often drier conditions relative to the surrounding dominant conditions; typically the result of protected slopes and southerly aspects (adapted from Hills 1959).

Warm Eastern Canadian Temperate Deciduous Forest — a climatic and ecological zone that occurs in the central portions of the North American continent. In Ontario, the area is characterized by vegetation more commonly found in the temperate parts of the United States. Equivalent to Ecoregion 7E in Ontario.

West-Central Boreal Forest Vegetation Zone — a geographical area with common ecological characteristics. In Ontario, it corresponds to ecoregions 2W and 3S.

Wetland — land that is saturated with water long enough to promote hydric substrates or aquatic processes as indicated by poorly drained substrates, hydrophytic vegetation, and biological activity adapted to wet environments.

Woodland — a vegetation community characterized by tree species >5 m tall, the crowns of which form a sparse, discontinuous canopy as a result of ecological limitations such as climate, shallow soils, wetlands; typically have between 10% and 30% canopy cover.

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Appendix 2. List of species common and scientific names

Common name	Scientific name
Mammals	
American black bear	*Ursus americanus*
American marten	*Martes americana*
Arctic fox	*Vulpes lagopus*
Beaver	*Castor canadensis*
Canada lynx	*Lynx canadensis*
Franklin’s ground squirrel	*Poliocitellus franklinii*
Moose	*Alces americana*
Northern gray wolf	*Canis lupus occidentalis*
Northern myotis	*Myotis septentrionalis*
Polar bear	*Ursus maritimus*
Sasquatch	*Homo sapiens cognatus*
Snowshoe hare	*Lepus americanus*
Southern red-backed vole	*Myodes gapperi*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginana*
White-tailed deer	*Odocoileus virginianus*
Wolverine	*Gulo gulo*
Woodchuck	*Marmota monax*
Woodland caribou	*Rangifer tarandus caribou*
Birds	
Bald eagle	*Haliaeetus leucocephalus*
Barred owl	*Strix varia*
Black-billed magpie	*Pica hudsonia*
Blackpoll warbler	*Setophaga striata*
Black-throated green warbler	*Setophaga virens*

Common name	Scientific name
Boreal chickadee	*Poecile hudsonicus*
Broad-winged hawk	*Buteo platypterus*
Common eider	*Somateria mollissima*
Common loon	*Gavia immer*
Connecticut warbler	*Oporornis agilis*
Dunlin	*Calidris alpina*
Eastern kingbird	*Tyrannus tyrannus*
Eastern meadowlark	*Sturnella magna*
Field sparrow	*Spizella pusilla*
Fox sparrow	*Passerella iliaca*
Gray jay	*Perisoreus canadensis*
Great blue heron	*Ardea herodias*
Green heron	*Butorides virescens*
Hermit thrush	*Catharus guttatus*
Hooded merganser	*Lophodytes cucullatus*
Horned lark	*Eremophila alpestris*
Hudsonian godwit	*Limosa haemastica*
Magnolia warbler	*Setophaga magnolia*
Pileated woodpecker	*Dryocopus pileatus*
Red knot	*Calidris canutus rufa*
Red-throated loon	*Gavia stellata*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Sandhill crane	*Grus canadensis*
Scarlet tanager	*Piranga olivacea*
Semipalmated plover	*Charadrius semipalmatus*
Semipalmated sandpiper	*Calidris pusilla*
Snow goose	*Chen caerulescens*

Common name	Scientific name
Veery	*Catharus fuscescens*
Western meadowlark	*Sturnella neglecta*
Western palm warbler	*Setophaga palmarum palmarum*
Whimbrel	*Numenius phaeopus*
White-throated sparrow	*Zonotrichia albicollis*
Winter wren	*Troglodytes troglodytes*
Wood duck	*Aix sponsa*
Wood thrush	*Hylocichla mustelina*
Yellow rail	*Coturnicops noveboracensis*
Yellow-rumped warbler	*Setophaga coronata*
Amphibians	
American bullfrog	*Litobates catesbeiana*
American toad	*Anaxyrus americanus*
Blue-spotted salamander	*Ambystoma laterale*
Boreal Chorus frog	*Pseudacris maculata*
Central newt	*Notophthalmus viridescens louisianensis*
Gray treefrog	*Hyla versicolor*
Green frog	*Lithobates clamitans*
Mink frog	*Lithobates septentrionalis*
Northern leopard frog	*Lithobates pipiens*
Red-spotted newt	*Notophthalmus viridescens viridescens*
Spotted salamander	*Ambystoma maculatum*
Spring peeper	*Pseudacris crucifer*
Wood frog	*Lithobates sylvatica*
Reptiles	
Blanding's turtle	*Emydoidea blandingii*
Eastern gartersnake	*Thamnophis sirtalis sirtalis*

Common name	Scientific name
Massasauga rattlesnake	*Sistrurus catenatus*
Midland Painted turtle	*Chrysemys picta marginata*
Northern watersnake	*Nerodia sipedon sipedon*
Red-bellied snake	*Storeria occipitomaculata*
Red-sided gartersnake	*Thamnophis sirtalis parietalis*
Ring-necked snake	*Diadophis punctatus*
Snapping turtle	*Chelydra serpentina*
Western painted turtle	*Chrysemys picta bellii*
Fish	
Arctic char	*Salvelinus alpinus*
Banded killifish	*Fundulus diaphanus*
Black crappie	*Pomoxis nigromaculatus*
Bluntnose minnow	*Pimephales notatus*
Brook stickleback	*Culaea inconstans*
Brook trout	*Salvelinus fontinalis fontinalis*
Burbot	*Lota lota*
Emerald shiner	*Notropis atherinoides*
Fathead minnow	*Pimephales promelas*
Finescale dace	*Chrosomus neogaeus*
Golden shiner	*Notemigonus crysoleucas*
Goldeye	*Hiodon alosoides*
Johnny darter	*Etheostoma nigrum*
Lake chub	*Couesius plumbeus*
Lake sturgeon	*Acipenser fulvescens*
Lake trout	*Salvelinus namaycush*
Logperch	*Percina caprodes*
Mottled sculpin	*Cottus bairdi*

Common name	Scientific name
Muskellunge	*Esox masquinongy*
Northern pike	*Esox lucius*
Northern redbelly dace	*Chrosomus eos*
Pearl dace	*Margariscus margarita*
Pumpkinseed	*Lepomis gibbosus*
Rock bass	*Ambloplites rupestris*
Smallmouth bass	*Micropterus dolomieu*
Spoonhead sculpin	*Cottus ricei*
Walleye	*Sander vitreus vitreus*
White sucker	*Catostomus commersoni*
Yellow perch	*Perca flavescens*
Plants	
Alaska paper birch	*Betula neoalaskana*
Alaskan rein-orchid	*Platanthera unalascensis*
Alkali bulrush	*Bolboschoenus maritimus* ssp. *paludosus*
Alpine bistort	*Bistorta vivipara*
Alpine bluegrass	*Poa alpina*
Alpine chickweed	*Cerastium alpinum*
Alpine hedysarum	*Hedysarum americanum*
Alpine woodsia	*Woodsia alpina*
Alternate-flowered water-milfoil	*Myriophyllum alterniflorum*
Alternate-leaved dogwood	*Cornus alternifolia*
American basswood	*Tilia americana*
American beachgrass	*Ammophila breviligulata*
American beech	*Fagus grandifolia*
American bladdernut	*Staphylea trifolia*
American bluehearts	*Buchnera americana*

Common name	Scientific name
American chestnut	*Castanea dentata*
American elm	*Ulmus americana*
American golden dock	*Rumex fueginus*
American larch	*Larix laricina*
American lotus	*Nelumbo lutea*
American milk-vetch	*Astragalus americanus*
American mountain-ash	*Sorbus americana*
American sea rocket	*Cakile edentula*
American sloughgrass	*Beckmannia syzigachne*
American spikenard	*Aralia racemosa*
American witch-hazel	*Hamamelis virginiana*
Arctic bellflower	*Campanula uniflora*
Arctic bluegrass	*Poa arctica* ssp. *arctica*
Arctic pyrola	*Pyrola grandiflora*
Arctic raspberry	*Rubus arcticus*
Arctic willow	*Salix arctica*
Ash spp.	*Fraxinus* spp.
Aspen spp.	*Populus* spp.
Assiniboia sedge	*Carex assiniboinensis*
Balsam fir	*Abies balsamea*
Balsam groundsel	*Packera paupercula* var. *paupercula*
Balsam poplar	*Populus balsamifera*
Balsam willow	*Salix pyrifolia*
Barren strawberry	*Geum fragarioides*
Bastard toadflax	*Comandra umbellata*
Bayonet rush	*Juncus militaris*
Beach pea	*Lathyrus japonicus*

Common name	Scientific name
Bear oak	*Quercus ilicifolia*
Bicknell’s geranium	*Geranium bicknellii*
Big bluestem	*Andropogon gerardii*
Billings’ sedge	*Carex billingsii*
Bird’s-eye primrose	*Primula mistassinica*
Bitternut hickory	*Carya cordiformis*
Black ash	*Fraxinus nigra*
Black cherry	*Prunus seritona*
Black crowberry	*Empetrum nigrum*
Black gum	*Nyssa sylvatica*
Black holly	*Ilex verticillata*
Black huckleberry	*Gaylussacia baccata*
Black maple	*Acer nigrum*
Black oak	*Quercus velutina*
Black raspberry	*Rubus occidentalis*
Black spruce	*Picea mariana*
Black walnut	*Juglans nigra*
Black willow	*Salix nigra*
Blue ash	*Fraxinus quadrangulata*
Blue bead-lily	*Clintonia borealis*
Blue cohosh	*Caulophyllum thalictroides*
Blue giant hyssop	*Agastache foeniculum*
Blue-beech	*Carpinus caroliniana*
Blueberry species	*Vaccinium* spp.
Bog birch	*Betula pumila*
Bog yellow-eyed-grass	*Rhexia virginica*
Boundary meadow-rue	*Thalictrum confine*

Common name	Scientific name
Branched bartonia	*Bartonia paniculata*
Bristle-leaved sedge	*Carex eburnea*
Brittle prickly-pear cactus	*Opuntia fragilis*
Brown beakrush	*Rhynchospora fusca*
Brownish beakrush	*Rhynchospora capitellata*
Bulblet fern	*Cystopteris bulbifera*
Bur oak	*Quercus macrocarpa*
Butternut	*Juglans cinerea*
Canada moonseed	*Menispermum canadense*
Canada plum	*Prunus nigra*
Canadian St. John's-wort	*Hypericum canadense*
Cardinalflower	*Lobelia cardinalis*
Carey's smartweed	*Persicaria careyi*
Carolina geranium	*Geranium carolinianum*
Carolina rose	*Rosa Carolina* ssp. *carolina*
Chaffy sedge	*Carex paleacea*
Chinquapin oak	*Quercus muehlenbergii*
Clasping-leaved Venus' looking glass	*Triodanis perfoliata*
Climbing prairie rose	*Rosa setigera*
Clustered sedge	*Carex cumulata*
Common butterwort	*Pinguicula vulgaris*
Common elderberry	*Sambucus canadensis*
Common hackberry	*Celtis occidentalis*
Common hop-tree	*Ptelea trifoliata*
Common juniper	*Juniperus communis*
Common Labrador tea	*Rhododendron groenlandicum*
Common prickly-ash	*Zanthoxylum americanum*

Common name	Scientific name
Common wood-sorrel	*Oxalis montana*
Crack willow	*Salix euxina*
Crawe's sedge	*Carex crawei*
Crooked-stem aster	*Symphyotrichum prenanthoides*
Cucumber tree	*Magnolia acuminata*
Cursed buttercup	*Ranunculus sceleratus* var. *multifidus*
Cut-leaved anemone	*Anemone multifida*
Cut-leaved coneflower	*Rudbeckia laciniata*
Daisy fleabane	*Erigeron hyssopifolius*
Daisy-leaved moonwort	*Botrychium matricariifolium*
Davis' sedge	*Carex davisii*
Deerberry	*Vaccinium stamineum*
Dense blazing-star	*Liatris spicata*
Ditch-grass	*Ruppia maritima*
Douglas' knotweed	*Polygonum douglasii*
Downy arrowwood	*Viburnum rafinesquianum*
Downy rattlesnake-plantain	*Goodyera pubescens*
Drummond's thistle	*Cirsium drummondii*
Dusty-spike sedge	*Carex capillaris* ssp. *fuscidula*
Dwarf bilberry	*Vaccinium caespitosum*
Dwarf chinquapin oak	*Quercus prinoides*
Dwarf hackberry	*Celtis tenuifolia*
Dwarf lake iris	*Iris lacustris*
Dwarf tansy	*Tanacetum bipinnatum*
Eastern buttonbush	*Cephalanthus occidentalis*
Eastern cottonwood	*Populus deltoides* ssp. *deltoides*
Eastern false rue-anemone	*Enemion biternatum*

Common name	Scientific name
Eastern flowering dogwood	*Cornus florida*
Eastern green-violet	*Hybanthus concolor*
Eastern hemlock	*Tsuga canadensis*
Eastern hop-hornbeam	*Ostrya virginiana*
Eastern leatherwood	*Dirca palustris*
Eastern ninebark	*Physocarpus opulifolius*
Eastern poison ivy	*Toxicodendron radicans* var*. radicans*
Eastern prairie fringed orchid	*Platanthera leucophaea*
Eastern red cedar	*Juniperus virginiana*
Eastern white cedar	*Thuja occidentalis*
Eastern white pine	*Pinus strobus*
Edible valerian	*Valeriana edulis*
Elliptic spikerush	*Eleocharis elliptica*
Estuary beggarticks	*Bidens hyperborean*
Estuary sedge	*Carex recta*
Evergreen wood fern	*Dryopteris intermedia*
False northwestern moonwort	*Botrychium pseudopinnatum*
False pennyroyal	*Trichostema brachiatum*
Fen grass-of-Parnassus	*Parnassia glauca*
Fern-leaved yellow false foxglove	*Aureolaria pedicularia*
Field chickweed	*Cerastium arvense* ssp*. arvense*
Flat-stemmed spikerush	*Eleocharis compressa*
Foam lichen	*Stereocaulon* spp.
Fragrant sumac	*Rhus aromatica*
Fragrant wood fern	*Dryopteris fragrans*
Fries' pondweed	*Potamogeton friesii*
Fringed black bindweed	*Fallopia cilinodis*

Common name	Scientific name
Fringed gentian	*Gentianopsis crinita*
Garber's sedge	*Carex garberi*
Gattinger's false foxglove	*Agalinis gattingeri*
Gay-wing milkwort	*Polygaloides paucifolia*
Glaucous bluegrass	*Poa glauca*
Golden puccoon	*Lithospermum caroliniense*
Goldie's wood fern	*Dryopteris goldiana*
Grassleaf mud-plantain	*Heteranthera dubia*
Gravel sedge	*Carex glareosa*
Gray birch	*Betula populifolia*
Great Lakes sandreed	*Calamovilfa longifolia* var*. magna*
Great northern aster	*Canadanthus modestus*
Great plains ladies`-tresses	*Spiranthes magnicamporum*
Green arrow arum	*Peltandra virginica*
Green ash	*Fraxinus pennsylvanica*
Greenish sedge	*Carex viridula*
Greenland silverweed	*Potentilla anserina* ssp. *groenlandica*
Hair-like bulbostylis	*Bulbostylis capillaris*
Hairy goldenaster	*Heterotheca villosa* var. *minor*
Hairy Solomon's seal	*Polygonatum pubescens*
Hairy-nerved carrionflower	*Smilax lasioneura*
Hayden's sedge	*Carex haydenii*
Heart-leaved willow	*Salix eriocephala*
Herbaceous carrionflower	*Smilax herbacea*
Hickey's tree-clubmoss	*Dendrolycopodium hickeyi*
Hill's thistle	*Cirsium pumilum var. hillii*
Hoary puccoon	*Lithospermum canescens*

Common name	Scientific name
Hobblebush	*Viburnum lantanoides*
Honey-locust	*Gleditsia triacanthos*
Hooked violet	*Viola adunca*
Horned sea-blite	*Suaeda calceoliformis*
Houghton's goldenrod	*Solidago houghtonii*
Indian cucumber-root	*Medeola virginiana*
Inland bluegrass	*Poa interior*
Jack pine	*Pinus banksiana*
Jack-in-the-pulpit	*Arisaema triphyllum*
Juniper sedge	*Carex juniperorum*
Kalm's brome	*Bromus kalmii*
Kalm's lobelia	*Lobelia kalmii*
Kalm's St. John's-wort	*Hypericum kalmianum*
Kentucky coffee-tree	*Gymnocladus dioicus*
Kidney-leaved white violet	*Viola renifolia*
Lake Huron single-spike sedge	*Carex scirpoidea* ssp. *convoluta*
Lakecress	*Rorippa aquatica*
Lakeside daisy	*Tetraneuris herbacea*
Lance-leaved tickseed	*Coreopsis lanceolata*
Lapland azalea	*Rhododendron lapponicum*
Lapland diapensia	*Diapensia lapponica*
Large cranberry	*Vaccinium macrocarpon*
Large field chickweed	*Cerastium velutinum*
Large tick-trefoil	*Hylodesmum glutinosum*
Large-pod pinweed	*Lechea intermedia*
Large-seeded forget-me-not	*Myosotis macrosperma*
Large-toothed aspen	*Populus grandidentata*

Common name	Scientific name
Late-flowering muhly	*Muhlenbergia uniflora*
Leatherleaf	*Chamaedaphne calyculata*
Limestone oak fern	*Gymnocarpium robertianum*
Little bluestem	*Schizachyrium scoparium*
Little floatingheart	*Nymphoides cordata*
Little-tree willow	*Salix arbusculoides*
Livid sedge	*Carex livida*
Long-leaved aster	*Symphyotrichum robynsianum*
Long-leaved bluets	*Houstonia longifolia*
Low blueberry willow	*Salix myrtillifolia*
Low spikemoss	*Selaginella selaginoides*
Mackay’s bladder fern	*Cystopteris tenuis*
Maidenhair spleenwort	*Asplenium trichomanes*
Male fern	*Dryopteris filix-mas*
Manitoba maple	*Acer negundo*
Maple spp.	*Acer spp.*
Marginal wood fern	*Dryopteris marginalis*
Marsh ragwort	*Tephroseris palustris*
Marsh valerian	*Valeriana dioica*
Mat muhly	*Muhlenbergia richardsonis*
Mountain cranberry	*Vaccinium vitis-idaea*
Mountain holly	*Ilex mucronata*
Mountain huckleberry	*Vaccinium membranaceum*
Mountain sweet cicely	*Osmorhiza berteroi*
Multi-rayed goldenrod	*Solidago multiradiata*
Naked mitrewort	*Mitella nuda*
Nannyberry	*Viburnum lentago*

Common name	Scientific name
Narrow false oats	*Trisetum spicatum*
Narrow-leaved arnica	*Arnica angustifolia*
Narrow-leaved gentian	*Gentiana linearis*
Narrow-leaved glade fern	*Homalosorus pycnocarpos*
Net-veined willow	*Salix reticulata*
New England sedge	*Carex novae-angliae*
New Jersey tea	*Ceanothus americanus*
New York fern	*Thelypteris noveboracensis*
Nodding ladies'-tresses	*Spiranthes cernua*
Nodding onion	*Allium cernuum*
Northeastern paintbrush	*Castilleja septentrionalis*
Northeastern sedge	*Carex cryptolepis*
Northern bayberry	*Morella pensylvanica*
Northern bog rosemary	*Andromeda polifolia* var. *polifolia*
Northern dewberry	*Rubus flagellaris*
Northern firmoss	*Huperzia selago*
Northern holly fern	*Polystichum lonchitis*
Northern Labrador tea	*Rhododendron tomentosum*
Northern maidenhair fern	*Adiantum pedatum*
Northern pin oak	*Quercus ellipsoidalis*
Northern pitcher plant	*Sarracenia purpurea*
Northern red oak	*Quercus rubra*
Norwegian cinquefoil	*Potentilla norvegica*
Nuttall’s waterweed	*Elodea nuttallii*
Oak spp.	*Quercus* spp.
Ontario goldenrod	*Solidago ontarioensis*
Pale dogwood	*Cornus obliqua*

Common name	Scientific name
Pale laurel	*Kalmia polifolia*
Pale-spike lobelia	*Lobelia spicata*
Palmate-leaved violet	*Viola palmata*
Paper birch	*Betula papyrifera*
Pawpaw	*Asimina triloba*
Pennsylvania cinquefoil	*Potentilla pensylvanica*
Pennsylvania sedge	*Carex pensylvanica*
Pignut hickory	*Carya glabra*
Pin cherry	*Prunus pensylvanica*
Pine spp.	*Pinus spp.*
Pitch pine	*Pinus rigida*
Pitcher’s thistle	*Cirsium pitcheri*
Plains cottonwood	*Populus deltoides* ssp. *monilifera*
Plains rough fescue	*Festuca hallii*
Pointed moonwort	*Botrychium acuminatum*
Poison sumac	*Toxicodendron vernix*
Poplar spp.	*Populus* spp.
Prairie buttercup	*Ranunculus rhomboideus*
Prairie cordgrass	*Spartina pectinata*
Prairie dropseed	*Sporobolus heterolepis*
Prairie onion	*Allium stellatum*
Prairie redroot	*Ceanothus herbaceus*
Prairie rosinweed	*Silphium terebinthinaceum*
Prairie sagebrush	*Artemisia frigida*
Prairie sandreed	*Calamovilfa longifolia* var. *longifolia*
Prickly gooseberry	*Ribes cynosbati*
Purple clematis	*Clematis occidentalis*

Common name	**Scientific name**
Purple-stemmed cliffbrake	*Pellaea atropurpurea*
Red maple	*Acer rubrum*
Red mulberry	*Morus rubra*
Red pine	*Pinus resinosa*
Red spruce	*Picea rubens*
Reindeer lichen	*Cladonia* spp.
Richardson's alumroot	*Heuchera richardsonii*
Riddell's goldenrod	*Solidago riddellii*
Riverbank grape	*Vitis riparia*
Rock elm	*Ulmus thomasii*
Rock spikemoss	*Selaginella rupestris*
Rose pogonia	*Pogonia ophioglossoides*
Ross' sedge	*Carex rossii*
Rough cocklebur	*Xanthium strumarium*
Round-headed bush-clover	*Lespedeza capitata*
Saltmarsh bulrush	*Bolboschoenus maritimus* ssp. *maritimus*
Sand-dune Wildrye	*Elymus lanceolatus* ssp. *psammophilus*
Saskatoon	*Amelanchier alnifolia*
Sassafras	*Sassafras albidum*
Scarlet paintbrush	*Castilleja coccinea*
Schweinitz's flatsedge	*Cyperus schweinitzii*
Sea lymegrass	*Leymus mollis*
Seaside spurge	*Euphorbia polygonifolia*
Sedge spp.	*Carex* spp.
Seneca snakeroot	*Polygala senega*
Shagbark hickory	*Carya ovata*
Sheep laurel	*Kalmia angustifolia*

Common name	Scientific name
Shellbark hickory	*Carya laciniosa*
Short-capsuled willow	*Salix brachycarpa*
Showy lady's-slipper	*Cypripedium reginae*
Showy locoweed	*Oxytropis splendens*
Showy pussytoes	*Antennaria pulcherrima*
Shumard oak	*Quercus shumardii*
Silver maple	*Acer saccharinum*
Skunk cabbage	*Symplocarpus foetidus*
Sky-blue aster	*Symphyotrichum oolentangiense*
Slender beardtongue	*Penstemon gracilis*
Slender flatsedge	*Cyperus lupulinus ssp. macilentus*
Slender water-milfoil	*Myriophyllum tenellum*
Slippery elm	*Ulmus rubra*
Small cranberry	*Vaccinium oxycoccos*
Small enchanter's nightshade	*Circaea alpina*
Small skullcap	*Scutellaria parvula* var. *parvula*
Small-flowered blue-eyed Mary	*Collinsia parviflora*
Small-flowered purple false foxglove	*Agalinis purpurea* var. *parviflora*
Smooth arrowwood	*Viburnum recognitum*
Smooth cliffbrake	*Pellaea glabella*
Smooth sumac	*Rhus glabra*
Smooth woodsia	*Woodsia glabella*
Snow cinquefoil	*Potentilla nivea*
Southern milk-vetch	*Astragalus australis*
Sparrow's-egg lady's-slipper	*Cypripedium passerinum*
Spicebush	*Lindera benzoin*
Spotted beebalm	*Monarda punctata*

Common name	Scientific name
Spreading alkaligrass	*Puccinellia distans*
Spreading cinquefoil	*Potentilla supina*
Spring forget-me-not	*Myosotis verna*
Spruce spp.	*Picea* spp.
Squarrose goldenrod	*Solidago squarrosa*
Staghorn sumac	*Rhus typhina*
Steeplebush	*Spiraea tomentosa* var*. rosea*
Steller’s rockbrake	*Cryptogramma stelleri*
Sticky goldenrod	*Solidago simplex*
Stiff cowbane	*Oxypolis rigidor*
Stiff yellow Flax	*Linum medium* var*. medium*
Stout woodreed	*Cinna arundinacea*
Striped maple	*Acer pensylvanicum*
Sugar maple	*Acer saccharum*
Sundial lupine	*Lupinus perennis*
Swamp rose	*Rosa palustris*
Swamp white oak	*Quercus bicolor*
Sweet crabapple	*Malus coronaria*
Sweet fern	*Comptonia peregrina*
Sweet gale	*Myrica gale*
Sycamore	*Platanus occidentalis*
Tall wormwood	*Artemisia campestris* ssp*. caudata*
Tea-leaved willow	*Salix planifolia*
Three-flowered avens	*Geum triflorum*
Three-toothed cinquefoil	*Sibbaldia tridentata*
Trembling aspen	*Populus tremuloides*
Tuberous Indian-plantain	*Arnoglossum plantagineum*

Common name	Scientific name
Tulip tree	*Liriodendron tulipifera*
Tundra alkaligrass	*Puccinellia tenella*
Twig rush	*Cladium mariscoides*
Twin-stemmed bladderwort	*Utricularia geminiscapa*
Twisted draba	*Draba incana*
Two-flowered dwarf-dandelion	*Krigia biflora*
Upland white goldenrod	*Solidago ptarmicoides*
Virginia chain fern	*Woodwardia virginica*
Virginia false dragonhead	*Physostegia virginiana*
Virginia meadow-beauty	*Rhexia virginica*
Virginia saxifrage	*Micranthes virginiensis*
Walking fern	*Asplenium rhizophyllum*
Water lobelia	*Lobelia dortmanna*
Western fairy-candelabra	*Androsace septentrionalis*
Western fescue	*Festuca occidentalis*
White ash	*Fraxinus americana*
White avens	*Geum canadense*
White mountain saxifrage	*Saxifraga paniculata*
White oak	*Quercus alba*
White spruce	*Picea glauca*
White trillium	*Trillium grandiflorum*
White-stemmed pondweed	*Potamogeton praelongus*
Whorled loosestrife	*Lysimachia quadrifolia*
Whorled wood aster	*Oclemena acuminata*
Wild chives	*Allium schoenoprasum* var. *sibiricum*
Winged sumac	*Rhus copallinum*
Woodland pinedrops	*Pterospora andromedea*

Common name	Scientific name
Woodland sunflower	*Helianthus divaricatus*
Woolly beach-heath	*Hudsonia tomentosa*
Yellow birch	*Betula alleghaniensis*
Yellow Indian-grass	*Sorghastrum nutans*
Yellow mandarin	*Prosartes lanuginose*
Yellow stargrass	*Hypoxis hirsuta*
Yellow wild indigo	*Baptisia tinctoria*
Zigzag goldenrod	*Solidago flexicaulis*

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